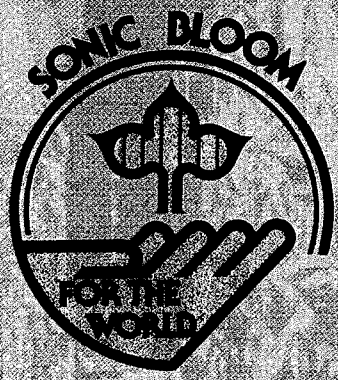
SONIC BLOOM SCIENTIFIC PACKET



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Good Vibrations

A 'Sound' Diet for Plants

by Michael Spillane

Dan Carlson

Even in silence, there is no escape from sound. People, plants and animals are surrounded by natural and artificial vibrations 24 hours a day, every day, whether we choose to listen or not. Poets, musicians and scientists have long been voicing their theories that the frequencies we are exposed to have a dramatic effect on our spiritual and physical well-being.

While the effects of sound on plant health and growth has been the subject of some speculation and scientific research, few have attempted to put that knowledge to practical use. But one innovative pioneer has come up with a system that uses high frequency sound with an organic foliar spray that he says leads to early maturity, greater yields, improved taste, more nutrition and longer shelf life.

Hunger, or more precisely the problem of world hunger, is at the root of this fascinating new technology. While serving as an Army border guard in South Korea in the early '60s, Dan Carlson witnessed a Korean woman placing her baby under the wheels of an Army truck. "I went over to stop her, but as I looked in her eyes, I realized that she was acting out of desperation, that she and her child were starving to death." From that moment on, Carlson says, he dedicated his life to helping solve the problem of world hunger.

After leaving the service, Carlson enrolled at the University of Minnesota to study agriculture. There he began extensive research into plant growth stimulants. His breakthrough came in 1972 when he discovered that certain sound frequencies stimulated plants to absorb more nutrients which are taken in by the stomata on the leaf surface and are then translocated throughout the plant.

Upon graduation in 1975, Carlson formed his own company, Dan Carlson Scientific Enterprises, Inc. (708 119th Lane N.E., Dept. LGG, Blaine, MN 55434). In 1976 he traveled the country conducting trials with his system, which he began marketing under the name Sonic Bloom.

"Initially people are skeptical," Carlson says. "But once they use the product, the results speak for themselves. We've had offers to sell out, but the hunger problem is my main concern, and we're starting to see real possibilities."

The key to unlocking those possibilities is a high-frequency electro-

Dan Carlson

Carl Webster, president of the Natural Food Association, (above) with corn grown using Carlson's method.
Tomatoes (left) produced 500 fruits per plant.

magnetic radiation wave developed from natural sounds. It is similar to the frequency range of many bird calls, such as those made by swallows, martins and warblers. The sound, according to Carlson, opens the stomata, tiny openings on the leaf surface, allowing the plant to more readily absorb nutrients.

The other factor is a balanced foliar nutrient spray that contains no harmful elements and is derived from seaweed. The spray is composed of 55 trace minerals and amino acids, as well as gibberelic acid, a plant growth enhancer that is naturally found in seaweed extracts.

For indoor plants, the tape, classical and easy listening music selections combined with the high-frequency sounds, is played once every morning, preferably between 5 a.m. and 9 a.m. when plants naturally absorb dew and nutrients. Plants are sprayed with the foliar solution once a week while the music is played.

The treatment is the same for commercial operations, although the commercial units do not play music, only the high-pitched oscillating frequency. Crops are treated with the nutrient once every 10 days to two weeks. A tape player activated by a photocell can be used to turn the sound on in the morning and off at night.

Carlson claims that the system can substantially increase both yields and quality at a fraction of the cost of chemical fertilizers. One gallon of the concentrated nutrient will provide 256 gallons of spray, enough to provide five treatments on 4.5 acres of crops.

'A Safe Alternative'

One of the proponents of the system is Ken Taylor, owner of Windmill Point Farms and Nursery on Ile Perrot, off the southwest tip of Montreal. Taylor is a plant collector, college chemistry teacher and lecturer on chemical-free gardening at McDonald College in Quebec.

Taylor is convinced that his own plants have become healthier since he began using the system in the spring of 1990 and expects "incredible results" over the next few years.

"Sonic Bloom is a safe alternative to the use of chemicals and, combined with traditional fertilizers such as manure and compost, can provide a blueprint for carrying out methods of crop production that are safer for the environment," Taylor said.

He believes that the common method of crop production, with its over reliance on chemicals, is producing plants that are stressed out. In other words, plants that are unable to meet their capacity for growth. Carlson's system permits plants to reach their full genetic potential, he says. "Remove the stress from plants by influencing the way they absorb nutrients and they will become more adaptable and pest and disease resistant."

Taylor's initial trials were conducted on carrots. Last spring, he soaked germinated carrot seeds in the nutrient solution (1/2 ounce per gallon of water) and left them overnight with the cassette tape playing. That crop of carrots was the best he had ever produced. With an average yield of 400 pounds of carrots from each 40-foot row, Taylor decided to try a few more experiments. "I Tried it on a batch of acid-loving bog cranberry, grown in containers with peat moss," he said. "No nutrients were added except for the treatments ... The plants grew like weeds."

The 100 citrus plants that inhabit Taylor's sunroom were also subjected to experiments. After treatment, Taylor left the plants outside throughout the summer and fall where they survived temperatures as low as 14 degrees (-10 C). In December, there wasn't a blemish on the dark, glossy foliage of any of the grapefruit, orange, tangerine or variegated lemon plants.

More recently, Taylor has been carrying out trials on grass seed germination without the use of soil or fertilizers. The results so far are "extremely positive," he said. The seed was treated and then germinated in metal containers. Within three weeks the grass had reached a height of 6 inches.

Improved Adaptability

Carlson says that plants exposed to the recorded sounds and foliar spray not only grow bigger and faster but are better able to adapt to adverse soil and water conditions. "One of the problems with world hunger," he explained, "is that people are trying to grow food in semi-arid regions with marginal soils. Now we can establish food-producing plants in these regions that will adapt to the conditions."

Northern growers, who are constantly struggling with a short growing season, can benefit as well. At a conference at McDonald College in Quebec in November 1990, Canadian horticulturalists had an opportunity to examine Carlson's claims of early maturity and how plants can adapt to new weather and soil conditions.

He told of apple trees grown in cooler climates that produced three times the yield and cucumbers that grew six to a leaf instead of one. They saw slides of strawberries that produced earlier and cauliflower, beets and cantaloupe that were huge. They heard of incredible yields of corn, cherry tomatoes and ornamentals.

But the crowning glory was the tale of Carlson's purple passion vine (*Cynura sp*), which has grown to 1,300 feet and is still thriving in his home after 19 years. The plant usually grows to a maximum of 3 feet. This success gained Carlson entry into the Guiness Book of World Records for the world's largest indoor plant.

Professor Michael Dickson of the Department of Plant Science at the University of Guelph in Ontario has carried out his own experiments using Carlson's Sonic Bloom. He said

that his tests demonstrated a positive effect of the treatment on vegetative growth, but he would like to see more long term research and analysis of the product.

"Without such controlled research, there's no real basis for the claims. There are a host of other environmental variables, such as soil conditions, annual rainfall, temperature to name a few, that have to be put into the equation," he said.

Dickson hypothesizes that the influence of sound frequencies may be felt at the membrane level in the plants. This in turn is measured in increased osmotic pressure (the uptake and translocation of water and nutrients), and cell extension, which are manifested in apparent growth. Of the tests that were carried out at Guelph on soybeans, it was reported that plants grew twice as big as they would normally, requiring only half the amount of water.

Based on these initial findings, Carlson hopes his technique will be useful for farmers in California and other drought stricken areas. Because of the growing severity of the drought problem worldwide, Carlson would like to see a more concerted effort to research the process. Stuart Hill, professor of entomology at McDonald College, Quebec, agreed: "It would be interesting to see more varied experiments carried out on positive sound frequencies measured against negative sound frequencies."

The agricultural bulletin, *Acres USA*, has reported on tests done using Carlson's tapes and foliar spray over the 1985 growing season in the American Southwest. The journal reported impressive results with alfalfa and corn crops. Other tests, carried out at San Juan Pueblo, a Native American community not far from Santa Fe, on peppers, tomatoes, melons, corn and amaranth produced impressive results. Sonic Bloom was used on ancient open pollinated seeds collected from Central and South America. It was found that the seeds became more productive and retained their resistance to stress. Plants were grown in the Sudan with only 1 1/4 inches of rainfall and temperatures of up to 135 degrees. Save the Children has distributed treated seeds to nine different African countries, again with impressive results.

Landowner, the bulletin of the Professional Farmers of America reported that laboratory studies of a variety of plants showed yields of vegetable and field crops were increased by 20 to 100 percent. In Israel, 450 endangered North African varieties of shrubs, fruit and nut trees are being treated with Carlson's system and successfully established. It is now in use in 14 countries and all 50 states. One Sonic Bloom grower won an award for the Most Beautiful Vegetable Garden in Colorado last year. But despite the incredible claims of devotees of the product, more development, research and data is needed to firmly establish its validity as a major breakthrough.

In the meantime, there is no rest for Dan Carlson. Currently he is working on his 140-acre farm near River Falls, Wisconsin, grafting and developing different species of nut trees. "Many of these trees are endangered," he said. "My job is to produce thousands of nuts per tree. If I can turn these nuts into seedlings to produce nuts the second year, the trees aren't going to be endangered for long."❖

Michael Spillane is a landscape designer and freelance writer living in Montreal, Canada.

ORGANIC GROWING AIDS

1) **Sonic Bloom**- we have not sold any plant fertilizers in the past as we felt that the organic grower should use "homemade" compost made from available waste materials around the home such as kitchen scraps, leaves, wood chips, newspapers, etc. We now realize that many folks don't have the time or enough materials to do this so we are offering one alternative - "SONIC BLOOM". We have tried most of the commercially available organic soil amendments and plant growing aids such as bonemeal, bagged manures, liquid seaweed, fish emulsions, plant growth hormones, foliar sprays, etc and all are useful to some extent. However these all have serious limitations while the " Sonic Bloom" product seems to have wide applicability and is an incredibly effective organic growing aid. It is a liquid extract made from several different plant species and contains 55 trace minerals/amino acids. This liquid is applied to the plant as a foliar spray or as a soil amendment. The term "sonic" is used in its name because when this liquid is applied with sound (ressembling the singing of birds), the effectiveness increases dramatically. Radio isotope studies have shown that the plant will absorb and translocate nutrients as much as 700% more efficiently with this high frequency "bird sound". The sound and nutrient solution combine to create vigorous plant growth, increase yields, shorten crop maturity time but increase crop storage time and, most importantly, crop nutrient content dramatically increases. Insect and disease pressures are also greatly reduced which eliminates the need for some other organic controls. The sound can also be used to "presensitize" weeds and thus reduce the amount of herbicide needed by over 50% - an effect aptly called "SONIC DOOM" Dan Carlson Scientific Enterprises in Minnesota developed and tested this product over the past 20 yrs. and we have just started our own testing over the past couple of years on garden vegetables, fruit trees, indoor plants and seeds. The results have been so dramatic that we are already convinced Sonic Bloom is not just another "miracle nutrient" fad!! Organic farmers, gardeners, orchardists and greenhouse growers will find this product so much superior to anything presently being used. We have pages of scientific results and published papers on Sonic Bloom and there is ample discussion of it in Christopher Bird's new book "Secrets of the Soil" We are handling the Canadian distribution at the moment so if you are interested in equipment and supplies to handle a large acreage please write - the cost is about $60/acre. For gardeners and orchardists of an acre or less we have assembled a "Sonic Bloom Home Garden" kit. We sell the following this year;

Sonic Bloom Home Garden Kit containing - cassette sound tape with high frequency "bird music"
(kit price is $85) - nutrient concentrate to make 155 litres of solution
- a plastic 1-litre size mechanical mist sprayer
- instructions

Sonic Bloom Greenhouse Kit containing - a leased solid state sound unit which covers 5 acres
(kit price is $400) - nutrient concentrate to make 1000 litres of solution
- instructions

Sonic Bloom Video showing results and data from using sonic bloom - about 90 minutes long
(video price is $25)

2) **Javelin W.G.** - a new formulation of BT or bacillus thuringiensis that is more effective against armyworms than the usual biological insecticides Dipel or Thuricide. It is also controls a wide range of other destructive insects such as Cabbageworms, Tent Caterpillars, Gypsy Moth, Leafrollers, Corn Earworm and many more. It is totally safe to humans, birds, etc and can be sprayed without worry of ingestion - broccoli sprayed in morning can be eaten for supper! Package containing enough BT to do an acre for entire season.....$10/ea

3) **M-One.** This is a new biological control for Colorado Potato Beetle. It is a another strain of BT(bacillus thuringiensis) called "San Diego", again totally safe to humans. No more need to use dangerous chemicals insecticides to grow potatoes. Must be applied when larvae are just hatching from egg clusters laid by adult beetles. All season package for an acre.....$10/ea

HARRY OZBURN BARLEY TRIAL

50 VARIETIES - AVERAGE YIELD 109.9 BUSHELS PER ACRE
SONIC BLOOM 59% INCREASE OVER
SONIC BLOOM 68% INCREASE OVER UNTREATED, 1987

United States Department of Agriculture
Agricultural Research Service
Northwest Area
P.O. Box [redacted]
Aberdeen, ID 83210

September 30, 1987

H.D. Ozburn
Box 482
Soda Springs, Idaho 83276

Dear Harry:

Please find enclosed a preliminary summary of yield data (yield in grams per plot) for the 1987 Soda Springs Barley Trial grown on your land as per your request following harvest. Please write or call if you have any comments or questions concerning these data. We will provide you with seed from the trial following completion of the test weight and kernel assortment determinations.

The trial did yield very well as we discussed at the time of harvest. We have not completely summarized the yield data, but it appears that the normal (hulled) barleys ranged in yeild from 93.0 bu/A ('Otis') to 133.4 bu/A ('Karla'). These data come with the standard disclaimer concerning the performance of individual entries in a single environment.

Thanks again for your cooperation and interest in these trials. Best regards.

Sincerely,

1987 SODA SPRINGS SPRING BARLEY (Ozburn)

Ent. No.	Variety or Sel. No.	Parentage	Rep I	Rep II	Rep III	Rep IV	Avera (bu/
1	Munsing		92	90	100	95	94
2	Steptoe		126	114	111	119	118
3	Clark		95	90	108	90	96
4	Hector		100	94	109	103	101
5	81Ab10099-B	60Ab1810-53/Hector	98	122	117	106	110
6	Levis		113	112	108	95	107
7	Bowman		113	92	128	116	112
8	BA280529	B1201(2880-529)	109	94	107	111	105
9	MT81143	Nector/Klages//Klages/Summit	102	105	114	9[illegible]	105
10	MT81502	Clark//Klages/Zephyr	103	108	123	103	109
11	MT81616	TR440/Clark	107	110	110	116	111
12	OR8432	KG8537-68/US8763073-01K-XK	97	116	111	108	108
13	BA814038	B1202(2881-4038)	104	117	97	126	111
14	BA280350	2880-350	115	114	100	110	110
15	78Ab10274	Hector/60Ab1810-53	108	108	112	94	105
16	MT81161	Levis//Klages/Summit	125	112	110	116	116
17	MT140523	Hector/Klages	107	105	120	104	109
18	OM8413	60Ab1810/Diamant	113	94	112	109	107
19	MT83422	Clark/TR450	113	116	108	109	112
20	MT83424	Clark/TR450	112	114	109	110	111
21	MT83435	Clark/TR450	120	101	116	100	109
22	MT83533	Clark/Lamont	126	111	109	124	118
23	MT328202	Steptoe/Klages	100	110	90	96	99
24	ND8671	Bowman//Mazurka/ND5698	99	101	100	75	94
25	WA877178	Klages/8537-68	116	133	113	122	121
26	Karla		145	138	119	131	133
27	Lindy		115	119	117	107	114
28	Morex		114	124	100	100	110
29	Russell		127	103	139	112	120
30	Teton		119	122	108	100	112
31	84Ab897	M75-7/M74-101	117	109	130	110	116
32	84Ab1843	79-44-7/77Ab2966	127	132	112	104	119
33	85Ab2506	Morex/Karla	102	96	86	99	96
34	85SR52	Karl/Morex	102	114	94	105	104
35	85SR431	Morex/ND5377	117	129	117	126	122
36	Gallatin		118	118	102	105	111
37	Harrington		105	118	110	120	113
38	Heavyweight		116	106	114	108	111
39	Korol		100	91	91	90	93
40	Lamont		110	105	108	119	110
41	Otis		90	107	79	95	93
42	Piroline		99	107	96	108	102
43	Premier		116	107	114	111	112
44	Sunbar 560		113	124	120	113	117
45	Waxbar		83	96	84	84	87
46	WA890878	Klages*2/WA8537-68	128	116	102	113	118
47	78Ab6871	Columbs/Klages	114	111	110	103	109
48	79Ab10740-SRC	60Ab1810-53/Summit	118	107	109	111	11
49	83Ab6656	78Ab6871/78Ab10264	124	113	115	124	119
50	85SR882	Klages/AmagiNijo	113	82	101	95	9
						Average	10

This will give you some ~~etc~~ of yields past

Table Summary of agronomic data* for barley varieties and selections grown on dryland at Soda Springs, Idaho. 1981-85. (Ozburn and Reed sites).

Variety or Selection	Parentage	Yield (bu/A)					Average			Sonic Bloom 1987 (bu/A)	85-87 Incr (%)
		1981	1982	1983	1984	1985	1981-85	1983-85	1984-85		
Munsing		62.7	63.3	52.1	59.1	63.1	60.1	58.1	61.1	94.3	49.4
Steptoe		65.8	78.7	79.4	90.4	74.1	77.7	81.3	82.3	117.6	58.7
Hector		44.0	63.9	58.5	63.0	81.5	62.2	67.7	72.3	101.4	24.7
Clark		43.4	58.6	51.0	61.0	81.3	59.1	64.4	71.2	95.9	17.7
Russell (78Ab9009-SRC)		57.1	59.0	57.5	71.5	67.2	62.5	65.4	69.4	120.4	79.2
Karla		40.9	61.2	61.1	80.7	69.7	62.7	70.5	75.2	133.3	91.2
Morex		52.8	53.6	44.2	56.7	61.3	53.7	54.1	59.0	109.9	79.3
Gallatin		54.1	73.1	58.7	74.2	73.5	66.7	68.8	73.9	110.9	50.2
Lamont		56.7	70.1	52.9	61.5	74.0	63.0	62.8	67.8	110.5	49.3
78Ab10264	60Ab1810-53/Hector	54.8	63.4	54.4	58.9	78.3	62.0	63.9	68.6	--	--
78Ab10099	60Ab1810-53/Hector		66.2	64.1	81.8	82.3		76.1	82.1	--	--
Bowman			61.2	46.4	68.0	72.3		62.2	70.2	112.2	55.1
Lewis				55.5	57.1	74.1		62.2	65.6	106.9	44.2
Lindy				73.6	71.3	75.5		73.5	73.4	114.6	51.3
Teton				70.3	54.1	81.1		68.5	67.6	112.1	53.3
79Ab10719	73Ab2199/Karla			70.8	56.5	73.3		66.9	64.9	--	--
79Ab13597	74Ab4099/Glenn			64.3	67.2	53.3		61.6	60.3	--	--
Harrington				60.4	76.6	70.8		69.3	73.7	113.2	59.8
Menuet				59.5	69.6	64.1		64.4	66.9	--	--
Otis				57.9	70.6	68.2		65.6	66.9	93.0	36.2
Sunbar 560				71.9	73.6	75.3		73.6	74.5	117.2	55.6
PB 1-29				54.3	59.0	71.1		61.5	65.1	--	--
BA 26					66.1	68.6			67.4	--	--
Apex					60.4	56.0			58.2	--	--
Bellona					59.6	63.4			61.5	--	--

Table . Summary of agronomic data* for barley varieties and selections grown on dryland at Soda Springs, Idaho. 1981-85. (Ozburn and Reed sites).

Variety or Selection	Parentage	Yield (bu/A) 1981	1982	1983	1984	1985	Average 1981-85	1983-85	1984-85	Sonic Bloom 1987 (bu/A)	85-87 Incr (%)
MT 312613	Summit/Hector				54.9	78.7			66.8	--	--
UT 1713	Steptoe/M27				67.3	66.9			67.1	--	--
UT 1733	Steptoe/M27				49.3	70.2			59.8	--	--
UT 1734	Steptoe/M27				71.0	68.2			69.6	--	--
Robust					71.5	59.5			65.5	--	--
Korol					47.2	63.9			55.6	93.1	45.6
79Ab10740	60Ab1810-53/Summit				66.0	52.9			59.5	111.0	109.9
AZ 2221	CC XXXIX Sel. 2-22-1					54.4				--	--
AZ 2229	CC XXXIX Sel. 2-22-9					58.8				--	--
BA 280529						74.8				105.3	40.7
MT 81143	Hector/Klages//Klages/Summit					60.6				104.7	72.7
MT 81502	Clark//Klages/Zephyr					60.8				109.4	79.9
MT 81816	TR 440/Clark					76.0					
MT 81619	TR 440/Clark					61.2				--	--
OR 8432	KG8537-68/OSB763073+-01K-XK					60.2				108.0	79.4
OR 8406	WW/CI 1237//Robur					49.5				--	--
UT 1685	Steptoe/M27					73.1				--	--
UT 1696	Steptoe/M27					66.3				--	--
UT 275248	UT 7381-1009/Steptoe					71.2				--	--
Piston						64.1				--	--
Spirit						68.5				--	--
WA 890878	Klages*2/WA 8537-68					74.2				118.0	58.8
82Ab23436	76Ab4300/M75-7					68.5				--	--
78Ab10274	Hector/60Ab1810-53					67.3				105.4	56.6
79Ab10591	60Ab1810-53/Hector					56.9				--	--

* 1981 and 1984 yields are Ozburn site only. 1982, 1983, and 1985 yields are an average for the Ozburn and Reed sites.

69.9 109.1 56.1

1987 Soda Springs (Ozburn) Barley Trial

Preliminary Summary
Not for Publication

Yield in Grams
Conversion Factor: .0536

North ↑

110	109	108	107	106	105	104	103	102	101
Piroline	MT 81143	WA 877178	Lewis	OR 8432	Heavyweight	Karla	Bowman	84Ab1843	Waxbar
1787=	2135	2109	2006	2076=	2138=	2220=	2388=	2098=	1567=
95.7 Bu/A	114.4 Bu/A	113.6 Bu/A	101.5 Bu/A	111.2 Bu/A	114.5 Bu/A	118.9 Bu/A	129.9 Bu/A	112.4 Bu/A	93.9 Bu/A
120	119	118	117	116	115	114	113	112	111
Lamont	MT 140523	83Ab6656	85SR52	MT 328202	MT 81616	Lindy	MT 81502	BA 280350	MT 83422
2013=	2248=	2139=	1752=	1674=	2051=	2184=	2304=	1861=	2010=
107.8 Bu/A	130.4 Bu/A	114.6 Bu/A	93.9 Bu/A	97.7 Bu/A	101.9 Bu/A	117.0 Bu/A	123.4 Bu/A	99.7 Bu/A	101.7 Bu/A
130	129	128	127	126	125	124	123	122	121
BA 814038	Steptoe	MT 83435	Harrington	Morex	Sunbar 560	MT 83533	81Ab10099-B	Munsing	85Ab2506
1817=	2080=	2164=	2045=	1875=	2231=	2042=	2182=	1870=	1597=
97.3 Bu/A	111.4 Bu/A	115.9 Bu/A	109.6 Bu/A	100.3 Bu/A	119.5 Bu/A	109.4 Bu/A	116.9 Bu/A	100.2 Bu/A	85.5 Bu/A
140	139	138	137	136	135	134	133	132	131
ND 8671	Hector	Russell	84Ab897	85SR882	Premier	MT 83424	78Ab6871	Clark	85SR431
1870	2034=	2597=	2471=	1890=	2131=	2040=	2050=	2013=	2184=
100.2 Bu/A	109.0 Bu/A	139.1 Bu/A	130.5 Bu/A	101.3 Bu/A	114.2 Bu/A	109.3 Bu/A	109.8 Bu/A	107.8 Bu/A	117.0 Bu/A
150	149	148	147	146	145	144	143	142	141
Galatin	Teton	WA 890878	Korol	MT 81161	OM 8413	Otis	79Ab10740-SRC	BA 280529	78Ab10274
1907	2007=	1896=	1694=	2061=	2099=	1483=	2034=	2001=	2084=
102.2 Bu/A	107.5 Bu/A	101.6 Bu/A	90.7 Bu/A	110.4 Bu/A	112.5 Bu/A	79.4 Bu/A	109.0 Bu/A	107.2 Bu/A	111.7 Bu/A
160	159	158	157	156	155	154	153	152	151
Munsing	BA 280529	Morex	78Ab10274	ND 8671	Galatin	Teton	MT 81616	MT 83424	84Ab1843
1766=	2068=	1876=	1762=	1401=	1959=	1871=	2162=	2052=	1939=
94.6 Bu/A	110.8 Bu/A	100.5 Bu/A	94.4 Bu/A	75.2 Bu/A	105.0 Bu/A	100.2 Bu/A	115.8 Bu/A	109.9 Bu/A	103.9 Bu/A
170	169	168	167	166	165	164	163	162	161
MT 81143	MT 140523	MT 81502	78Ab6871	Lewis	Hector	Korol	OR 8432	Lamont	MT 83435
1809=	1938=	1926=	1921=	1776=	1916=	1684=	2017=	2214=	1874=
96.9 Bu/A	103.8 Bu/A	103.2 Bu/A	102.9 Bu/A	95.1 Bu/A	102.6 Bu/A	90.2 Bu/A	108.1 Bu/A	118.6 Bu/A	100.4 Bu/A
180	179	178	177	176	175	174	173	172	171
MT 328202	Russell	83Ab6656	84Ab897	WA 890878	Sunbar 560	BA 280350	Piroline	WA 877178	Otis
1795=	2084=	2316=	2052=	2365=	2103=	2061=	2021=	2284=	1774=
96.2 Bu/A	111.7 Bu/A	124.1 Bu/A	109.9 Bu/A	126.1 Bu/A	112.7 Bu/A	110.4 Bu/A	108.3 Bu/A	122.4 Bu/A	95.0 Bu/A
190	189	188	187	186	185	184	183	182	181
85SR882	Bowman	79Ab10740-SRC	OM 8413	85SR431	Waxbar	Clark	85Ab2506	Lindy	MT 83422
1771=	2157=	2065=	2036=	2349=	1576=	1685=	1847=	1997=	2032=
94.9 Bu/A	115.6 Bu/A	110.6 Bu/A	109.1 Bu/A	125.9 Bu/A	84.4 Bu/A	90.3 Bu/A	98.9 Bu/A	107.0 Bu/A	108.9 Bu/A
200	199	198	197	196	195	194	193	192	191
Steptoe	MT 81161	Karla	Heavyweight	Premier	BA 814038	Harrington	85SR52	81Ab10099-B	MT 83533
2229=	2164=	2448=	2011=	2064=	2351=	2089=	1955=	1970=	2324=
119.4 Bu/A	115.9 Bu/A	131.2 Bu/A	107.7 Bu/A	110.6 Bu/A	126.0 Bu/A	111.9 Bu/A	104.7 Bu/A	105.5 Bu/A	124.5 Bu/A

Bu/A = Bushels Per Acre.

1987 Soda Springs (Ozburn) Barley Trial

Preliminary
Not for Publication

Yield in Grams
Conversion Factor: .0536

North ↑

10	9	8	7	6	5	4	3	2	1
MT 81502	MT81143	BA 280529	Bowman	Levis	81Ab10099-B	Hector	Clark	Steptoe	Munsing
1923 =	1920 =	2032 =	2117 =	2101 =	1837 =	1870 =	1779 =	2343 =	1723 =
103.0 Bu/A	102.9 Bu/A	108.9 Bu/A	113.4 Bu/A	112.6 Bu/A	98.4 Bu/A	100.3 Bu/A	95.3 Bu/A	125.5 Bu/A	92.3 Bu/A
20	19	18	17	16	15	14	13	12	11
MT 83424	MT 83422	OM 8413	MT 140523	MT 81161	78Ab10274	BA 280350	BA 814038	OR 8432	MT 81616
2086 =	2115 =	2111 =	1909 =	2341	2012	2148 =	1939 =	1815 =	2003 =
111.8 Bu/A	113.3 Bu/A	113.1 Bu/A	106.6 Bu/A	125.4 Bu/A	101.5 Bu/A	115.1 Bu/A	103.9 Bu/A	97.2 Bu/A	107.3 Bu/A
30	29	28	27	26	25	24	23	22	21
Teton	Russell	Norex	Lindy	Karla	WA 877178	ND 8671	MT 328202	MT 83533	MT 83435
2221 =	2377 =	2135 =	2140 =	2718 =	2161 =	1855 =	1864 =	2356 =	2231 =
119.0 Bu/A	127.4 Bu/A	114.4 Bu/A	114.7 Bu/A	145.5 Bu/A	115.8 Bu/A	99.4 Bu/A	99.9 Bu/A	126.2 Bu/A	119.5 Bu/A
40	39	38	37	36	35	34	33	32	31
Lamont	Korol	Heavyweight	Harrington	Gallatin	85SR431	85SR52	85Ab2506	84Ab1843	84Ab897
2060 =	1871 =	2171 =	1960 =	2202 =	2177 =	1899 =	1904 =	2377 =	2176 =
110.4 Bu/A	100.2 Bu/A	116.3 Bu/A	105.6 Bu/A	118.0 Bu/A	116.6 Bu/A	101.7 Bu/A	102.0 Bu/A	127.4 Bu/A	116.6 Bu/A
50	49	48	47	46	45	44	43	42	41
85SR882	83Ab6656	79Ab10740-SRC	78AB6871	WA 890878	Waxbar	Sunbar 560	Premier	Piroline	Otis
2114	2316	2195	2128 =	2391 =	1547 =	2109 =	2172 =	1852 =	1689 =
113.3 Bu/A	124.1 Bu/A	117.6 Bu/A	114.0 Bu/A	128.1 Bu/A	82.9 Bu/A	113.0 Bu/A	116.4 Bu/A	99.2 Bu/A	90.5
60	59	58	57	56	55	54	53	52	51
78Ab10274	Bowman	MT83424	Munsing	Sunbar 560	Hector	Russell	ND 8671	Korol	84Ab897
2011	1716	2126	1682 =	2313 =	1747 =	1932 =	1892 =	1707 =	2027 =
107.7 Bu/A	91.9 Bu/A	113.9 Bu/A	90.1 Bu/A	123.9 Bu/A	93.6 Bu/A	103.5 Bu/A	101.4 Bu/A	91.4 Bu/A	108.6 Bu/A
70	69	68	67	66	65	64	63	62	61
BA 280350	MT 83533	WA 890878	MT 81143	Harrington	Piroline	BA 814038	85SR52	MT 328202	MT 83435
2130	2066	2155	1958 =	2212 =	1996 =	2185 =	2130 =	2050 =	1888 =
114.1 Bu/A	110.7 Bu/A	115.5 Bu/A	104.9 Bu/A	118.5 Bu/A	106.9 Bu/A	117.1 Bu/A	114.1 Bu/A	109.8 Bu/A	101.1 Bu/A
80	79	78	77	76	75	74	73	72	71
Karla	79Ab10740-SRC	85Ab2506	OM 8413	81AB10099-B	Steptoe	MT 81161	Otis	Waxbar	Gallatin
2570 =	1995 =	1784 =	1757 =	2267 =	2133 =	2058 =	1994 =	1785 =	2210 =
137.7 Bu/A	106.9 Bu/A	95.6 Bu/A	94.1 Bu/A	121.5 Bu/A	114.3 Bu/A	111.7 Bu/A	106.8 Bu/A	95.6 Bu/A	118.4 Bu/A
90	89	88	87	86	85	84	83	82	81
Clark	Premier	Teton	BA 280529	MT 81616	Lamont	MT 140523	WA 877178	Lindy	85SR882
1690 =	2004	2267 =	1761 =	2057 =	1964 =	1962 =	2482 =	2216 =	1536 =
90.5 Bu/A	107.4 Bu/A	121.5 Bu/A	94.3 Bu/A	110.2 Bu/A	105.4 Bu/A	105.1 Bu/A	133.0 Bu/A	118.7 Bu/A	82.3 Bu/A
100	99	98	97	96	95	94	93	92	91
MT 81502	MT 83422	85SR431	83Ab6656	Levis	Heavyweight	84Ab1843	Norex	78Ab6871	OR 8432
2021 =	2172 =	2400 =	2102 =	2099 =	1977 =	2459 =	2322 =	2072 =	2160 =
108.3 Bu/A	116.4 Bu/A	128.6 Bu/A	112.6 Bu/A	112.5 Bu/A	105.9 Bu/A	131.8 Bu/A	124.4 Bu/A	111.0 Bu/A	115.7 Bu/A

Bu/A Bushels Per Acre

The Effect of SONIC BLOOM on the Germination of 89 Kinds of Flowering Plant Seeds

by

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August 18, 1987

INTRODUCTION

Sonic Bloom, a nutritional system for plants that combines a high-frequency sound system with foliar feeding of gibberellic acid plus trace minerals from the ocean has been reported to stimulate the growth and fruiting of many kinds of plants. In this paper, I report the effects of Sonic Bloom on the germination and initial growth of a variety of flowering plant seeds.

EXPERIMENTAL DESIGN

Germination of each kind of seed was done in duplicate: one set was soaked in water and the other in Sonic Bloom (1:300 dilution in tapwater) in small plastic dishes for 8 hours at 70F in an illuminated refrigerator. The sound system was running during the initial soaking and then during the duration of the germination experiment. After soaking, the seeds were washed onto Scott paper towels in a buchner funnel, rinsed with 40 cc of tapwater, transferred to plastic petri dishes and incubated until germination was completed. Generally this required 3-7 days. Occasionally it required 2 weeks. Plates were misted with tapwater daily to prevent drying out.

RESULTS

Seeds representative of 16 families of flowering plants have been tested for their response to Sonic Bloom. Two characterisitics are noted in the experiments (see Table "Sonic Bloom Experiments 1987). The first is the germination frequency or percentage (% Germ). The second is the size and vigor of the newly germinated seeds (SB Effect). The data are presented in the appended list. The list is organized alphabetically in families.

Sonic Bloom dramatically stimulated the germination of Yellow Doll Watermelon, Bushel Basket Container Gourd, Hull-less seeded (Godiva) Winter Squash, Green Hokkaido Winter Squash, *Hypericum revolutum*, the Blazing Star flower, Black Aztec Sweet Corn, Rhubarb, the Chinese Empress Tree (*Paulownia tomentosa*), Louisiana Hot Pepper, three species of rare Solanums, *Urtica cannabina*, and the Chinese Parasol Tree (*Firmiana simplex*). Four of these germinated only in the presence of Sonic Bloom.

Sonic Bloom stimulated the growth of the germinated sprouts of 2 Amaranths, 15 Lettuces, 3 kinds of other composits, Red Russian Kale, 4 kinds of cucurbits including a cucumber, a watermelon, a container gourd and an acorn squash, 8 varieties of corn, 2 varieties of peppers and a nettle.

DISCUSSION

The effects of the plant growth hormone gibberellic acid have been known for many years. Fruit set from diverse crops such as tomatoes and grapes are enhanced by this molecule. The combination of a sound system and the plant hormone is a unique and worthwhile discovery. In this paper, we demonstrate the utility of the Sonic Bloom system in stimulating the germination and early growth of a variety of angiosperm seeds.

In recent years, analyses of the fungi that grow as mycorhiza on the roots of plants have shown that more than 95% of the seed plants that grow on this planet have mycorhiza associated with them. In some cases, these fungi fix atmospheric nitrogen. From the results of these experiments, one is led to suggest that a major natural germination process is provided by fungi who provide gibberellic acid for the germination of seeds and the stimulation of early plant growth. One suspects that many of our crops have been selected by virtue of their seeds being able to germinate in the absence of the natural mycotrophic fungi and hence the growth and germination hormone gibberellic acid. It is impressive that seeds of the Chinese Parasol Tree and several rare South American Solanums germinated *only* in the presence of Sonic Bloom.

In Figure 1 and Figure 2, the experimental results with Sonic Bloom on the germination and growth stimulation are presented in the Dahlgren Coevolutionary format of the Flowering Plants. This method of representation puts the experimental data in perspective of all the species of plants that grow on this planet. It permits one to distinguish between the effect of Sonic Bloom on germination and that on early seedling growth. Most striking in this regard can be seen for lettuce in the Asteriflorae whose germination is unaffected yet whose growth is uniformly stimulated. For further discussion and relationship of this mapping procedure, one can refer to the 1986 and 1987 Peace Seeds Catalogs and Research Journals.

An improvement in the experimental design wherein all experiments are done in the absence as well as the presence of the sound would make an even more impressive case for the efficacy of the Sonic Bloom technique. Furthermore, it now becomes useful to extend the tests to all of the Superorders and Orders of flowering plants. Some particular results such as the stimulation of starch corns relative to sweet corns is also worthy of pursuit.

1	Amaranthaceae	Amaranth	Burgundy	+	99	++	much larger root
2	Amaranthaceae	Amaranth	Burgundy	-	95		
3	Amaranthaceae	Amaranth	Golden Giant	+	86		no difference
4	Amaranthaceae	Amaranth	Golden Giant	-	89		
5	Amaranthaceae	Amaranth	Nepalese	+	95	+	roots larger
6	Amaranthaceae	Amaranth	Nepalese	-	95		
7	Asteraceae	Chrysanthemum	Edible leaf	+	27	-	
8	Asteraceae	Chrysanthemum	Edible leaf	-	50		
9	Asteraceae	Coneflower	Pallid	+	33		no difference
10	Asteraceae	Coneflower	Pallid	-	36		
11	Asteraceae	Coneflower	Purple	-	85		
12	Asteraceae	Coneflower	Purple	+	85		no difference
13	Asteraceae	Lettuce	Australian Oaklea	-	98		
14	Asteraceae	Lettuce	Australian Oaklea	+	99	++	
15	Asteraceae	Lettuce	Barcarole Cos	-	82		
16	Asteraceae	Lettuce	Barcarole Cos	+	86	++	
17	Asteraceae	Lettuce	Brown Golding	+	88	++	
18	Asteraceae	Lettuce	Brown Golding	-	89		
19	Asteraceae	Lettuce	Buttercrunch	+	94	+	
20	Asteraceae	Lettuce	Buttercrunch	-	92		
21	Asteraceae	Lettuce	Cosmo	+	93	++	
22	Asteraceae	Lettuce	Cosmo	-	97		
23	Asteraceae	Lettuce	Iceberg Head	-	76		
24	Asteraceae	Lettuce	Iceberg Head	+	77	++	
25	Asteraceae	Lettuce	Little Gem	+	94	+	sprouts elongate
26	Asteraceae	Lettuce	Little Gem	-	89		
27	Asteraceae	Lettuce	Lobjoit's Cos	-	96		
28	Asteraceae	Lettuce	Lobjoit's Cos	+	92	+	
29	Asteraceae	Lettuce	Lollo Rosso	+	92	+/-	
30	Asteraceae	Lettuce	Lollo Rosso	-	83		
31	Asteraceae	Lettuce	North Pole	-	92		
32	Asteraceae	Lettuce	North Pole	+	91	+	
33	Asteraceae	Lettuce	Pirat	+	94	++	
34	Asteraceae	Lettuce	Pirat	-	96		
35	Asteraceae	Lettuce	Red Sails	+	97	+	
36	Asteraceae	Lettuce	Red Sails	-	95		
37	Asteraceae	Lettuce	Sandrina	+	99	++	
38	Asteraceae	Lettuce	Sandrina	-	97		
39	Asteraceae	Lettuce	Simpson Leaf	-	93		
40	Asteraceae	Lettuce	Simpson Leaf	+	94	++	
41	Asteraceae	Lettuce	Waldeman's	-	99		
42	Asteraceae	Lettuce	Waldeman's	+	96	+++	
43	Asteraceae	Lettuce	Winter Density	+	91	++	
44	Asteraceae	Lettuce	Winter Density	-	94		
45	Asteraceae	Marigold	Cempanzuchil	+	68		no difference
46	Asteraceae	Marigold	Cempanzuchil	-	63		
47	Asteraceae	Marigold	T. minuta	+	20	+/-	
48	Asteraceae	Marigold	T. minuta	-	17		
49	Asteraceae	Marigolds	Mixed	+	21	++	
50	Asteraceae	Marigolds	Mixed	-	6		
51	Asteraceae	Salsify	American	+	65	++	
52	Asteraceae	Salsify	American	-	54		
53	Asteraceae	Salsify	European	-	85		

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	Family	Kind	Variety	+/- SB	%Germ.	SB Effect	Comments
54	Asteraceae	Salsify	European	+	85	+++	fine stimulation
55	Asteraceae	Strawflowers	Orange/Yellow	+	48	+/-	
56	Asteraceae	Strawflowers	Orange/Yellow	-	51		
57	Asteraceae	Sunflower	Lion's Mane	+	87		no diff.
58	Asteraceae	Sunflower	Lion's Mane	-	89		
59	Asteraceae	Sunflower	Polyheaded	+	81		no difference
60	Asteraceae	Sunflower	Polyheaded	-	92		
61	Asteraceae	Sunflower	Single Giant	+	82	-	
62	Asteraceae	Sunflower	Single Giant	-	96		adv. without SB
63	Brassicaceae	Kale	Red Russian	+	99	++	larger seedlings
64	Brassicaceae	Kale	True Siberian	+	99		no difference
65	Brassicaceae	Kale	True Siberian	-	97		
66	Brassicaceae	Kale	Red Russian	-	87		
67	Cucurbitaceae	Cantalope Melon	Ha-Ogen	+	94		
68	Cucurbitaceae	Cantalope Melon	Ha-Ogen	-	73		
69	Cucurbitaceae	Cucumber	Early Russian	+	100	+++	
70	Cucurbitaceae	Cucumber	Early Russian	-	98		
71	Cucurbitaceae	Cucumber	Perfection	+	100	-	
72	Cucurbitaceae	Cucumber	Perfection	-	98		2x Ahead
73	Cucurbitaceae	Gourd	BB Lagenaria	+	70	++	
74	Cucurbitaceae	Gourd	BB Lagenaria	-	20		
75	Cucurbitaceae	Melon	Ananas	+	79		
76	Cucurbitaceae	Melon	Ananas	-	62		
77	Cucurbitaceae	Summer Squash	Sunburst	-	100		Ahead +
78	Cucurbitaceae	Summer Squash	Sunburst	+	100	-	
79	Cucurbitaceae	Watermelon	Sugar Baby	-	79		
80	Cucurbitaceae	Watermelon	Sugar Baby	+	90	+	
81	Cucurbitaceae	Watermelon	Yellow Doll	-	26		
82	Cucurbitaceae	Watermelon	Yellow Doll	+	98	++	
83	Cucurbitaceae	Winter Squash	Godiva Bush	+	79	+	
84	Cucurbitaceae	Winter Squash	Godiva Bush	-	50		
85	Cucurbitaceae	Winter Squash	Godiva Vine TS	+	100	-	
86	Cucurbitaceae	Winter Squash	Godiva Vine TS	-	88		Ahead +++
87	Cucurbitaceae	Winter Squash	Golden Acorn	+	93	+++	
88	Cucurbitaceae	Winter Squash	Golden Acorn	-	32		
89	Cucurbitaceae	Winter Squash	Green Hokkaido	+	100		
90	Cucurbitaceae	Winter Squash	Green Hokkaido	-	21		slightly ahead
91	Fabaceae	Licoriceroot		+	65	-	
92	Fabaceae	Licoriceroot		-	78		
93	Fabaceae	Mimosa	Sensitiveleaf	-	75		
94	Fabaceae	Mimosa	Sensitiveleaf	+	80		no difference
95	Hypericaceae	Hypericum	revolutum	-	0		
96	Hypericaceae	Hypericum	revolutum	+	14		
97	Linaceae	Flax	Herra	-	98		
98	Linaceae	Flax	Herra	+	99		no difference
99	Loasaceae	Blazing Star	Mentzelia l.	+	50	+	
100	Loasaceae	Blazing Star	Mentzelia l.	-	23		
101	Malvaceae	Okra	Star of David	+	98		no difference
102	Malvaceae	Okra	Star of David	-	86		
103	Malvaceae	Okra	Texas Red	-	57		
104	Malvaceae	Okra	Texas Red	+	69		no difference
105	Onagraceae	Primrose	Evening	+	30		no difference
106	Onagraceae	Primrose	Evening	-	30		

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	Family	Kind	Variety	+/- SB	%Germ.	SB Effect	Comments
107	Poaceae	Corn	Bantam Sweet	+	90	+	
108	Poaceae	Corn	Bantam Sweet	-	86		
109	Poaceae	Corn	Big Timber Indian	+	99	++	
110	Poaceae	Corn	Big Timber Indian	-	86		
111	Poaceae	Corn	Blk Aztec Swt	+	78	++	
112	Poaceae	Corn	Blk Aztec Swt	-	44		
113	Poaceae	Corn	Early Pearl Swt	+	87	+++	vigorous sprouts
114	Poaceae	Corn	Early Pearl Swt	-	76		
115	Poaceae	Corn	Golden Jubillee Sv	+	70		
116	Poaceae	Corn	Golden Jubillee Sv	-	76		
117	Poaceae	Corn	Hopi Blue	+	89	+	
118	Poaceae	Corn	Hopi Blue	-	97		
119	Poaceae	Corn	Kandy Sweet	+	51	+++	vigorous sprouts
120	Poaceae	Corn	Kandy Sweet	-	45		
121	Poaceae	Corn	Ornamental	-	100		
122	Poaceae	Corn	Ornamental	+	99	+++	vigorous
123	Poaceae	Corn	Posole	+	77	-	
124	Poaceae	Corn	Posole	-	95		
125	Poaceae	Corn	Rainbow Inca Sw.	-	46		
126	Poaceae	Corn	Rainbow Starch	+	97	+++	vigorous
127	Poaceae	Corn	Rainbow Starch	-	90		
128	Poaceae	Corn	Rainbow Inca Sw.	+	65		no growth diff.
129	Poaceae	Eragrostis	abyssinica	+	77		no difference
130	Poaceae	Erogrostis	abyssinica	-	95		
131	Poaceae	Millet	Foxtail	-	95		
132	Poaceae	Millet	Foxtail	+	96	+	more vigorous
133	Polygonaceae	Buckwheat	Medawaska	-	>95		
134	Polygonaceae	Buckwheat	Medawaska	+	>95	+	
135	Polygonaceae	Rhubarb	emodi	-	50		
136	Polygonaceae	Rhubarb	emodi	+	69	+	
137	Polygonaceae	Rhubarb	palmatum	+	75		no difference
138	Polygonaceae	Rhubarb	palmatum	-	46		
139	Scrophulariacea	Paulownia	elongata	-	55		
140	Scrophulariacea	Paulownia	tomentosa	-	12		
141	Scrophulariacea	Paulownia	tomentosa	+	40		no difference
142	Scrophulariacea	Paulownia	elongata	+	40		no difference
143	Solanaceae	Husk Tomato	Tomatillo	+	>95	-	
144	Solanaceae	Husk Tomato	Tomatillo	-	>95		
145	Solanaceae	Naranjilla	Equadorean	+	85	+	
146	Solanaceae	Naranjilla	Equadorean	-	85		
147	Solanaceae	Pepino	Dulce	-	25		
148	Solanaceae	Pepino	Dulce	+	21		no difference
149	Solanaceae	Pepper	Cubanelle	+	65		no diff.
150	Solanaceae	Pepper	Cubanelle	-	65		
151	Solanaceae	Pepper	Louisiana Hot	-	45		
152	Solanaceae	Pepper	Louisiana Hot	+	>90		no growth diff.
153	Solanaceae	Pepper	Red Heart Pimento	-	90		
154	Solanaceae	Pepper	Red Heart Pimento	+	90	++	
155	Solanaceae	Pepper	Relleno	+	85	++	
156	Solanaceae	Pepper	Relleno	-	85		
157	Solanaceae	Pepper	Yellow Cheese	+	80		no diff.
158	Solanaceae	Pepper	Yellow Cheese	-	80		
159	Solanaceae	Potato Tree	Common	-	25		

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	Family	Kind	Variety	+/- SB	%Germ.	SB Effect	Comments
160	Solanaceae	Potato Tree	Common	+	50	+	
161	Solanaceae	Solanum	chimelewskii	+	100		
162	Solanaceae	Solanum	chimelewskii	-	0		
163	Solanaceae	Solanum	macrocarpum	-	0		
164	Solanaceae	Solanum	pectinatum	-	89		
165	Solanaceae	Solanum	peruvianum	+	75		no difference
166	Solanaceae	Solanum	peruvianum	-	75		
167	Solanaceae	Solanum	pseudolulo	-	0		
168	Solanaceae	Solanum	pseudolulo	+	85		
169	Solanaceae	Solanum	macrocarpum	+	50		
170	Solanaceae	Solanum	pectinatum	+	89		no difference
171	Solanaceae	Tomato	Hairy	+	80		no difference
172	Solanaceae	Tomato	Hairy	-	100		
173	Sterculiaceae	Firmiana	simplex	-	0		
174	Sterculiaceae	Firmiana	simplex	+	40		
175	Unknown	Aeolanthus	parviflorus	+	18		no difference
176	Unknown	Aeolanthus	parviflorus	-	22		
177	Urticaceae	Nettle	Cannabina	-	1		
178	Urticaceae	Nettle	Cannabina	+	6	++	sprouts 2x large

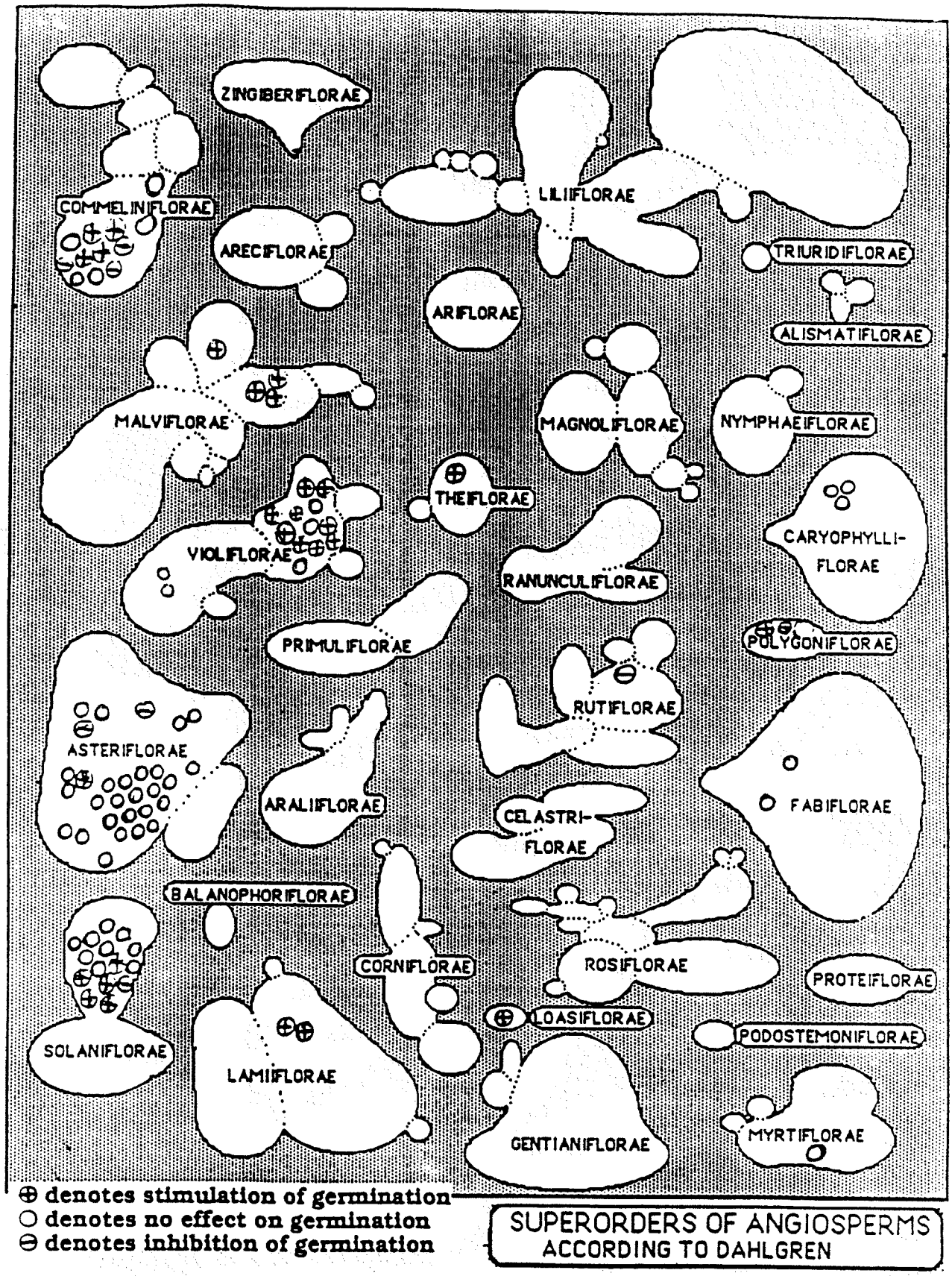

Figure 1. Effect of SONIC BLOOM on Seed Germination

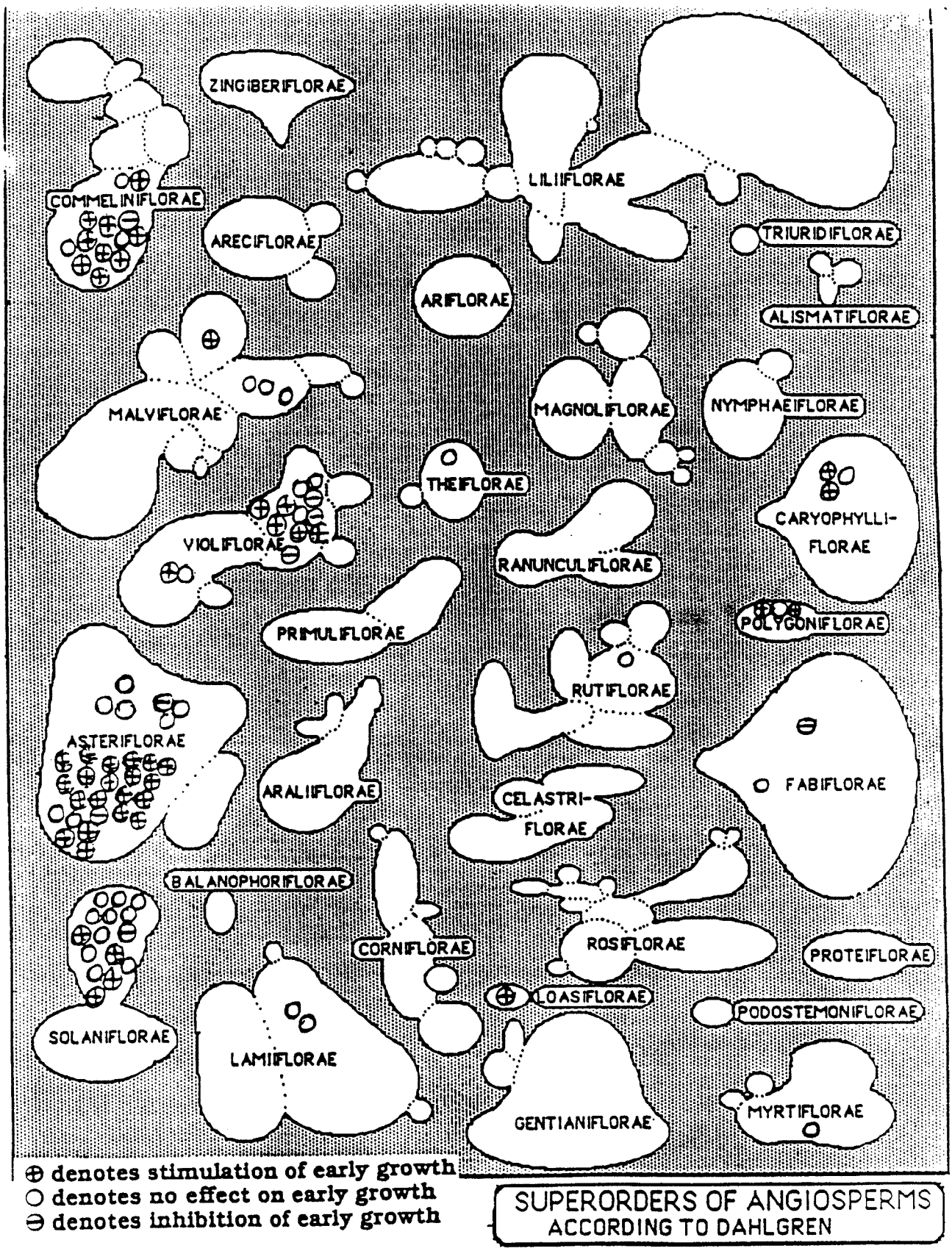

Figure 2: Effect of SONIC BLOOM on Early Plant Growth

Experiments on Introduced Sonic Bloom Technique

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ABSTRACT

Sonic Bloom Technique was introduced from United States. This technique utilize sound wave to stimulate plant growth, accompanied by spray of chemical fertilizer, to increase the yield of crops or vegetables. Based on three-year period experiments, The technique has been confirmed effective to raise the yield of tested vegetables and crops. When treated with sound alone, fertilizer alone, or the combination of sound and fertilizer, the yield increase of for *phaseolus vulgaris L.*,*Glycine max*, and seeds of water melon was at the range of 13-81%, 19-67%, and 25-64%, respectively, when compared with their controls.

Key Words: Sonic, Plant.

INTRODUCTION

Sonic Bloom technique was developed by Dan Carlson Scientific Enterprise in 1980's. This technique utilize certain frequency of sound wave to stimulate plants, accompanied with surface application of chemical fertilizers, to increase the qualities or yields of some crops, vegetables, fruit tree, flowers, and forage grass. There is no environmental contamination problem when using this technique. Up to now, this technique has obtained U.S. technical patent and applied in several States in the country [1], and has been introduced into 14 countries in the world. A Japanese company has built two 'music breeding' greenhouses in two Japanese cities and their 'music vegetables' have been commercialized[2].

The Author was invited and visited the company in 1987 as a visiting professor of University of Minnesota at Twin Cities. Mr. Carlson, the president of the company, kindly provided samples of music cassette, chemical nutrients and

basic information for our experiments conducted in China. The following is a brief report of our greenhouse and field experiments.

MATERIALS AND METHODS

Experiments conducted during 1989-91 were composed of three large groups:

Experiment 1.

Tomato seeds were planted on the seedling bed of a greenhouse on March 3rd, 1989. the seedling of approximately 10 cm high (23 days) were transplanted onto 15 cm lower pots, one seedling per pot. When the plants reached about 20 cm in height, 40 pots of plants of equal height were chosen for the experiment. The chosen pots were randomly grouped into 4 groups (A, B, C, and D), 10 plants per group. Group A received sound wave stimulation, Group B received only chemical treatment, group C received both sound and chemical treatment, and group D received no treatment as a control. The first treatment was conducted at 8:00 am, April 17, 1989. During the treatment, groups A and C received 15 music stimulation, and group received the chemical spray within the same music time period. Group A and D received clean water spray. After the spray,music was played for another 30 min. Second treatment was followed 7 days after the first one, and a total of 4 treatments was conducted. plant height, flowing time, and fruit number and weight were recorded for each group. Due to hot weather in earlier June, 1989, all the tomato plants were transferred out off the greenhouse to avoid high temperature attack in the greenhouse. Unfortunately, some mature tomatoes were stolen by theft. As a result, only the record of May 20 was reported in the result.

Experiment 2.

A field experiment was conducted during 1990 at the Experiment Station. Xinjiang Academy of Forestry Science, Urumqi, Xinjiang. greenbeab(*Phaseolus vulgaris L*), sweet beet, and soybean (*glycine max*) were selected for the experiment. Two 300 m^2 trials (20 x 15 m) with similar fertilizer condition were chosen. The trials were 200 meters apart to reduce influence of sound treatment. Each trial was further divided into 4 smaller trials (replications), and greenbean, beets and soybean were planted in each smaller trial. Only one of the trial received sound plus

chemical treatment, the other trial was treated with chemical or left as control. All the treatment was followed the directional guidance from the company. A total of 4 treatments were conducted through a grow season. Data of fruit weights was collected by random sampling for green bean, sweet beet, and soybean.

Experiment 3.

1991 experiment was conducted at a larger scale on water melon in a field of An-ning Experiment Station, Xinjiang Academy of Forestry Science. Seed-production water melon variety was selected to receive the treatment. Two fields of 660 m2 with controlled soil and fertilizer conditions were located 300 meters apart. The experimental layout, treatment, and control were similar to Experiment 2 except no variety variation. Five treatments was conducted through the growing season. At the time of harvest in September, 5 row of melons were randomly selected for each treatment and control, 10 melon plants were randomly chosen with each selected row, and total weight of seeds from each 10-plant melons were recorded.

RESULTS AND DISCUSSION

The effect of different treatments on tomato plant height, flower number, and number of fruit was given in table 1.

The effect of treatments on the yields of green bean, sweet beets and soybean were given in Table 2, 3, and 4, respectively.

The effect of treatments on the total weight of water melon seeds is given in Table 5.

According to our results on Experiment 1, Sonic bloom technique can significantly improve the tomato plant development and increase the number of flowers (Table 1). Comparing to the control, sound wave plus chemical spray resulted a 80% increase in number of lowers, and 24% increase in number of tomato fruits. Single sound or chemical treatment also increased the flower and fruit number. However, the effect of treatments on increase of plant height was not obvious. This may probably due to low sound volume we used in the experiment (we just used a normal cassette player, no amplifier was used).

An amplifier was used during experiment 2 to increase the sound volume. As a result, the yields of all three tested plants increased significantly.Comparing with the control, the yield of greenbean, sweet beet, and soybean increased 81, 67, and 29%, respectively, following the sound plus the chemical treatment; and increased 45, 52, 11%, respectively when treated with sound wave alone. Single chemical treatment resulted moderate yield increase for greenbelt (13%) and sweet beet (19%), but a decrease for soybean (-17%) when compared with their corresponding control. The reason for yield decreasing is unknown.

Similar trend of field increase was found in water melon experiment. The yield of water melon seeds for sound plus chemical spray, sound alone, and chemical spray alone was increased to 65, 42, and 25%, respectively, comparing with their controls.

The mechanism of yield increase for Sonic Bloom technique has not been systematically investigated. As Mr, Carlson and other scholar suggested, sound wave may stimulate spiracle open more widely, improving photosynthesis of plant [3]. One explanation given by Dr. San Lunjing, a professor of Zao-Dao-Tian University of Japan is that: the bioelectrical potential is shafted when plant receives sound wave stimulation. The shaft in turn, generates ionic flow, and such ionic flow stimulate cells, resulting in stimulated growth. The results of plant bioelectrical potential monitoring following sound stimulation confirmed the shaft of bioelectrical potential[4].

In our cooperated research in plant control system with Qing Hua University, China, we was able to detect the sound produced by Haiyu plant using laser resonation method. We also found that plant can selectively absorb sound wave at certain frequency. We all know that sound wave itself is a kind of energy. Our research is underway to investigate changes in plant photorespariation, enzyme activity, and hormone when plant was exposed to sound wave stimulation[5].

More than 10 years has passed since the application of Sonic Bloom techniques in agriculture and forestry. Its effect on increase the productivity of plant is significant. To further explore the potential of the technique, a systematic investigating and lager scale field experiment are necessary. It is possible that this technique may open a brand new way toward the solution of world grain production.

Table 1:

Influence of Sonic Bloom technique on height and flower numbers of tomato plant

Character	Reps.	Treatments			Control
		Sound	Fertilizer	S + F	
Height of Seedling (cm)	1	35	37	36	37
	2	37	35	44	32
	3	32	35	40	33
	4	35	37	35	32
	5	35	35	31	40
	6	35	42	40	34
	7	33	35	32	34
	8	35	37	37	34
	9	36	32	36	38
	10	34	35	32	37
	Ave.	35.2	36.2	36.3	35.1
	%	100	103	103	100
Number of flowers per plant	1	9	6	15	8
	2	7	4	13	6
	3	10	11	13	7
	4	14	13	10	3
	5	8	8	8	8
	6	11	8	12	1
	7	4	10	9	4
	8	7	8	13	10
	9	7	9	18	8
	10	12	10	14	9
	Ave.	8.9	8.7	11.5	6.4
	%	139	136	180	100
Number of fruit per plant	1	6	6	7	8
	2	3	4	5	5
	3	4	6	8	2
	4	4	5	8	2
	5	4	6	6	5
	6	6	2	3	3
	7	5	4	5	5
	8	3	5	6	3
	9	3	8	5	3
	10	5	6	2	3
	Ave.	4.3	4.9	5.2	4.2
	%	102	117	124	100

REFERENCES

[1]. Michael Spillane. Good vibrations a sound diet for plants. *The Growing Edge Magazine.*Spring 1991, 41-43.

[2]. Hai Xiao. Music vegetables. *Scientific picture*. No. 6:36. 1990

[3]. Chris Bird. A voice for Eco-agriculture foliar-fed nutrients and pulsed sound revisited Acres, U.S.A., July, 1986.

[4]. Same as [2].

[5]. Hou, Tianzhen et. al., Sonic property of Hai Yu and the influence of acupuncture on its development. (in preparation)

Table 2:

Effect of Sonic Bloom treatment on the yield of *Phaseolus vulgaris L.*

Treatment	Sound alone	Fertilizer alone	S + F	Control
Total yield of 50 plants (kg)	68.38	53.04	85.43	47.09
%	145	113	181	100

Table 3:

Effect of Sonic Bloom treatment on yield of sweet beet

Treatment	Sound alone	Fertilizer alone	S + F	Control
Total weight of 60 plants (kg)	69.9	54.00	75.80	45.45
%	152	119	167	100

Table 4.

Effect of Sonic Bloom treatment on the yield of *Glycine max*

Treatment	Sound alone	Fertilizer alone	S + F	Control
Total weight of 20 plants (g)	362.74	269.46	419.37	325.64
%	111	83	129	100

Table 5.

Sonic Bloom treatment on the yield of water mellon seeds

	Reps.	Treatment			Control
		Sound alone	Fertilizer alone	S + F	
Weight of Seeds (kg)	1	1.61	1.31	1.44	0.93
	2	1.26	1.42	1.86	1.23
	3	1.51	0.91	1.69	0.83
	4	0.91	1.14	1.42	0.81
	5	1.53	1.24	1.48	1.00
Average		1.36	1.20	1.58	0.96
%		142	125	165	100

SONIC BLOOM FOR THE WORLD
D.C.S.E

Dan Carlson
Scientific Enterprises, Inc.
Dan Carlson
CEO

708 119th Lane N.E.
Blaine, MN 55434
(612) 757-8274

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Member of Expert Committee of Biology and Biotechnic of Xinjiang
Director of Dipartment of Trees Physiology and Biochemistry of Xinjiang Academy of Forestry Science

Hou Tian Zhen
Associate Proffesor

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RESUME

1. NAME: Hou Tian Zhen

2. SEX: Male

3 DATE & PLACE OF BIRTH: February 5, 1940; Shanxi Province

4: CITIZENSHIP: People's Republic of China

5. MARITAL STATUS: Married

6. OCCUPATION: Assistant Researcher

7. ADDRESS: Xinjiang Academy of Forestry
Urumqi, Xinjiang, China

8. EDUCATION:

A. August 1947 -- August 1952 Primary School

B. August 1952 -- August 1958 Middle School

C. October 1960 - October 1964 College
Shen Yang Forestry and Soil College,
Liaoning Province; Biophysics,
Dept. of Forestry and Soil

9. PROFESSIONAL EXPERIENCE:

A. October 1964 - December 1977 Xinjiang Academy of Forestry--Research Area: The Application of New Technology To Forestry (i.e., irradiation induced variety; high frequency electromagnetic wave and laser breeding; and, the production application of the temperature-increasing synergism of soil surfaces).

B. January 1978 - April 1985 The research of resistivity physiology of tree species in the desert; and, the physiological research of broken and rotten trunks of the popolus Bollena.

10. WORKS & THESES:

I have written 12 academic theses; among which, 10 have been read at National Academic Conferences. Five were published on the production and application of the temperature-increasing synergism of soil surfaces. They were recognized and rewarded in Xinjiang in 1979.

Sonic boosters

A contingent of agriculture experts from Mongolia paid a visit to Dan Carlson's Sonic Bloom farm in River Falls Township. Dr. Hao Feng (fifth from left) brought Carlson's sound-wave growth inducement system to The Forestry Bureau in Xinjiang, China, where the scientists have seen 30 to 90 percent increases in growth over the last three years. The group came here through the University of Minnesota as part of a three-week visit to Wisconsin, Illinois and Missouri. Carlson, fourth from left, and the group pose around a 20-million-year-old petrified tree, dedicated to Carl Weschcke. Tom Evans photo.

Public Records

My Experiments Dealt with the Following Vegetables and Fruit

DATE'S PLANTED	VEGETABLES & FRUITS NAME OF SEED	AVERAGE DAYS TO GERMI-NATION	TIME TO GERMI-NATION WITH SONIC BLOOM	TREATED OR UNTREATED	WHAT TYPE OF FRUIT OR VEGETABLE
May 3, 87	(Corn) (Kandy Korn)	10-12 Days	5 Days	Treated	Sweet Corn
May 3, 87	(Tomato) Excel Seeds	14-18 Days	10 Days	Treated	Ruetgers
May 3, 87	(Pumpkin) Green Valley Seeds	10 Days	6 Days	Treated	Calabaza Connecticut
Field					
May 3, 87	(Squash) Bentley	10-12 Days	6 Days	Treated	Acorn Squash, Zucchini
May 3, 87	(Peppers) Excel Seeds	10-20 Days	6 Days	Treated	California Wonder
May 3, 87	(Potatoes) Idaho Norgold	15 Days	10 Days	Treated	Idaho Norgold
May 3, 87	(Radish) Bentley Seeds	8-10 Days	5 Days	Treated	Champion
May 3, 87	(Sunflower) Bentley Seeds	15 Days	5 Days	Treated	Mammoth
	7-8 Year Old	———	———	Treated	———
May 3, 87	(Cucumbers) Green Valley Seeds	7-14 Days	5 Days	Treated	Peppino, Straight Eight
May 3, 87	(Corn) (Kandy Korn)	10-12 Days	8 Days	Untreated	Sweet Corn
April 20, 87	(Tomato) Excel Seeds	14-18 Days	12 Days	Untreated	Ruetgers
May 3, 87	(Pumpkin) Bentley Seeds	10 Days	10 Days	Untreated	Calabaza Connecticut
Field					
May 3, 87	(Squash) Bentley Seeds	10-12 Days	9 Days	Untreated	Acorn Squash, Zucchini
April 20, 87	(Peppers) Excel Seeds	10-20 Days	15 Days	Untreated	California Wonder
April 20, 87	(Potatoes) Idaho Norgold	15 Days	14 Days	Untreated	Idaho Norgold
	Red Pontiac	———	———	Untreated	———
April 23, 87	(Radish) Bentley Seeds	8-10 Days	9 Days	Untreated	Champion
April 20, 87	(Sunflower) Bentley Seeds	15 Days	10 Days	Untreated	Mammoth
April 20, 87	(Cucumbers) Green Valley Seeds	7-14 Days	10 Days	Untreated	Peppino, Straight Eight
April 20, 87	(Onions) Lofts Seeds	10-15 Days	12 Days	Untreated	White Bunching,
Evergreen					Bunching
April 23, 87	(Beans) Green Valley Seeds	8-16 Days	10 Days	Untreated	Kentucky Wonder
April 23, 87	(Peas) Bentley	7-15 Days	12 Days	Untreated	Oregon Sugar Snap

Attn Dan Carlson

My name is Dan Thrawley and I was introduced to Sonic Bloom Through Ted Vaughn. Also By John Francisco of lifetime opportunities in Spokane Wash.

Naturally I was skeptical of Sonic Bloom, Playing Music to Your Plants was kind of Hard To Swallow.

I started My garden on May 3 1987 which was Treated with Sonic Bloom.

My Parents started A garden Approxamately 100 yds Away, therefore I got a great chance to Compare.

There garden has been treated with Manure & Mulch every year for about the Past Ten Years.

My garden was used for flowers and Raspberries for the last 2 years and has had very little Manure Spread on it.

We both used the same seeds with A couple of exceptions.

Ive grown gardens for About the last 5 Years now And Ive never had the results that I have had using Sonic Bloom.

Enclosed in this letter is All the data & Pictures from my Experiment with Sonic Bloom and the Rewards that I have recieved. If You Can use any of this Information in Your Book, feel free, but please Return My slides when You are finished, for they are for My Presentation's. Thank You and I'm looking forward to working with You in the Future

Sincy

Dan Thrawley

1987

AWARDS WON BY DAN THRAWLEY WITH SONIC BLOOM AT THE SPOKANE INTERSTATE FAIR

DAN THRAWLEY
OTIS ORCHARDS, WASH. 99027

NAME OF ENTRY	RIBBON COLOR
Black Berries	1st Blue
One Pie Pumpkin	1st Blue
Squash Zucchini Large Type	1st Blue
Potato 21 lbs or More	1st Blue
Dried Comfrey	1st Blue
Raspberries	2nd Red
Cucumbers 3 Slicing	2nd Red
Potatoes 4 Long White	2nd Red
Best Pumpkin in the Field	2nd Red
Squash 1 Sm. Acorn Type	2nd Red
Squash Zucchini Small	2nd Red
Tomato 4 Green	2nd Red
Sunflower, Roots Intact, with Best Head	2nd Red
Cucumbers 6 Pickling Under 6"	3rd White
Tomato 4 Red Ripe	3rd White
Dried Corn	3rd White
Largest & Best Head Sun Flower	NP
Sunflower, Roots Intact, w/Best Head	NP

PRIZE WINNING CORN

PRIZE WINNING SUNFLOWER

SONIC BLOOM
FOR THE WORLD

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P.O. BOX 750
101 N. MAIN
CLEARFIELD, UTAH 84015

PHONE 1-801-773-4631
TWX 910-971-5119
ALBION CLFD.

May 24, 1983

Mr. Norm Fredricks
MERCHANT & GOULD
1600 Midwest Plaza Building
Minneapolis, MN 55402

Dear Mr. Fredricks:

Mr. Dan Carlson has requested I furnish to you the results of our tests utilizing his foliar spray and ultra sound unit. The experiment was as follows:

OBJECTIVE: To measure the translocation of nutrients (Fe^{-59}) within plants by comparing ultra sound (high frequency sound) on plants sprayed with a compound containing multimineral chelate versus the translocation of nutrients (Fe^{-59}) within plants sprayed with the same nutrients minus the ultra sound. Separate base line translocation of nutrients (Fe^{-59}) in plants was established.

MATERIALS:

1. Red cherry tomatoes
2. Radioactive isotope - Fe^{-59}
3. Ultra sound unit
4. 12-volt battery
5. Oscilloscope (Telatronic) instrument
6. Scintillation counter

TECHNIQUE: Nine 6" cherry tomatoe plants were chosen as uniform as possible. They were divided into groups of three each.

Group 1 - To Group 1, 50 microliters Carlson 17-C spray was spotted over 2.0 sq. cm. on second leaf from top of plant. Spray was diluted 1:128.

64,000 corrected counts per minute (5 micro-curries Fe^{-59} isotope) was applied to the 2.0 sq. cm. surface area of the leaf. 20 MV energy with Carlson ultra sound unit, as determined by an oscilloscope, was applied 15 minutes pre-treatment and 15 minutes post treatment to the plants in Group 1.

Group 2 - Group 2 was treated exactly the same as Group 1 except the ultra sound was omitted.

Group 3 - Group 3 was treated exactly the same as Group 1 except the sound and Carlson spray were omitted.

RESULTS: The terminal leaf, opposite leaf, stem above point of application and stem below point of application was collected on all plants 24 hours post application. Corrected counts per minute per mg. are as follows:

	Group 1	Group 2	Group 3
Terminal Leaf	0.3 ± .2	.67 ± .29	0.2 ± .15
Opposite Leaf	0.17 ± .12	.47 ± .46	0.23 ± .06
Stem Above	2.47 ± .4	.40 ± .1	0.60 ± .18
Stem Below	2.5 ± .17	1.13 ± .42	0.35 ± .22

We won with a big 714% increase in absorption

Due to large variation in the standard deviation, a concrete evaluation is difficult. However, the preliminary data does suggest a synergistic effect between the ultra sound unit and Carlson 17-C foliar spray.

Very truly yours,

ALBION LABORATORIES, INC.

Harvey Ashmead

Harvey Ashmead, Ph.D.
Chairman of the Board

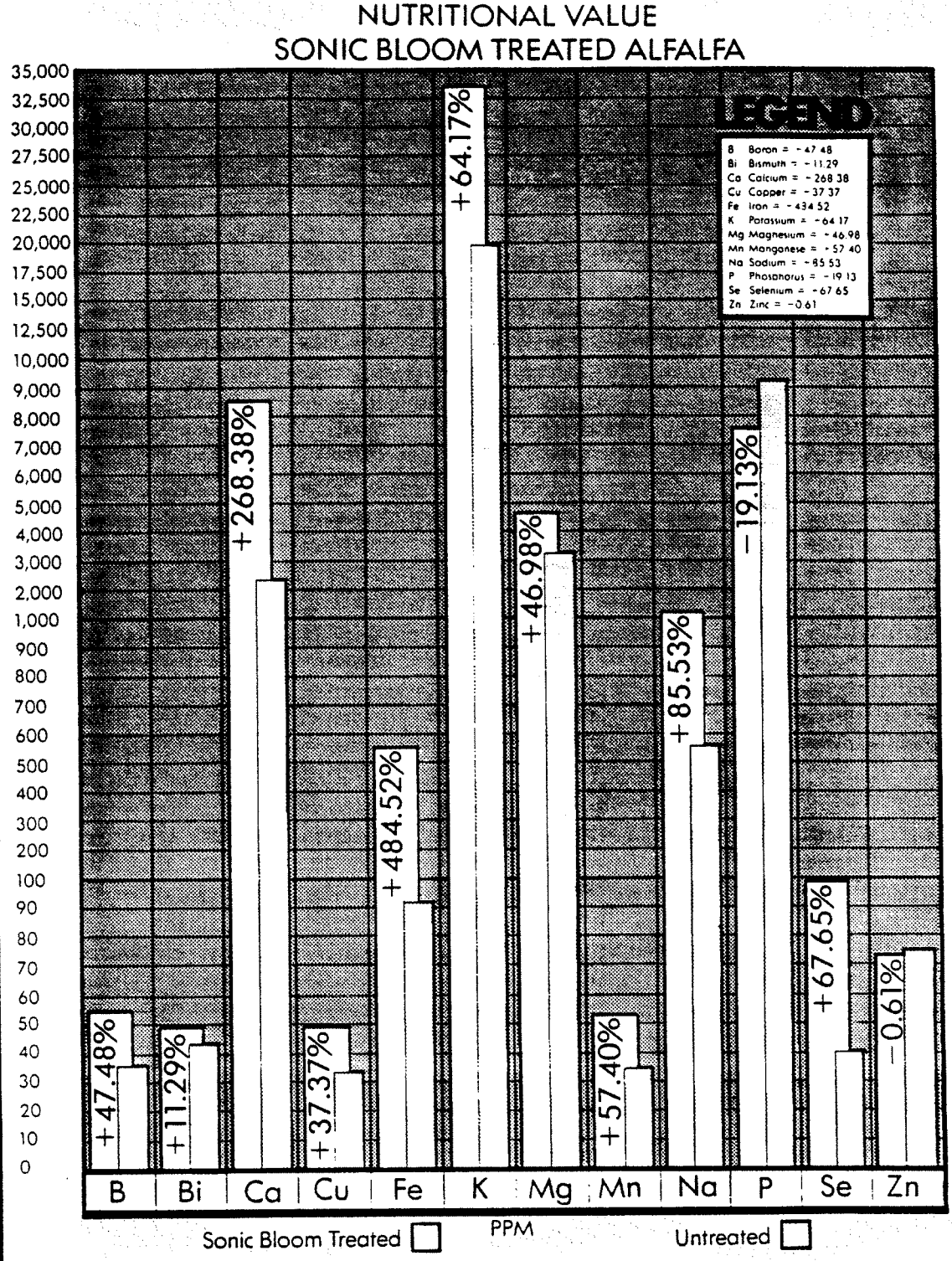
HA:lm

cc: Mr. Dan Carlson
708-119th Lane, N.E.
Blaine, MN 55434

SOYBEAN ANALYSIS
November, 1986

Symbol	Element	Offset	Soybean Untreated Data	Soybean Untreated PPM	Soybean Treated Data	Soybean Treated PPM	Soybean Difference PPM	Percent Change
AG	Silver	0.0000	0.0612	0.0000	0.0667	0.0000	0.0000	0.00%
AL	Aluminum	0.6242	0.0000	0.0000	0.0000	0.0000	0.0000	0.00%
IN	Indium	0.0000	0.9367	187.3400	1.0230	204.6000	17.2600	9.21%
AS	Arsenic	0.1054	0.2654	53.0800	0.2010	40.2000	(12.8800)	-24.27%
AU	Gold	0.0000	0.0684	13.6800	0.0683	13.6600	(0.0200)	-0.15%
B	Boron	0.0273	0.0421	8.4200	0.1728	34.5600	26.1400	310.45%
BA	Barium	0.0000	0.0052	1.0400	0.0324	6.4800	5.4400	523.08%
BI	Bismuth	0.0000	0.1780	35.5960	0.1733	34.6600	(0.9360)	-2.63%
CA	Calcium	0.0910	1.2730	254.6000	10.2900	2,058.0000	1,803.4000	708.33%
CD	Cadmium	0.0000	0.0117	2.3400	0.0163	3.2600	0.9200	39.32%
CO	Cobalt	0.0000	0.0370	7.4000	0.0411	8.2200	0.8200	11.08%
CR	Chromium	0.0000	0.0364	7.2800	0.0443	8.8600	1.5800	21.70%
CU	Copper	0.0115	0.2879	57.5800	0.0865	17.3000	(40.2800)	-69.95%
FE	Iron	0.0109	0.2332	46.6400	0.4457	89.1400	42.5000	91.12%
GA	Gallium	0.0000	0.5524	110.4800	0.5957	119.1400	8.6600	7.84%
K	Potassium	0.0000	18.5100	3,702.0000	90.6200	18,124.0000	14,422.0000	389.57%
LI	Lithium	0.0000	0.0092	1.8400	0.0101	2.0200	0.1800	9.78%
MG	Magnesium	0.0064	5.3770	1,075.4000	14.8000	2,960.0000	1,884.6000	175.25%
MN	Manganese	0.0094	0.3660	73.2000	0.1305	26.1000	(47.1000)	-64.34%
MO	Molybdenum	8.7360	1.1800	236.0000	1.2350	247.0000	11.0000	4.66%
NA	Sodium	0.1399	1.7520	350.4000	1.3050	261.0000	30.6000	8.73%
NI	Nickel	0.0000	0.0287	5.7400	0.0899	17.9800	12.2400	213.24%
P	Phosphorus	0.0586	13.2000	2,640.0000	44.2309	8,846.0000	6,206.0000	235.08%
PB	Lead	0.0000	0.2281	45.6200	0.2407	48.1400	2.5200	5.52%
RH	Rhodium	0.0000	0.3650	73.0000	0.3920	78.4000	5.4000	7.40%
SB	Antimony	0.1976	0.2213	44.2600	0.2619	52.3800	8.1200	18.35%
SI	Silicon	7.2850	2.1910	438.2000	1.3130	262.6000	(175.6000)	-40.07%
SN	Tin	0.0245	0.1189	23.7800	0.1363	27.2600	3.4800	14.63%
TI	Titanium	0.0114	0.0020	0.4000	0.0025	0.5000	0.1000	25.00%
TL	Tallium	0.0000	1.9840	396.8000	2.1390	427.8000	31.0000	7.81%
U	Uranium	0.0000	1.7300	346.0000	1.9280	385.6000	39.6000	11.45%
V	Vanadium	0.0194	0.0041	0.8200	0.0483	9.6600	8.8400	1078.05%
W	Tungsten	0.0000	9.8160	1,963.2000	11.0100	2,202.0000	238.8000	12.16%
ZN	Zinc	0.0259	0.3027	60.5400	0.3269	65.3800	4.8400	7.99%
ZR	Zirconium	0.2234	0.0177	3.5400	0.0197	3.9400	0.4000	11.30%

NUTRITIONAL ANALYSIS OF SONIC BLOOM TREATED ALFALFA



SONIC BLOOM

EQUALS

INCREASED YIELDS

IMPROVED NUTRITION

FROM AN ANALYSIS PREPARED BY
RICHARD B. RUSSELL
AGRICULTURAL RESEARCH CENTER
ATHENS GEORGIA

SONIC BLOOM
FOR THE WORLD

ALFALFA ANALYSIS
November, 1986

Symbol	Element	Offset	Alfalfa Untreated Data	Alfalfa Untreated PPM	Alfalfa Treated Data	Alfalfa Treated PPM	Alfalfa Difference PPM	Percent Change
AG	Silver	0.0000	0.0615	12.3000	0.0607	12.1400	(0.1600)	-1.30%
IN	Indium	0.0000	0.9184	183.6800	0.9697	193.9400	10.2600	5.59%
AU	Gold	0.0000	0.0658	13.1600	0.0702	14.0400	0.8800	6.69%
B	Boron	0.0273	0.1944	38.8800	0.2867	57.3400	18.4600	47.48%
BA	Barium	0.0000	0.0335	6.7000	0.0595	11.9000	5.2000	77.61%
BI	Bismuth	0.0000	0.1878	37.5600	0.2090	41.8000	4.2400	11.29%
CA	Calcium	0.0910	11.0000	2,200.0000	40.5200	8,104.0000	5,904.0000	268.36%
CD	Cadmium	0.0000	0.0147	2.9400	0.0135	2.7000	(0.2400)	-8.16%
CO	Cobalt	0.0000	0.0381	7.6200	0.0461	9.2200	1.6000	21.00%
CR	Chromium	0.0000	0.0428	8.5600	0.0529	10.5800	2.0200	23.60%
CU	Copper	0.0119	0.0891	17.8200	0.1224	24.4800	6.6600	37.37%
FE	Iron	0.0109	0.4650	93.0000	2.7180	543.6000	450.6000	484.52%
GA	Gallium	0.0000	0.5461	109.2200	0.5761	115.2200	6.0000	5.49%
K	Potassium	0.0000	95.2700	19,054.0000	156.4000	31,280.0000	12,226.0000	64.17%
LI	Lithium	0.0000	0.0086	1.7200	0.0248	4.9600	3.2400	188.37%
MG	Magnesium	0.0064	14.3900	2,878.0000	21.1500	4,230.0000	1,352.0000	46.98%
MN	Manganese	0.0094	0.1399	27.9800	0.2202	44.0400	16.0600	57.40%
MO	Molybdenum	8.7360	1.2410	0.0000	1.2310	0.0000	0.0000	
NA	Sodium	0.1398	2.6200	524.0000	4.8610	972.2000	448.2000	85.53%
NI	Nickel	0.0000	0.0707	14.1400	0.0596	11.9200	(2.2200)	-15.70%
P	Phosporus	0.0586	42.5600	8,512.0000	34.4200	6,884.0000	(1,628.0000)	-19.13%
PB	Lead	0.0000	0.2214	44.2800	0.2214	44.2800	0.0000	0.00%
RH	Rhodium	0.0000	0.3589	71.7800	0.3751	75.0200	3.2400	4.51%
SB	Antimony	0.1976	0.2266	45.3200	0.2685	53.7000	8.3800	18.49%
SI	Silicon	7.8250	1.3490	0.0000	3.2280	0.0000	0.0000	
SN	Tin	0.0245	0.1288	25.7600	0.1648	32.9600	7.2000	27.95%
TI	Titanium	0.0114	0.0020	0.0000	0.0344	6.8800	6.8800	
TL	Tallium	0.0000	1.9490	389.8000	2.0550	411.0000	21.2000	5.44%
U	Uranium	0.0000	1.7590	351.8000	1.9910	398.2000	46.4000	13.19%
V	Vanadium	0.0194	0.0452	9.0400	0.0518	10.3600	1.3200	14.60%
W	Tungsten	0.0000	6.7470	1,349.4000	12.8800	2,576.0000	1,226.6000	90.90%
ZN	Zinc	0.0259	0.3284	65.6800	0.3264	65.2800	(0.4000)	-0.61%
ZR	Zirconium	0.2234	0.0181	0.0000	0.0193	0.0000	0.0000	

SONIC DOOM

Dan Carlson Scientific Enterprises, Inc., 708 - 119th Lane NE, Blaine, MN 55434

Cheap way to "amplify" power of postemerge herbicides, possibly cut down on rates

"What a man hears, he may doubt.

"What he sees, he may possibly doubt.

"But what a man does himself, he cannot doubt."

Seaman A. Knapp, founder of the extension service in America, spoke those memorable words long before anyone envisioned the baffling experiment we tried this summer.

Two postemerge herbicides, Basagran and Poast, *killed weeds more effectively when sprayed on weeds as the plants were being stimulated by specific sound frequencies.*

Laugh if you want to, but the risk:reward ratio is super.

We've been working with Sonic Bloom projects for three years. A plant growth regulator is applied to a crop while the growing plants are stimulated into faster respiration and translocation by a warbling sound frequency. It sounds much like the flock of barn swallows which swoop over our farm pond.

We've seen photomicrographs of plant stomata opened wider than normal under stimulation by these frequencies.

And we've counted increases in soybean yields in previous experiments with the plant growth regulator (now patented).

The inventor is Dan Carlson of Blaine, Minnesota (612-757-8274) — no relative of ours.

The reasoning goes like this: If the sound increases absorption of nutrients, wouldn't it also increase uptake of herbicides?

We conducted six trials, and hired a professional agronomist to rate weed kill on four of the trials. The expert was not told which plots were sprayed accompanied with "music."

We tested the weedkillers on cocklebur, velvetleaf, pigweed and giant foxtail.

The increase in percentage of weed kill, and suppression effect on weed growth, was statistically significant beyond the 95% confidence level in almost all trials. Naturally we'll continue testing.

Plots in which we allowed 24-hour separation of sound-treated vs. conventional spraying showed the greatest difference. Plots with less than a 30-minute wait between spraying with and without sound in adjacent plots showed the least difference.

A cheap computer chip and small loudspeaker, clipped to your tractor battery, can generate the warbling sound for almost no operating cost per acre. If sound improves weed kill or allows lower herbicide rates, the rate of return on investment could be very attractive.

Excessive fertilizer recommendations under fire again

Fertilizer companies and laboratories which recommend fertilizer applications which are wasteful and lead to pollution could find themselves facing civil fraud charges, says Iowa Attorney General Tom Miller. Miller and the Iowa Department of Agriculture and Land Stewardship co-sponsored a conference a few days ago to focus on this problem.

University of Nebraska agronomist Don Sander tells *LandOwner* that experiment stations sent samples to four commercial labs during 1973-86, following their recommendations on test plots.

The labs recommended irrigated corn fertilizers costing from $43 per acre to $61. The university lab's recommendations averaged $23 per acre, says Sander.

"We believe the lab analysis is competent. We're primarily concerned with recommendations which are not based on yield response research," says Sander.

Ways to double-check tests:

1. Use a lab that's independent of a fertilizer company.
2. Cross-check the independent lab's recommendations with your state university by splitting samples. Use replicated check plots to see if you're actually getting results from higher applications.
3. Retain a skilled agronomic consultant whose job it is to generate long-term profits for you.
4. Maintain an ongoing field-by-field record of fertility tests, materials applied and crop results (see example in our July 27 issue).
5. Use sampling techniques that reduce variability: Multiple cores pulled for each sample sent in. Samples pulled the same time each year. Consistent sampling depth.

Landowner

Volume 9, No. 16, September 21, 1987

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he loan
a new

The attraction: Reasonably priced land, and 10-year fixed interest rates on new farmland loans. Fixed rates were offered at 8⅞% during May, then bumped to 9⅜% June 1.

"It's an attempt to generate profitable new business and stabilize farmland values," says Susie Bullock, FLB of Texas.

"Parcels of land are moving again,

The Federal Land Bank of Texas has an average current cost of funds behind existing loans of about 9.5%. Current Land Bank billing rates on outstanding farm and ranch loans in the FLB of Texas are at 10.25%.

The system's Funding Corporation has been raising new funds on a short-term basis at a cost of just under 8% during 1987.

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Landowner
Volume 6, No. 22, December 17, 1984

Biological buffs, here's what you've been waiting for

This is the followup to a *LandOwner* article last spring promising that we'd test several biological products and tell you what happened.

They were an organic fertilizer (Clod Buster), a hormone spray called XL-27, a soil bacterial stimulant named Grozyme, and a blue-green algae called *Microp* which is used as microscopic "cover crop."

Right away, we learned why researchers always conclude that more research is needed before conclusive evidence is confirmed.

For one thing, weather was abhorrent in these parts: A record-rainy April, record-dry August, a killing frost in September and a soggy harvest season.

1. Clod Buster: We applied a semi-load of it this spring, over winter wheat seeded last fall. This was on a farm at the Iowa-Missouri border 180 miles away, and the experiment went bonkers right away: The applicator didn't apply it in the patterns as instructed.

This summer, our custom operator estimated 40 bu. per acre wheat in the 30-acre test area, but the only control plots weren't on comparable soil. The remainder of the 70-acre field went far less than that, some on clay knobs as low as 15 bu. per acre.

The soil under two years of the treatment has visibly better tilth when you're working the ground.

So, we got a hopeful response, but like most farmer "research" by remote control, a precise amount of benefit is hard to nail down in one trial.

Sonic Bloom This growth regulator was developed by Dan Carlson of Blaine, Minnesota. We tested it at the home farm, with some precision. On soybeans, we averaged a 32% increase over controls, in five replications with various treatments. In a sandy field, which had virtually no rain in August, the best 3-acre plot made 29 bu. while control beans made 17.

The unusual aspect of this treatment is that a high-frequency sound is played about 15 minutes before and after spraying. The sound generator is carried on the tractor. Neighbors think you're a little weird. The theory: The particular sound frequency stimulates the plant's metabolism, so it absorbs and transports more of the hormone treatment.

There's an extensive body of research over the past couple of decades showing that certain sound frequencies have positive — and negative — influence on plants.

We also rode a potato harvester in Minnesota, where we saw a skeptical grower harvest 19% more No. 1 potatoes with the treatment. The treated potatoes were visibly larger and more uniform, with good density and skin color.

We tested the sound/spray treatment on garden vegetables, and harvested more than 40 bell peppers from one treated plant. A curious TV photographer trampled a second treated plant. Untreated plants yielded three weeks later than the treated ones, with far fewer and smaller peppers.

A vegetable grower in Minnesota had similar positive response with bell peppers and cauliflower.

Sweet corn treated with one spray silked and tasseled about four days earlier than untreated rows.

3. Grozyme results, we're told, show up in improved soil conditions the following year. So, this plot is on hold. No real yield difference noted on corn this year.

4. Microp, a symbiotic mix of blue-green algae (cyanophyte) with a second algae (chlamydamonas), is intended to improve soil tilth, permeability, and water retention. It's being introduced into the Midwest this year by Soil Technologies Corp., Fairfield, Iowa.

Users say that compacted soils gradually become "like coffee grounds."

In Washington state, growers claim they've been able to reduce fertilizer expense, yet hold up yields.

All of this should maintain yields with less fertilizer expense, improve emergence and root penetration.

Our spring treatment on 30 acres went on in June — rather late. It should be applied alone over bare soil and given time to multiply before any other chemical treatments are used.

This fall, after one treatment, our 30-acre plot chiseled a bit more easily than adjacent parts of the field. The top inch appears more crumbly, rather than puddled together. Again, this will take some time for yield results to show up. We'll continue a spring-fall application for three years.

Some test users in the Midwest this season were convinced enough to apply the algae to all their acres this fall. It costs $8 per acre per treatment, or $16 per year.

The effect of the Microp treatment is cumulative. First-year results with 70 field plots tested by the company show that 28% of the plots had statistically significant increases after only one "transplanting" of the algae cover crop.

The algae are applied by spraying in clean water (you are dealing with a live, microscopic plant). Almost 10 billion cells per acre are applied. Each milliliter of supplied concentrate solution contains about 10 million algae cells.

The algae live in the moisture film around soil particles, and in about three weeks have multiplied 20 times. After 20 divisions, the total wet weight of algae is around 25,000 lbs. in the top four inches of soil. The algae's primary purpose in life is to create polysaccharides, the same beneficial substances put into soil by other cover crops such as sweetclover.

Polysaccharides range between 15% and 57% of total organic matter. As little as .02% to .2% of polysaccharides by weight in soil causes significant aggregation of soil particles. Such aggregation improves tilth.

Multiplication of the algae generates polysaccharides totaling .21% to .81% of the weight of the soil's top 4 inches. That's enough to maintain substantial aggregation.

The company doesn't claim the blue-green algae fix nitrogen. However, rice growers in the Orient commonly use varieties of blue-green algae to enrich soil nitrogen.

Microp is considered a live cover crop by the Iowa Department of Agriculture. Because it's not a chemical, many farmers feel more comfortable knowing they're not applying something toxic.

It's like growing a cover crop underground *while you're growing a paying crop above ground.*

Landowner
Volume 6, No. 8, June 4, 1984

Four "biological farming" ideas we'll test for you this summer — and report to you in LandOwner next fall

A preview for you from Jerry Carlson, LandOwner editor

A rising number of farmers tell me they're looking at their crop production costs in an entirely new way. Rather than pushing input costs to the "maximum profit" point where the last extra dollar spent generates only a dollar of potential new income, they want ways to *cut crop costs but hold yields constant.*

Reasoning: High cash costs tied up with a crop create a big debt burden in case yields fail. Risk:reward ratios favor lower cash exposure.

Farmers who are searching for ways to cut costs are looking into biological products. This isn't "organic farming" but it's somewhere on the spectrum between total chemical dependence and zero chemical use.

This is why, as your *LandOwner* editor, I'll be buying and trying several manufacturer's products in field experiments this season in practical farming operations.

If some of these products sound far out, remember that in the late 1800s none of the scientific community accepted Dr. Joseph Lister's observation that microbes cause disease.

Algae inoculation to reduce erosion, increase soil tilth and produce nitrogen. Rice farmers around the world gain up to 35 lbs. of nitrogen fixation per season from blue-green algae in paddies. This species has the same nitrogen-fixing ability as the rhizobium that live in nodules on legume roots. Scientists have tried to find a nitrogen-fixing microorganism plant or animal that can live in the water film around soil particles in non-irrigated soils. For more than a decade, a few farmers in the erosive Palouse region of Washington have experimented with a combination of two soil algae which not only generate nitrogen, but create a softer, more absorbent soil structure.

One species exudes, as a waste product, around 30 lbs. of plant sugars. These polysaccharides help provide an environment that supports the nitrogen-fixing species. The "symbiosis", or relationship, gradually builds a soil which can absorb more moisture, erodes less, and supports higher yields.

The developers are trying to solve one problem of bringing the product to market: The algae must be grown in a liquid medium. Shipping and applying the organisms this way is expensive. They're trying to develop a way to dry the algae, then revive them at application time.

We'll run field trials for soil texture, yield and nitrogen content.

Stimulated foliar feeding. Foliar-feeding plants directly would be an efficient way to convert plant nutrients and hormones to payoff — if the process wasn't so touchy. It has proven erratic, sometimes yielding results and sometimes not.

We'll test a novel means of synchronizing plant uptake of growth regulators with application time. The claim comes from a Minneapolis innovator who has spent some 20 years developing the methodology: *A specific frequency of sound waves* are beamed at the plants several minutes before and after three separate applications.

Soybean leaves respond by lifting their leaf tips erect, show test photos. We'll see about that.

The inventor has grown ornamental vines as long as 1,300 feet, pushed tomatoes to produce over 800 fruit per plant and has several other apparent plant responses.

The scientific and commercial community has responded either in total skepticism or attempts to buy out the developer's technical rights.

We'll also try the sound-wave generator as a means of inducing weeds to absorb a higher percentage of postemerge herbicide, to see if lower rates will deliver effective results.

Last year, we found that a high-quality liquid fertilizer at a rate of 1 gal. per acre allowed effective cocklebur kill when added to a spray containing as little as .4 pint of Basagran. The theory was that plant uptake became more effective by addition of the fertilizer. If uptake can be increased by *sound* stimulation, that's certainly a cheap route.

Botanists have known for years that plants respond to certain sounds (rock music can actually kill some plants), but this is the first commercially promising application we've seen.

Humus application on heavy clay soils. Rolling clay soils derived from forests erode heavily under crop production. And our nation's midsection is largely made up of such soils. One producer of humus, mined in New Mexico, claims that 500 lbs. of his product per acre — costing about $15 — will over several years build up organic matter and yields. The theory: Vastly increased microbial activity converts more nonavailable minerals into plant-available form.

Over time, less commercial fertilizer is needed to maintain yields. Results reported by other farmers have been most pronounced on heavy, low-fertility soils.

We've applied 24 tons on alfalfa and soybean ground, and will be looking for differences this summer and fall.

Trace minerals to stimulate biological activity and improve soil tilth. Several products are on the market which claim to be a "catalyst" to encourage soil microbial activity. Certainly they don't feed microbes by themselves because they're applied at rates of only 3 to 12 ounces per acre. Test data we saw from last year does show some yield increases. But the main claim is an improvement in soil moisture retention, a gradually diminished plow layer and greater soil bacterial action. Lab tests show a bacterial bloom following application, but that surge gradually tapers off.

The four concepts above will be tested for yields and soil response primarily on corn, with some tests on soybeans, sweet corn and alfalfa.

Landowner®
Volume 6, No. 10, July 2, 1984

Music to your ears? A growth regulator and sound system promises faster crop growth

Farmland's productivity would jump to a higher level if a combination of foliar-spray hormones and *high-frequency sound stimulation* proves consistent on field crops.

As mentioned in our June 4 issue, *LandOwner* is experimenting with this unconventional treatment this summer. So far, we've seen a definite response on garden and ornamental plants. It's too early to tell on corn and soybeans.

The process was developed by a University of Minnesota graduate, Dan Carlson of Blaine, Minn., who markets the "system" through Dan Carlson Scientific Enterprises, Inc. (No relation to your *LandOwner* editor).

His agronomic studies pulled together several experiments showing that plants grow faster in response to certain sounds. He reasoned that the sound might stimulate nutrient transfer, and asked himself a revealing question: What would happen if plants were given a spray of growth minerals and hormones while they're stimulated to accept such nutrients?

Tracing with isotopes after treatment did show a sharp increase in nutrient transfer. Legumes such as soybeans show a physical response to the sound, such as a change in leaf angle.

After 10 years of experiments, he came up with a blend of growth hormones and a sound generator with which a few growers — those not afraid of getting laughed at — have gotten results like this:

Potatoes: Doubling of production.

Corn: 17.5% more ear weight, 16% more height, larger root mass.

Bell peppers: 100% increase in production.

Sunflowers: 83% larger heads.

Tomatoes: 133% more yield, plant foliage 54% larger.

Edible beans: 2,000 lbs. per acre vs. 1,400 lbs. on the tests.

Greenhouse plants: More blooms, faster maturity to marketplace, substantially larger root mass.

Carlson has pushed a few plants to extremes as a demonstration. For instance, he stimulated an 18-inch passion plant to 600 feet, which qualified it for the Guiness Book of World Records. Then he kept treating it, doubling its size again.

For experimenters, Carlson sells a $[illegible]8 kit (612-757-8274) which contains the two parts of his process: A cassete tape with the desired sound frequencies embedded in music, plus a sample of the nutrient/hormone spray.

The scientific community remains skeptical, says Carlson. He refuses to sell his formula to major firms, preferring to slowly keep experimenting and rely on word-of-mouth marketing among users.

BioResearch Farms
5330 South Union Road
Cedar Falls, Iowa 50613
319-277-6347

PROTOCOL SUMMARY OF SONIC RESEARCH IN CONJUNCTION WITH HERBICIDES

BioResearch Farms and ACRES Inc. are conducting a double-blind test of the Dan Carlson Scientific sound generator as a stimulant to herbicide uptake by plants.

The general hypothesis is that the sound generated by the speaker carried on spray equipment is associated with an increase in herbicide effectiveness. Presumably any rise in effectiveness would be caused by an increase in plant absorption and translocation, as the plant responds to the sound.

Test No. 1: Overnight separation, evening spray

General procedure: Herbicide sprayed without sound late in the day, then same herbicide sprayed with sound 24 hours later. Intent is to completely separate the sound effect from the plots sprayed without sound.

Test 1, Strip A:

Mixture was 4 pints of Basagran herbicide in 150 gallons of water, 5 gallons of 28% liquid nitrogen fertilizer and 1 gallon of molasses. The molasses and nitrogen act as a surfactant and increase the Basagran effectiveness. Rate of Basagran per acre: .66 pints or about half of recommended minimum rate.

The center boom and left-hand boom were activated, spraying at a rate of 25 gallons of water per acre, using fan tip nozzles, on a tractor-mounted sprayer. Boom height was 30 in. above the canopy. Target weed population was a mixture of velvetleaf, rough pigweed, giant foxtail, and cocklebur.

Travel was eastbound, with no sound. Time: July 9, 6:00 p.m., with temperature 80 degrees, humidity in mid-70s and overcast skies. Tractor was a John Deere 4430, driving in gear B2, at 1800 RPM, which is 5.5 mph.

Test 1, Strip B: Same mixture was used 23 hours later. Same speed. However, on this pass, westbound, the sound unit was played. It was mounted on the loader assembly forward of the tractor, and played 5 minutes before entering the field. After the spraying pass, the tractor was driven back through the identical tracks, with the sound unit on (but no spray), to simulate a normal return round which would be common in commercial conditions.

RESULTS: Dr. Bertel Schou, president of ACRES Inc., Cedar Falls, Iowa, rated six paired plots of the test July 17, 1987. The field data sheet is attached. He was not advised of which treatment was which.

His rating sheet notes N (north) which is the plot series with spray only, not sound. S (south) plots have sound. His overall comment: "Excellent velvetleaf control South side with fair pigweed control (5 - 6 phyto) for suppression. A crop could make it in the south but not in the north side."

Average ratings, in percent control:

	Pigweed	Velvetleaf	Lambsquarters	Cocklebur
Untreated	6.6	1.6	0.0	10.0
Treated with sound	45.0	81.6	26.6	76.6

The general weed canopy of grasses and broadleaves in the treated plots was about twice as high as in the plots treated with sound, indicating a suppressive effect. The dominant weed, rough pigweed, was 20 inches high on average in the untreated plots, 13.6 inches high in the treated. At treatment time, plant height was approximately 12 inches. Dr. Schou's comment is that "It looks like weed growth almost stopped upon spraying the south side plots."

Test 2: Two-hour separation, morning sprays

Two test areas of weeds were selected which are out of sight and hearing of each other, about a quarter-mile apart. One was sprayed first with sound, the other without. Two hours layer, a followup spraying was made to give each of the previous strips a parallel treatment: The sound-treated strip was paired with a strip sprayed without sound. The one sprayed without sound two hours earlier was paired with a spray-and-sound strip.

A heavier rate of spray was used on these, slowing the tractor speed to 4 mph. and applying approximately 1.5 pints of Basagran per acre.

Test 2, first pair, with sound treatment first:

At 9:00 a.m. July 11, the sprayer was driven westbound in gear A2, which is about 3.5 miles per hour, to deliver 1.25 pints of Basagran per acre. The sound unit faced forward and was in use. The strip was flagged on the south edge and allowed to dry. This rate of Basagran is approximately a minimum recommended

rate, although for complete control a three pint rate would normally be used with weeds of this height -- 10 to 12 inches.

RESULT: (Rated by Jerry Carlson, BioResearch Farms) 90% burndown of rough pigweed. Some browning of grasses. Larger cocklebur plants mottled and curled in 8 hours.

Two hours later, at 11:00 a.m., an adjoining strip was sprayed with about a five-foot separation between the two passes. No sound was used on this pass.

RESULT: 65% burndown of broadleaves. Slight browning of grasses. This is nearly a regular recommended rate of Basagran.

Test 2, second pair, with sound treatment second:

At 9:24 a.m. July 11, the sprayer was driven westbound with no sound in gear A2, delivering 1.25 pints of Basagran per acre. No sound was applied. Normally, this is enough of a treatment to burn down weeds, especially since there is 28% fertilizer to increase toxicity.

RESULT: Estimated 60% burndown of broadleaves.

At 11:30, the sound pass was made alongside Test 2's no-sound strip.

RESULT: 85% burndown of broadleaves. Some larger plants -- two feet high and larger -- burned but not killed.

Test 3, Poast herbicide on giant foxtail

On July 11, Poast grass herbicide was added to the Basagran mix used above to provide a rate of .5 (one half) pint per acre. This was sprayed using the sound treatment on a strip of giant foxtail in navy beans. The foxtail was six to eight inches over the navy bean canopy, and 20 inches tall overall.

One hour later, an adjoining strip was sprayed without sound, using the same mixture and application rate.

RESULTS: Dr. Schou estimates an 85% kill on the sound-treated strip, 50% on the adjoining strip treated without sound. Some uneven results were visible in both strips because the crowns of the target crop were only about 10 inches below the spray nozzles, resulting in uneven coverage.

Further tests will be done on smaller sized grasses in soybeans.

Test 4, One pint Basagran vs. one-half pint rate on 24-inch cocklebur and velvetleaf in soybeans.

On June 11, near noon, under approximately 80 degree temperatures, Laredo variety soybeans from Challenger Seeds in Waterloo, Iowa, were sprayed with the following treatments:

1. One pint rate, no sound. Spray material was same as used in Test 1 above, including 28% liquid nitrogen and molasses. A quarter-mile strip, 14 rows wide, was sprayed.

RESULT: 70% control of velvetleaf, 80% control of cocklebur. Necrosis (burning) of leaf edges on soybean top canopy where entire leaf was wetted by spray agent. No damage to lower leaves of crop.

2. Two hours after the above treatment, after the spray material had dried from the no-sound trip, the adjoining 14 rows were sprayed with the sound treatment on, but travel speed was doubled to cut the rate in half - to .5 pint per acre.

RESULT: No discernable difference in results. About 70% control of velvetleaf, 80% control of cocklebur. Same amount of leaf damage on soybeans. By July 17, the soybeans had mostly recovered from the leaf damage by putting out new leaves. No reduction in plant growth rate, compared with unsprayed beans in adjacent rows.

General observations on all the above tests

It appears that a two-hour separation of tests with and without sound is not enough to avoid some "blurring" of results. Further work will be done with low rates and 24-hour separation, with application done between 8 and 9 a.m.

Jerry A Carlson

July 17, 1987

BioResearch Farms
5330 South Union Road
Cedar Falls, Iowa 50613
319-277-6347

DAN CARLSON SCIENTIFIC ENTERPRISES, INC.
708-119th Lane N.E., Blaine, Mn. 55434

AFFIDAVIT OF
GERALD CARLSON

Gerald Carlson, being first duly sworn on oath, states as follows:

1. That affiant resides at 5330 South Union Road in Cedar Falls, Iowa;

2. That currently affiant is employed as a senior editor of Professional Farmers of America in Cedar Falls, Iowa, a marketing and financial management firm which is an advisory service to farmers across the United States;

3. That affiant also owns and operates farms in Black Hawk County, Iowa, and in partnership in another farming operation in Van Buren County, Iowa;

4. That affiant grew up on a farm in Southwest Iowa and farmed there with his family through high school, obtaining a Masters Degree from Iowa State University in Agricultural Business and Economics and Journalism;

5. That affiant was three years in the Air Force; ten years with Farm Journal Magazine, at which time he traveled nationwide to study all factors of agriculture, but particularly agricultural economics;

6. That affiant is presently a senior editor at Professional Farmers of America, editing the newsletter called "Landowner", which is primarily related to farmland, conservation management and financial management, the business side of farmland;

7. Affiant is also actively engaged in farm level research and other biological applications with the goal of reducing the overall cost of production and the improvement of food quality;

8. Affiant's farming operations span soybeans, corn, alfalfa, beet and sweet corn production;

9. In 1984 affiant began testing Sonic Bloom products of Dan Carlson Scientific Enterprises, Inc. on 30 acres of soybeans;

10. Affiant established eight replicated plots and two sets of control plots in which Sonic Bloom applications were applied one time and two times;

11. The Sonic Bloom process was applied by activating the sound unit and then applying the Sonic Bloom nutrients in a one ounce per gallon spray mixture;

12. That although there was an extremely dry August in which we had less than one inch of rain for the entire month, the treated acreage showed approximately a 30% increase over the untreated acreage. This was full season soybeans on light sandy ground in Black Hawk County, Iowa. That the test data is attached hereto and made a part hereof as Exhibit A.

13. That it was clear to the eye what was happening on the treated plots, since there was more vegetative growth and a larger size bean and increased number of pods on all those plants.

14. That affiant also did some experiments in the vegetable area treating the plants with sound and spray every week on bellpeppers, bush beans, tomatoes, and even on lawn grass, the physiological results are very obvious. For example, on the

succulent type of plant such as bush beans, they become much more prolific; they bear over a longer period of time and the regrowth is much more rapid after each picking;

15. This year, 1985, we have approximately six replications. These are strips about 400 ft. long and six rows wide on the three plots totalling about ten acres at my home at 5330 South Union Road; the growing conditions this year were nearly ideal, except for July, when we had very little rain.

16. The soybeans on the treated areas achieved an average height of about 42 inches, some as high as 49 and 52 inches measured, and the plans produced clusters of six to nine pods per cluster with large beans;

17. The control plans, which run side by side across several soil types, are shorter by several inches. There is a bit more lodging and the plants did not have the new top growth;

18. In late August and September we had about 4½ inches of rain on this particular location and the treated plots continued to blossom and generate new top growth, but the untreated plots tended to lodge and not develop fresh top growth;

19. There was about an eight to fourteen inch difference in the overall vegetative plant height, the treated plants being taller than the untreated, and this was due to a very visible amount of additional top growth in August. In other words, there was more plant vigor when the moisture became available.

20. The 1985 Harvest is attached as Schedule A, 1986 Harvest, Schedule B.

21. Last spring, affiant tried one of the Sonic Bloom experiments, which was soaking the soybean seeds for 12 hours in a solution of one teaspoon of Sonic Bloom spray material to a gallon of water. This solution was supplied to a pioneer brand early variety of bean seed, and we spread these out on a flat absorbant surface, and maintained the wetness of this by continually applying a fresh solution every ten to fifteen minutes, keeping the beans wet, and allowing them to absorb the moisture until they have swollen in size over four hours by about 30%, all the time applying the sound; the treated seeds were then put in one planter box out of six so that we would have a pair of treated rows side by side in a pattern of four untreated and two treated, or five untreated and two treated, with the left hand planter box of a six row planter carrying the treated seeds; as the first beans began to emerge so they could be rowed, as we call it, affiant sent observers out and asked them to report back to the affiant and tell him what they saw; the observers stated that it "looks like you only planted two rows" because they could see two rows emerging and the other rows had only begun to crack the ground as the beans emerged; there was uniform emergence in excess of 90%; there was a higher percentage of germination and more uniform germination of the treated rows versus the untreated rows.

Further affiant sayeth naught.

Jerry G. Carlson

GERALD CARLSON

DONNA RAE JOHNSON
NOTARY PUBLIC - MINNESOTA
COUNTY

Subscribed and sworn to before me this 13th day of November, 1986.

Donna Rae Johnson

SPRAY PLUS SOUND VERSUS SOUND ALONE,
SWEET CORN, 1986

BioResearch Farms, Cedar Falls, Iowa 50613

Plots of Illini "Ivory and gold" sweet corn, a short and early variety, were planted with a JD 6-row Max-Emerge planter and divided into adjacent plots of 1/100 acre, which makes a six-row strip 29 feet long. Plots were end to end, with odd numbers treated with spray and sound, even numbers treated with sound alone. Sound unit was on 30 minutes before spraying, which was done with a hand sprayer at recommended solution mix of Sonic Bloom in non-chlorinated well water.

These plots were part of a larger three-acre planting of the same variety. Harvest was by hand, selecting ears judged ready for market. All corn was counted, weighed and sold at retail.

		A.M. time	Wind	Temp F.
Spraying dates:	May 29	6:00	calm	71
	June 13	7:00	9 mph	65
	June 19	7:00	calm	68

	July 24 harvest					July 29 harvest			
	TREATED		UNTREATED			TREATED		UNTREATED	
PLOT	Lbs.	Ears	Lbs.	Ears		Lbs.	Ears	Lbs.	Ears
1	78	120				51	26		
2			38	57				20	20
3	79	114				34	24		
4			68	105				33	47
5	70	118				25	19		
6			74	113				19	25
7	69	109				38	30		
8			91	111				11	14
9	90	120				19	24		
10			88	121				11	18
11	81	110				15	24		
Total	467	691	359	507	0	182	147	94	124

Sound and spray average per acre:	10,117	13,967	0.774
Sound alone average per acre:	9,060	12,620	0.718
Average advantage for three sprays plus sound versus sound alone at spraying time:	11.94%	11.07%	10.79%

Samples taken from plots approximately 200 feet from the test site, and thus somewhat isolated from the sound, averaged 8,140 lbs. and 9,768 ears per acre. These samples were taken at random points in the untreated field. This may not be enough distance to isolate completely from the sound unit.

	Lbs.	Ears
Untreated sweet corn 200 ft. away	8,140	9,768
Increase over untreated, sound and spray:	32.88%	42.98%
Increase over untreated, sound alone:	11.13%	29.20%

Discussion: The increases for total pounds of production are consistent with earlier work in 1984 and 1985 on soybeans and vegetables.

One of the interesting aspects is the number of ears which reached market size. The treated plants, whether with sound alone or sound and spray together, generated more double ears and pushed them to maturity.

Customer acceptance of this variety, from the total plot, was very high. Our retailer/buyer told us, "Don't you dare miss planting this kind of corn for us again next year... maybe twice as much."

Promising research: Testing of total solids and sugars in treated versus untreated. Testing of such content several days after harvest, and after freezing and being kept for a year.

Field trials 1985, Gerald Carlson, Cedar Falls, Iowa
Senior Editor Professional Farmers of America and Land Owner

Test No.	Treatment	Total weight lbs.	Number of rows (30 in.)	Row length ft.	Total area (acres)	Moist. test	Bu.per acre
1	Three sprays	365	5	400	0.114784	15.6	53.0
2	Sound only	360	5	400	0.114784	15.9	52.3
3	Three sprays	380	5	400	0.114784	16.0	55.2
4	Sound only	275	5	400	0.114784	15.5	39.9
5	Three sprays	260	5	320	0.091827	15.2	47.2
6	Three sprays	255	5	320	0.091827	15.5	46.3
7	Sound only	245	5	320	0.091827	15.8	44.5
8	Three sprays	270	5	320	0.091827	15.3	49.0
9	Three sprays	270	5	320	0.091827	15.6	49.0
10	Sound only	250	5	320	0.091827	15.3	45.4
11	Sound only	250	5	320	0.091827	15.6	45.4
12	Five sprays*	95	5	70	0.020087	15.6	78.8
13	Five sprays*	190	5	150	0.043044	15.9	73.6
14	Three sprays	290	5	300	0.086088	15.7	56.1
15	Sound only	188	5	300	0.086088	15.2	36.4

Ave. yield, five sprays, extra sound	75.2
Ave. yield, three sprays	51.0
Ave yield, sound only	44.2
Ave yield, untreated	37.0

Note: These trials were done in strips in three adjacent plots. Planted May 20. Pioneer early beans. The plots with sound only outyielded the same variety on similar soils which were one-half mile away, and exposed to neither sound nor spray. Those beans yielded 35 to 40 bushels in various yield checks. The additional sprays on tests 12 and 13 were applied by hand. Other sprays were applied by ground boom and tractor. Soybean size was visibly larger than in untreated fields. Pods per plant were higher, usually 60 to 100 pods. Clusters were typically five to seven per bract, sometimes high as nine clusters. Beans had a tendency to behave as a climbing plant, twining themselves around each other and around buttonweeds which grew up above the canopy.

Treated beans had few nodules on roots, compared with other fields which had normal nodulation.

* Test 12 and 13 also had extra sound for 2 weeks in June, with sound played continually during daylight hours.

FIELD TRAILS WITH SOYBEANS, 1986

BioResearch Farms, Cedar Falls, Iowa 50613

Three strips of 30-in. row soybeans were sprayed four times with a tractor mounted sprayer in a 40-acre field June 18, 27, July 5 and 12. The sound unit was mounted facing backward, and one round trip was used per treated strip. This exposed the treated area to two passes of sound, one of spray. Pressure was 35 lbs. and 12 gallons of unchlorinated well water was the carrier. Fan type nozzles were used.

	Treated (bu./a)	Untreated (bu./a)
Yield average of three replications:	44.8	34.1
Increase in sound/spray treated:	31%	

This of is a "field style" test and has only three replications, but it is consistent with earlier soybean work. The plot was on a neighbor's land, and was planted May 28 because of late rental arrangements and wet weather. Weed control was conventional premerge, with a post spot spray. Weed control was good in both treated and untreated soybeans.

Dan Carlson Scientific Enterprises, Inc.

State of New Mexico
County of Rio Arriba

Affidavit of Gabriel Howearth

Gabriel Howearth, being first duly sworn, on oath, states as follows:

That I am a Master Gardener; (See resume attached.)

That for the last 10 years I have been collecting strains of ancient, historic open-pollinated seeds, which have been close to extinction, and have been developing seed banks of such seeds;

That as part of my experience in developing seed lines, I have tested many products using standard testing procedures with test plants and control plants;

That for the last two years, I have been working with the Pueblo Indians at San Juan Pueblo, New Mexico to assist them in the development of their agricultural program, and as part of that program, I have cultivated a three (3) acre research garden;

That I have grown out many of the historic seed lines in that garden for the last two years, and during this last season, I have tested Dan Carlson's process in the garden, and I have found that the process is very effective;

That the process was applied as follows: during the test period the sound unit was posted in the garden and activated one half (1/2) to one (1) hour before and after each foliar spraying, which took place three to four (3-4) mornings (6-9am) every other week; the foliar spraying was done by hand on account of the large variety of test plants in the research garden (the total number of sprayings on each variety is indicated on the attached data sheets); the control plants were treated by sound, but not by foliar spray;

That I have attached all of the data I have collected on the varieties tested during the 1985 growing season at the Research Garden at San Juan Pueblo, New Mexico, said season beginning April 15, 1985 and ending November 15, 1985, which is hereby and herewith attached hereto and make a part hereof.

Further affiant sayeth naught.

DONNA RAE JOHNSON
NOTARY PUBLIC
RIO ARRIBA COUNTY
STATE OF NEW MEXICO

Gabriel Howearth
Gabriel Howearth

Subscribed and sworn to before me this 31st day of December, 1985.

Donna Rae Johnson
Notary Public

** San Juan Pueblo Agricultural Project **
Fertilization Trials Research Data

CROP, VARIETY	SOIL TYPE	TYPE/QUAT. OF FERTIL. (See Note 1)	TIMES IRRIG.	PLANT DATE	% GERM.	1ST FRUIT/ SEED	TOTAL # OF PLANTS	TOTAL YIELD (lbs.)	AVG. YIELD PER PLANT (lbs.)	FOLIAR SPRAY (Note 2)	COMMENTS
AMARANTH											
Cruentes Multiflora	Clay-loam, 7.9 ph		2	5/27							
Row 1		N/3/2/N			97	8/25	305	65.0	0.21	4/0	Sonic Bloom increased avg. yield from 1600 to 2600 lbs/acre, and reduced avg. maturity time by 15 days.
Row 2		N/3/2/N			97	8/30	278	39.5	0.14	*	
Row 3		N/1.5/2/N			95	8/27	292	60.8	0.21	4/0	
Row 4		N/1.5/2/N			95	9/2	312	37.3	0.12	*	
Row 5		N/1.5/N/N			95	8/30	310	57.5	0.19	4/0	
Row 6		N/1.5/N/N			95	9/3	261	30.7	0.12		
Hypochondriacus (golden)	Clay, Rocky 8.0		2	5/27							
Row 1		N/3/2/N			94	8/20	298	70.8	0.24	4/0	Sonic Bloom increased avg. yield from 1800 to 2750 lbs/acre, and reduced avg. maturity time by 13 days.
Row 2		N/3/2/N			94	8/26	308	37.2	0.12	*	
Row 3		N/N/N/N			90	8/22	292	68.1	0.23	4/0	
Row 4		N/N/N/N			90	9/1	285	32.6	0.11	*	
Nepalese	Clay loam, 7.9 phh		3	5/27							
Row 1		N/3/N/N			96	9/18	256	71.8	0.28	5/0	Sonic Bloom increased avg. yield from 2000 to 2950 lbs/acre, and reduced avg. maturity time by 56 days.
Row 2		N/3/N/N			96	9/24	272	36.3	0.13	*	
Row 3		N/N/N/N			94	9/20	297	67.2	0.23	5/0	
Row 4		N/N/N/N			94	9/27	311	33.7	0.11	*	
Cruentes (White)	Adobe, Sandy Loam, 7.7 ph		3	5/26							
Row 1		N/6/N/N			95	8/27	548	157.0	0.29	6/0	Sonic Bloom increased avg. yield from 1900 to 3025 lbs/acre, and reduced avg. maturity time by 16 days.
Row 2		N/6/N/N			95	8/31	579	85.8	0.15	*	
Row 3		N/3/N/N			93	8/28	567	146.8	0.26	6/0	
Row 4		N/3/N/N			93	9/3	598	73.7	0.12	*	

o sprays control

6 sprays Sonic Bloom test

Note 1: Notation conveys both amount and kind of soil additives used. The four additives used are listed in this order: Biodynamic Compost/Humates/Sulfur Soil/Kelp. Respectively, the amount used of each type is expressed in pounds or as N for none, L for light application, M for medium and H for heavy.

Note 2: Similar to the above notation for fertilization, the foliar sprays used are listed in this order: Sonic Bloom formula/Seacrop. The numbers refer to the # of applications of each. If sound alone was used there is an asterisk (*).

** San Juan Pueblo Agricultural Project **
Fertilization Trials Research Data

CROP, VARIETY	SOIL TYPE	TYPE/QUAT. OF FERTIL. (See Note 1)	TIMES IRRIG.	PLANT DATE	% GERM.	1ST FRUIT/ SEED	TOTAL # OF PLANTS	TOTAL YIELD	AVG. YIELD PER PLANT	FOLIAR SPRAY (Note 2)	COMMENTS
MELONS											
Afghani honeydew	Clay, loam 7.9 ph		7	5/18	90						
Crater 1		N/2/2/N				9/9	3	34	11.3	5/0	
Crater 2		N/2/2/N				9/14	3	19	6.3	*	
Crater 3		N/1/2/N				9/11	2	21	10.5	5/0	
Crater 4		N/1/2/N				9/17	3	17	5.7	*	
Crater 5		N/N/N/N				9/14	3	21	7.0	5/0	
Crater 6		N/N/N/N				9/25	3	13	4.3	*	
Golden honey Watermellon	Adobe, sandy loam, 7.7 ph		6	5/18							
Crater 1		N/2/N/N			98	8/17	2	25	12.5	5/0	
Crater 2		N/2/N/N			90	8/23	3	21	7.0	*	
Crater 3		N/1/N/N			98	8/18	3	28	9.3	5/0	
Crater 4		N/1/N/N			85	8/25	2	10	5.0	*	
Crater 5		N/N/N/N			95	8/24	3	19	6.3	5/0	
Crater 6		N/N/N/N			85	8/31	3	10	3.3	*	
Escondido Gold Muskmelon	Adobe, loam 7.8 ph		7	5/26							
Crater 1		N/N/2/N			98	8/29	3	31	10.3	4/0	Seeds were soaked
Crater 2		N/N/2/N			95	9/4	3	19	6.3	*	in S.B. overnight
Crater 3		N/N/1/N			98	9/1	2	20	10.0	4/0	whereever the foliar
Crater 4		N/N/1/N			90	9/6	3	16	5.3	*	spray was later used.
Crater 5		N/N/N/N			95	9/3	2	20	10.0	4/0	
Crater 6		N/N/N/N			85	9/10	3	12	4.0	*	
Crimson Sweet Watermelon	Adobe, loam 7.8 ph		5	5/26							
Crater 1		N/N/N/N			95	8/31	2	29	14.5	12/0	Optimum number
Crater 2		N/N/N/N			95	9/1	2	27	13.5	10/0	of foliar appli-
Crater 3		N/N/N/N			95	9/3	3	31	10.3	8/0	cations seems to
Crater 4		N/N/N/N			90	9/9	3	19	6.3	6/0	
Crater 5		N/N/N/N			95	9/11	3	18	6.0	4/0	
Crater 6		N/N/N/N			95	9/19	2	14	7.0	*	

Note 1: Notation conveys both amount and kind of soil additives used. The four additives used are listed in this order: Biodynamic Compost/Humates/Sulfur Soil/Kelp. Respectively, the amount used of each type is expressed in pounds or as N for none, L for light application, M for medium and H for heavy.

Note 2: Similar to the above notation for fertilization, the foliar sprays used are listed in this order: Sonic Bloom formula/ Seacrop. The numbers refer to the # of applications of each. If sound alone was used there is an asterisk (*).

** San Juan Pueblo Agricultural Project **
Fertilization Trials Research Data

CROP, VARIETY	SOIL TYPE	TYPE/QUAT. OF FERTIL. (See Note 1)	TIMES IRRIG.	TRANS-PLANT DATE	1ST MATURE FRUIT	1ST MATURE SEED	TOTAL # OF PLANTS	TOTAL YIELD (FRUITS)	AVG. YIELD PER PLANT	FOLIAR SPRAY (Note 2)	COMMENTS
PEPPERS											
Cubanelle	Adobe, Sandy Loam. 7.7 ph		8	6/9							
Row 1		N/2/2/N			8/21	9/18	18	609	33.83	8/0	Plants matured
Row 2		N/2/2/N			9/1	9/30	16	277	17.31	*	21 days before
Row 3		N/N/2/N			8/24	9/20	19	604	31.79	8/0	normal with
Row 4		N/N/2/N			9/6	10/5	20	307	15.35	*	much more yield.
Italian - Sweet marconi	Same as above		8	6/9							
Row 1		N/2/2/N			8/27	9/9	15	436	29.07	8/0	Matured 19 days
Row 2		N/2/2/N			9/7	9/18	16	221	13.81	*	before normal with
Row 3		N/N/2/N			8/27	9/11	18	459	25.50	8/0	very large fruit.
Row 4		N/N/2/N			9/7	9/18	17	226	13.29	*	
Choco	Same as above		8	6/9							
Row 1		N/2/2/N			9/4	9/16	20	412	20.60	8/0	Sprayed alternate
Row 2		N/2/2/N			9/5	9/16	18	376	20.89	8/0	plants in each row
Row 3		N/N/2/N			9/9	9/22	16	318	19.88	8/0	and yields
Row 4		N/N/N/N			9/10	9/23	20	308	15.40	8/0	corresponded.
Cayenne	Same as above		8	6/9							(eg.:Row 1, alternating spray with
Row 1		N/2/2/N			8/25	9/8	22	1542	70.09	6/0	sound and sound
Row 2		N/2/2/N			9/3	9/17	19	893	47.00	*	only resulted with
Row 3		N/N/2/N			8/27	9/12	18	1402	77.89	6/0	34, 14, 29, 15, 37,
Row 4		N/N/2/N			9/9	9/24	21	827	39.38	*	11, 27, 12, 32, 9,
Santa Fe	Same as above		8	6/9							35, 16, 28, 17, 31, 11, 39, 18.)
Row 1		N/2/2/N			8/30	9/14	20	918	45.90	6/0	
Row 2		N/2/2/N			9/5	9/21	17	591	34.76	*	
Row 3		N/2/N/N			8/31	9/14	20	915	45.75	6/0	
Row 4		N/2/N/N			9/3	9/23	16	533	33.31	*	
De Comida	Same as above		8	6/9							
Row 1		N/2/2/N			8/24	9/7	19	609	32.05	6/0	Same as Choco.
Row 2		N/2/N/N			8/24	9/8	22	622	28.27	6/0	(see note and
Row 3		N/N/2/N			8/29	9/14	16	486	30.38	6/0	example above)
Row 4		N/N/N/N			9/1	9/19	16	459	28.69	6/0	
Chimayo	Same as above		8	6/9							
Row 1		N/2/2/N			8/15	8/30	16	390	24.38	6/0	
Row 2		N/2/2/N			8/21	9/5	24	283	11.79	*	
Row 3		N/N/N/N			8/22	9/5	18	379	21.06	6/0	
Row 4		N/N/N/N			8/27	9/11	17	221	13.00	*	

Note 1: Notation conveys both amount and kind of soil additives used. The four additives used are listed in this order: Biodynamic Compost/Humates/Sulfur Soil/Kelp. Respectively, the amount used of each type is expressed in pounds or as N for none, L for light application, M for medium and H for heavy.

Note 2: Similar to the above notation for fertilization, the foliar sprays used are listed in this order: Sonic Bloom formula/ Seacrop. The numbers refer to the # of applications of each. If sound alone was used there is an asterisk (*).

** San Juan Pueblo Agricultural Project **
Fertilization Trials Research Data

CROP, VARIETY	SOIL TYPE	TYPE/QUAT. OF FERTIL. (See Note 1)	TIMES IRRIG.	TRANS-PLANT DATE	% GERM.	1ST FRUIT/ SEED	TOTAL # OF PLANTS	TOTAL YIELD (lbs.)	AVG. YIELD PER PLANT (lbs.)	FOLIAR SPRAY (Note 2)	COMMENTS
TOMATOES											
Marvel	Adobe, sandy, loam, 7.8 ph	N/2/4/N	6	6/6							In tomatoe trials, we varied number of treatments with Sonic Bloom to determine optimum amount. Although not conclusive, it appears that between 6 and 8 are best, because less than 6 brought lower yield. Of course, earlier maturity and higher yield than normal were observed.
Row 1						9/9	12	519	43.25	8/0	
Row 2						9/12	12	492	41.00	6/0	
Row 3						9/19	12	368	30.67	4/0	
Peron Sprayless	Same	N/2/4/N	6	6/6							
Row 1						9/13	12	278	23.17	8/0	
Row 2						9/17	11	241	21.91	6/0	
Row 3						9/24	11	193	17.55	4/0	
Bonny Best	Same	N/2/N/N	6	6/6							
Row 1						9/1	11	434	39.45	8/0	
Row 2						9/4	12	397	33.08	6/0	
Row 3						9/10	12	258	21.50	4/0	
Stupice	Same	N/N/4/N	6	6/6							
Row 1						8/22	12	514	42.83	8/0	
Row 2						8/26	10	407	40.70	6/0	
Row 3						9/3	12	321	26.75	4/0	
Large Cherry	Same	N/N/N/N	6	6/6							
Row 1						8/28	11	1975	179.55	8/0	
Row 2						9/1	11	1788	162.55	6/0	
Row 3						9/6	12	1514	126.17	4/0	

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** San Juan Pueblo Agricultural Project **
Fertilization Trials Research Data

CROP, VARIETY	SOIL TYPE	TYPE/QUAT. OF FERTIL. (See Note 1)	TIMES IRRIG.	PLANT DATE	% GERM.	1ST FRUIT/ SEED	TOTAL # OF PLANTS	TOTAL YIELD	AVG. YIELD PER PLANT	FOLIAR SPRAY (Note 2)	COMMENTS
CORN											
Mandan Red Sweet	Sandy, adobe loam, 7.6 ph		3	6/15							
Row 1		N/6/4/N			95	9/10	108	427	3.95	4/0	In one case, one seed made 5 stalks and 14 ears. On the average, ears were twice normal size.
Row 2		N/6/4/N			95	9/23	120	255	2.13	*	
Row 3		N/3/4/N			95	9/9	115	442	3.84	4/0	
Row 4		N/3/4/N			95	9/28	131	257	1.96	*	
Row 5		N/N/N/N			95	9/12	128	483	3.77	4/0	
Row 6		N/N/N/N			90	9/30	122	175	1.43	*	
Inca Rainbow Sweet	Heavy Clay, Rocky, 7.9 ph		4	5/16							
Rows 1-3		N/30/15/N			98	3/31	668	2739	4.10	6/0	Seeds for this section were soaked with Sonic Bloom and came up in 2 days.
Rows 4-6		N/30/15/N			90	9/18	716	1891	2.64	*	
Rows 7-9		N/15/15/N			92	9/4	635	2367	3.73	6/0	
Rows 10-12		N/15/15/N			85	9/16	650	1512	2.33	*	
Rows 13-15		N/5/15/N			94	9/3	698	2504	3.59	6/0	
Rows 16-18		N/5/15/N			87	9/16	647	1403	2.17	*	
Rows 19-21		N/N/N/N			90	9/5	602	2142	3.56	6/0	
Rows 21-24		N/N/N/N			85	9/18	587	1023	1.74	*	
Hickory King	Clay, Loam 8.0 ph		2	5/26							
Row 1		N/6/4/N			98	9/2	117	412	3.52	3/0	Sonic Bloom shortened maturity time from normal of 120 days to 99 days, despite very cool growing season. Normally, this variety only produces 1 ear per stalk.
Row 2		N/6/4/N			98	9/6	132	240	2.12	*	
Row 3		N/3/4/N			95	9/2	108	401	3.71	3/0	
Row 4		N/3/4/N			95	9/8	152	217	2.21	*	
Row 5		N/N/3/N			90	9/4	124	380	3.06	3/0	
Row 6		N/N/3/N			90	9/9	112	166	1.95	*	

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Note 2: Similar to the above notation for fertilization, the foliar sprays used are listed in this order: Sonic Bloom formula/ Seacrop. The numbers refer to the # of applications of each. If sound alone was used there is an asterisk (*).

GABRIEL HOWEARTH

6/74 Graduated from Fullerton College, CA with Associates Degree in both Music & Architecture.

1975 Apprenticeship with Alan Chadwick, world reknown master gardener who came up with the French Intensive/Bio-dynamic System of gardening. Parttime study with him during school year at U.C. Santa Cruz and full-time during main growing season.

6/76-11/76 Apprenticeship with Peter Dukish, well-known Bio-dynamic farmer and teacher of Rudolph Steiners principles and philosophies especially in regard to farming. Also prepared the apprentices on many levels for going to third world countries and spreading this method of farming and gardening on a very personal and spiritual level. Peter was my main inspiration to spread this form and spirit of agriculture wherever I went.

12/76 With this inspiration I moved up to Oregon to begin farming where land was still cheap. During the next 7 years I perfected what I had learned with very practical experience on a 600 acre organic farm.

2/78 Setting up and running an organic seed and herb company - Earthstar Botanicals, now called Peace Seeds - provided him with hands-on learning of just about every aspect of agriculture (including processing and marketing).

1982 During these two years the farm had most of its land either in non-hybrid seed crops or in medicinal and culinary herbs, which were sold both wholesale domestically and internationally, and retail in our seed and herbal products catalog. During these two years our organic 10 acre permacultural orchard and vineyard began bearing what we had planted a few years back. That was quite a process in itself. Between pruning, organic spraying, integrated pest management studies and application, soil building with legumes, harvesting, fruit drying, juice and wine making I began an apprenticeship program which encompassed all of these activities both as hands-on experience and in the classroom and laboratory making both food and medicinal preparations and doing soil and nutritional analysis.

During almost every winter of this seven year cycle I spent time in the Yucatan peninsula, Mexico, farming with Mayan villagers. I was able to glean much practical knowledge of their ancient farming techniques as well as help them by developing product lines out of their crops, setting up solar driers, providing new seeds and showing them how to grow tropical medicinal and culinary herbs organically. Both dried tropical organic fruits and herbs have helped greatly boost their economy and health as the demand and price for both of these crops goes up all the time.

3/84 Moved to Santa Fe, New Mexico to study accupuncture to really fully understand the healing properties and how to use the herbs I had been growing in the most effective way. But once again the plant and seed spirit called me back this time to work with Rio Grande Pueblo Indians and help them return to and regain their native roots through agriculture. Through a grant with Eight Northern Indian Pueblos I, an elder farmer and several Indian apprentices grew out a three acre research test plot of nearly 300 non-hybrid varieties of grains, vegetables, fruits and various herbs. The research data pointed the project toward seed crops of many varieties including their native strains of corn, chili-pepers, melons, beans, squash and amaranth as well as some newcomers to the region - quinoa, various herbs and root crops.

We are now carrying out seed searches in traditional communities and establishing seed banks to preserve older seed varieties. We are carrying out research and development with these native seed strains as well as with imported heirloom strains. We are using the higher return which seed crops offer to encourage our young people to return to farming. Training and technical assistance will include state-of-the-art techniques for sustainable agriculture as well as the Elder's guidance on carrying on the older traditions. Finally, we are establishing a seed market company to provide a dependable outlet for their crops.

The Intercrop Two-level Aboricultural Project

The Intercrop Project is based on the concept of required biological space. Trees and plants of different types have different requirements as to water, light, physical space, and protection from the elements.

In the Intercrop, an attempt is being made to use this concept in the planting of fruit trees. Hardy citrus trees grafted on to salt-resistant rootstocks have been introduced to a recently reclaimed area. And between these trees, the more delicate subtropicals have been introduced, the malabar nut, the mangosteen, the acerola.

The citrus trees grow quickly, thrive in full sun, need little protection from the wind and have a dense, deep root system. The mangosteen and the malabar need protection from wind and sun, they grow slowly, are not large trees and have shallow root systems.

The trees in the intercrop have been chosen to complement one another, allowing for a closer planting and a saving in drip irrigation equipment and land. In theory, two orchards will be able to occupy the space of one.

The current experiment is designed to turn theory into fact.

Ketura Experimental Grove, Kibbutz Ketura, 88840, Israel

Sonic Bloom, sound and spray was applied five time to 70 young citrus and subtropicals in the ercrop Project (see following page for an explanation) at five suggested intervals, some of which re estimated by the behavior of older trees in the grove.

The trees involved were as follows:

12 Miniola/HH and 6 controls

3 Orlando/HH and 3 controls

8 Blood Oranges/HH and 4 controls

10 Mandarin/HH and 4 controls

10 Pomelit/HH and 6 controls

14 Valencias/HH and 8 controls

4 Nova/HH and 4 controls

4 magosteen and 4 controls

4 malabar nuts (bombax glabra) and 4 controls

4 acerola and 2 controls

The sound and spray was applied as per directions, though none of the trees are mature enough to safely bear fruit; so the fruit that set was removed by hand, and the fifth spray and sound application followed the fourth at a three-week interval.

The results were interesting.

Among the subtropicals there was a general increase in vigor, less chlorosis, good growth and color. None of the treated subtropicals showed signs of salt-poisoning, while 2 malabar nut trees and 1 mangosteen in the control group were badly marked by leaf burns.

Albinism disappeared in the blood oranges and pomelits in the treated group. The mandarins, minolas, novas and orlandos had excellent growth and color and few signs of deficiency, apart from one case of "Little-leaf syndrome" in the mandarins. The control group was less healthy, with three trees showing zinc deficiency signs, and two other marked chlorosis.

Increased resistance to spider-mites was noted in the blood oranges, the minolas, the mandarins and the valencia oranges. One application of a mild miticide was enough in the treated group. The controls groups required two applications.

Certainly, this second experiment with citrus has pointed out the need for a larger experiment in a commercial orchard, on trees that are old enough to bear fruit.

Only in this way will the system be proved truly effective.

Ketura Experimental Grove, Kibbutz Ketura, 88840, Israel

Sonic Bloom in solution to remove growth inhibitors in seeds of desert plants.

The four desert plants: a description, the experiment.

Tylosema escuelenta, the morama bean: 10 in 100 cc/liter solution
10 in 50 cc/liter solution
10 control

The morama bean is a native of the Kalahari region and not a cultivated plant. It produces seeds similar to the groundnut and a huge edible tuber which is also used as an emergency source of water by humans and animals. One of the problems that stand between the morama and cultivation is the presence of growth inhibitors in the seeds. The seeds do not sprout until the inhibitor is leached away by sufficient quantities of moisture. In the wild, this means that the plant does not sprout unless there is enough water to see it through the season.

Of the 10 seeds in 100 cc/liter solution, six sprouted within a month after two hours soaking time.

Of the 100 seeds in the 50/cc liter solution, five sprouted within a month after two hours soaking time.

Two seeds from the control group sprouted within a month, and then one the month after.

Narra melon: 25 seeds in 100cc/liter solution
25 seeds in 50/cc solution
25 control

The Narra melon is from Namibia. It is a wild plant producing a melon-like fruit on a spiny, leafless plant. The seeds of this melon are esteemed and used as a snack and flavoring. In South Africa they are called "butter pits", as they are rich in oil. Growth inhibitors are also a problem with this plant.

Of the 25 seeds in 50 cc/liter solution, 17 sprouted within ten days after two hours soaking.

Nine sprouted in the control group.

The yehib: 10 seeds in 100cc/liter solution
10 seeds in 50 cc/liter solution
10 control

The yehib is a wild legume of the arid regions of Ethiopia and Somalia. The shrub produces a nut with a chestnut-like flavor, high in protein and oil. Very few plants can survive in the poor, dry

soils of the yehib's native habitat. Because of this, the yehib deserves investigation as a possible commercial crop for arid areas.

Of the 10 seeds in 100cc/liter solution, 7 sprouted within a month after an hour's soaking time.

Of the 10 seeds in 50cc/solution, 6 seeds sprouted within a month after an hour's soaking time.

Two seeds sprouted in the control group. All seeds were fresh, acquired from Voi, Kenya.

The moth bean, Vigna aconitfolia:

100 seeds in 100cc/liter solution

100 seeds in 50cc/liter solution

100 control

The moth bean is the most drought-tolerant pulse crop grown in India. It thrives in high temperatures and poor, sandy soils. The young pods can be eaten as a table vegetable, and the foliage is good as livestock feed and can be dried as hay. The seeds are small but high in protein. Because of the presence of growth inhibitors, the seeds are soaked for days before they are planted. The seed bed has to be prepared carefully so that the small seeds and delicate sprouts will not be foiled by the crust of the soil.

Of the 100 seeds in 100cc/liter solution, 98 sprouted within 10 days after one hour of soaking time.

Of the 100 seeds in 50cc/liter solution, 86 sprouted within ten days after one hour's soaking time.

The control group was soaked in water and only 37 sprouted within ten days. Another twenty sprouted in the two weeks following, and sixteen more in the week after that.

If these plants are to be planted commercially, some kind of treatment to remove the growth inhibitors must be devised. Perhaps this is another use for Sonic Bloom.

E. M. Solowey, Kibbutz Ketura, 88840 Israel

Ketura Experimental Grove, Kibbutz Ketura, 88040 Israel

Sonic Bloom, spray and sound, weekly applications on yehib, legumous shrub (endangered species).

Plant material

3 three year old plants	1 control
2 two year old plants	1 control
2 one year old plants	1 control

Duration 16 weeks. July 15th 1987 to November 15th 19[illegible]

Results: Decreased chlorosis and albinism
Increase in leaf size
Decrease in salt damages (2 plants, one one year old the other two years old,
Accelerated growth in older plants
Thicker growth in all plants
Improvement in general vigor
Improved resistance to sucking insects
Increased heat tolerance

Other observations: One control plant died during the test period but no plants that were being treated with Sonic Bloom showed any signs of withering or heat damage despite the heat wave in July and August and the 40 degree temperatures.

Recommendations: the fragile and temperamental yehib should be treated regularly with Sonic Bloom to increase its viability. This rare and valuable shrub has great potential as a food crop. But little plant material is available and we can allow none of it to be wasted. Bringing existing seedlings to maturity will allow us to breed the yehib into a hardier and more fruitful plant from the seeds of the plants in the grove.

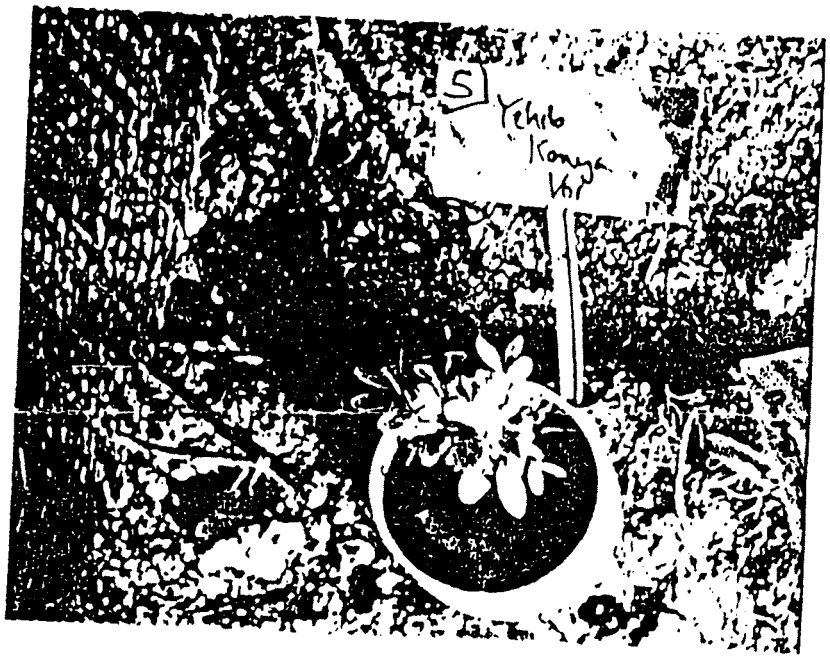
I gave Dr. Avinoam Haard of ben-Gurion University a liter of Sonic Bloom for the yehib seedlings in the greenhouse in Beersheva and for the plants in situ in other experimental plots in the Arava and the Negev.

See next page

ELPINE SOLONEY

This photo is of a plant treated for sixteen weeks with Sonic Bloom, sound and spray.

This photo is of the control plant, of the same age and similar condition before the experiment.



STATE OF VERMONT)
)
COUNTY OF CHITTENDEN)

Carolyn Ormsbee, being first duly sworn, on oath, states as follows:

That she is employed by Gardener's Supply Company, 128 Intervale Road, Burlington, Vermont 05401, as a Product Technician;

That in that capacity, she had occasion to test Dan Carlson's Sonic Bloom process, which combines sound and a foliar plant food, during the 1986 growing season;

That affiant established two garden plots, located at opposite ends of the Gardener Supply buildings, to separate the sound, and divided plots into Control, spray only in one field and sound only and sound and spray in the other field. Sea Mix and Sterns Miracle Grow were also tested on plot not exposed to sound;

That affiant planted Champion variety tomatoes, and treated them as follows:

1. Using 6 teaspoons to 1 gallon of water, test plants were sprayed 30 seconds per plant, for a total of 8 oz. per plant of solution mixture.

2. Plants were exposed to sound fifteen minutes prior to spraying and during time spray administered, letting sound continue to emit after spraying for a total time period of one hour.

3. Plants were treated ~~nine~~ eight times, on June 21, July 1, 15, 21 and 28, August 4, 8 and 11.

That on September 16, 1986, affiant gathered the following preliminary data, using ripe tomatoes only:

Sea Mix . . .	19.75 lbs.
Control . . .	22.10 lbs.
Sterns . . .	22 lbs.
Sonic Spray only . .	17.15 lbs.
Sonic spray/sound .	31.85 lbs.
Sonic sound only . .	28.75 lbs.

That the week of October 20, 1986, affiant harvested all remaining tomatoes, both ripe and unripe, and compiled total yield data, as follows:

Foliar Spray	Tomato Yield in Pounds *
Sea Mix	132.70 lbs.
Sterns Miracle Grow	108.40 lbs.
Sonic Bloom, spray only	111.40 lbs.
Control	109.65 lbs.
Sonic Bloom, sound only	150.00 lbs.
Sonic Bloom, sound and nutrient spray	163.20 lbs.

* Yield includes all tomatoes, both ripe and unripe. Total plants per application = 18 with the exception of control which had one plant loss for a total count of 17.

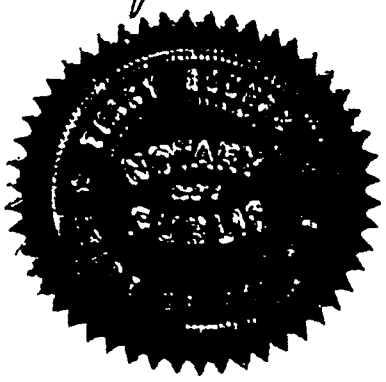
Further affiant sayeth naught.

Carolyn A. Armsbee

Subscribed and sworn to before me this 20 day of November, 1986.

Notary Public

EXP 2-10-87



ahead of your rapidly growing vines and keep removing any new pumpkins other than your original one to two you have chosen. Check once a week for new pumpkins and by September 1st, start burying the ends of any new runners that will be blooming and setting new pumpkins. The buried ends will set roots and help feed your giant pumpkin. Watch for stem bind. The pumpkin will grow from five to eight pounds per day during August and September. They can easily twist and split the vine where it attaches to the pumpkin. When your winner is the size of a football and you place the plywood or corrugated plastic under it, be sure the stem from the center of the plant is flexible and not too rigid. Sometimes the vine will root down close to the pumpkin and tighten up the vine to cause cracking of the stem. Just pull these roots free as you place the pumpkin of your choice on its wood or plastic foundation. Be careful about turning or moving your pumpkin as the stems are very brittle and it is possible to lose a beauty. My advice is to do all your turning or moving before it gets larger than a football.

October 1st to 15th, pick your winner, and enter it in a contest. Lay a wheelbarrow on its side next to your pumpkin. Line wheelbarrow with padding. One person holds the wheelbarrow rigid and two people roll the 400 pounder into the wheelbarrow. Twist and heave and soon your pumpkin will be mobile. Good Luck.

You can join the World Pumpkin Confederation for $10 per year and read all about the other pumpkin growers and their world record pumpkins, squash and watermelons. They publish a quarterly bulletin with lots of ideas, instructions, and pictures. Write W.P.C., 14050 Gowanda State Road, Collins, NY 14034 for sample bulletin and information.

tender loving care. The pumpkin plant thrives in a quiet protected environment. We play music each morning to the pumpkin patch and treat them to foliate feed twice a week. You should see the size of our leaves and the size of our pumpkins from this extra nice treatment. We use the Sonic Bloom system, originated by Dan Carlson of 708 119th Lane NE, Blaine, MN 55434. Write Dan and ask him about his music and foliate food.

Another good tip we received was from UCLA Professor Arthur Wallace, who is a world famous Plant Nutrition expert. Dr. Wallace developed PAM, a special polymer to be used in the soil to increase its friability and water penetration ability. Contact his company, Complete Green at 2066 Westwood Blvd., Los Angeles, CA 90025. PAM added 50 to 100 lbs. to our giant pumpkins that gave us First Prize and Best of Show at the Sonoma County Harvest Fair for eight consecutive years.

I want to end with the message that the purpose of this publication is to encourage all people, young or old to learn to grow things, as nature has provided for man.

Teach a man how to grow his own food and you will feed him the REST OF HIS LIFE.

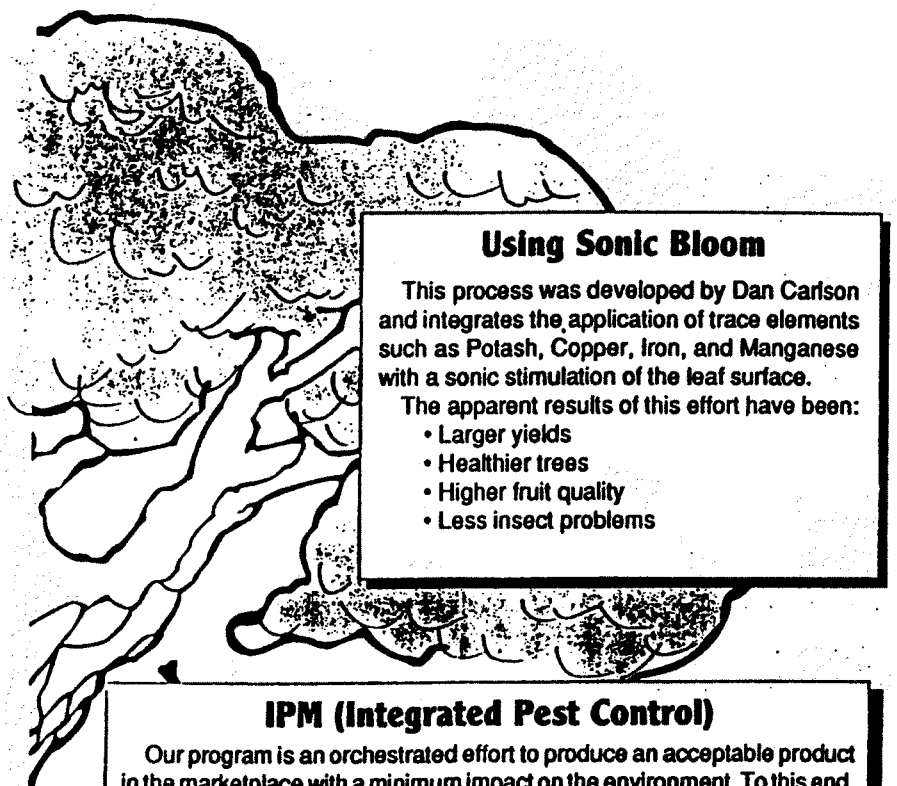
Eddie Albert

THE SEED CORPS
POST OFFICE BOX 1705
SANTA ROSA, CALIFORNIA 95402

EDDIE ALBERT'S SECRET

or

"How To Grow Your Own 400 Lb. Pumpkin".



Using Sonic Bloom

This process was developed by Dan Carlson and integrates the application of trace elements such as Potash, Copper, Iron, and Manganese with a sonic stimulation of the leaf surface.

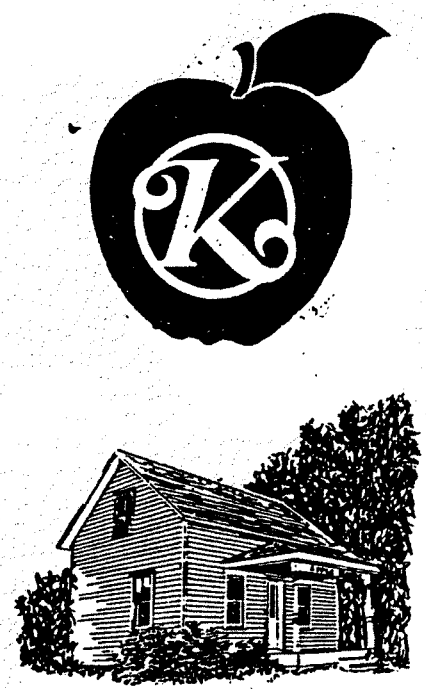
The apparent results of this effort have been:

- Larger yields
- Healthier trees
- Higher fruit quality
- Less insect problems

IPM (Integrated Pest Control)

Our program is an orchestrated effort to produce an acceptable product in the marketplace with a minimum impact on the environment. To this end, we are involved with the State of Wisconsin in a monitoring program using Pheromone traps to determine the presense of damaging insects such as, Spotted Tentiform Leafminer, Redbanded Leafroller, Codling Moth, and Apple Maggot. In addition to the Pheromone traps, systematic leaf samples are analyzed to determine the level of European Red Mite infestation. With this information, together with daily temperature records and leaf wetness periods, we are able to reduce the number of sprays applied to the orchard, as well as, target specific pests and avoid the random reduction of desirable predators.

Circle K Orchard
N7653 650th St.
Beldenville, WI 54003



Circle K Orchard

N7653 650th St.
Beldenville, WI 54003

(715) 273-3093

Circle K VARIETIES	Eating	Cooking	Sweet	Tart
Viking	X		X	
W. Crab	X	X	X	
Paula Red	X	X	X	
Beacon	X	X	X	
McIntosh	X		X	
Haralson	X	X		X
Honeygold	X		X	
Cortland	X	X	X	
NW Greening		X		X
Connel Red	X		X	
Fireside	X		X	
Regent	X	X	X	

COMMITTMENT...

Is our key word to better apples, a better environment, and the best way that we can serve you!

Variety...

12 Select Upper Midwest Varieties

specially developed for our climate for hardiness and flavor.
The orchard offers pick-your-own or pre picked apples.

More than just apples....

- Fresh Cider
- Apple Wood Chips For Smoking
- Pies (frozen)
- Gifts

WORLDWIDE SHIPMENT OF APPLE GIFT BOXES!

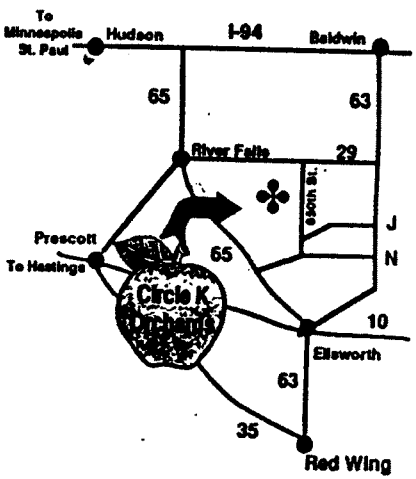
Environment...

Consultation available:

- **Pest Control**
- **Pruning Techniques**
- **Sonic Bloom**
- **Tree Selection**
- **IPM Programs** (Integrated Pest Management)
- **Free group orchard tours** (by appt.)

Harvest Schedule

Varieties	Start Date	thru	End Date
Viking	Aug. 12	thru	Aug. 22
Whitney Crab	Aug. 18	thru	Sept. 12
Paulared	Aug. 18	thru	Sept. 12
Beacon	Aug. 18	thru	Sept. 12
McIntosh	Sept. 1	thru	Sept. 28
Haralson	Sept. 15	thru	Oct. 22
Honeygold	Sept. 15	thru	Oct. 10
Cortland	Sept. 22	thru	Oct. 15
NW Greening	Sept. 22	thru	Oct. 31
Connell Red	Sept. 22	thru	Oct. 31
Fireside	Sept. 22	thru	Oct. 31
Regent	Sept. 22	thru	Oct. 31



The Orchard is located 9 miles east of River Falls, WI on 650th Street (formerly Hillcrest Road).

The Orchard is open 7 days a week from noon to dusk.

Phone (715) 273-3093

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Dantian Shen

Aug. 30, 1993.

Super Sonic

Dan Carlson breaks barriers with Sonic Bloom

I had read the articles—Dan Carlson develops Sonic Bloom, a product designed to increase plant growth by using an oscillating frequency of bird and cricket-like sounds along with an organic foliar spray. I had heard the amazing stories—Dan Carlson grows a purple passion plant one tenth of a mile long using Sonic Bloom and winds up in the Guinness Book of World Records. I even tried Sonic Bloom in my own garden—my hot pepper plants, for instance, produced twice as much per plant in thirty days less time than the previous year. Yet, it wasn't until I spoke to Dan that I understood the realm of possibilities for his sound-enhanced growth system. In short, he has missions for Sonic Bloom that make landing on the moon seem frivolous. In his own words Dan Carlson has a "blueprint to end world hunger."

According to Carlson, Sonic Bloom is simply "sound aiding in the absorption of an organic foliar nutrient." The theory behind his product is that plants open their surface pores or stomata when stimulated by certain sounds. During and after a serenade of pulsed chirps and whistles (for the plants) mixed with various classical music selections (for the humans) the spray, consisting of 55 trace minerals, amino acids, and seaweed is sprayed on the plant's surface. This odd, but highly successful treatment system has lead to increased publicity and profit for Carlson.

However, it is clear when talking to this world renowned inventor that his focus is not on material success or international fame. He is more interested in proving the limitless abilities of Nature to support all existing life and heal the wounds of human error. "It's exactly what we need at this time. This planet wants to save itself."[1] Carlson's "blueprint" begins with a solid foundation and expands into almost mind-boggling proportions.

"We're definitely developing some techniques that can carry this from A to Z." says Carlson, "One is we've been working with a sprout company called Sprouts Extraordinaire out of Longmont Colorado. The reality is we have found that sprouts, alfalfa in particular, increase in weight by 1200% in 72 hours. We take a seed, soak it in Sonic Bloom, play the sound, and seventytwo hours later

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[1] Adolph, Jonathan. 1991. "Music Therapy for Plants." *New Age Journal.* VIII(4): 13

we have an edible sprout. Our sprouts get almost a thirty day shelf life instead of three or four days."

"We believe that within six to eight months we will produce a shipping container, 8 1/2 feet wide, 8 feet tall, 40 feet long, totally self-contained that will make sprouts. We believe that it will produce 5,000 pounds of sprouts per week, 260,000 pounds of food per year. You can reuse the water and if you divide 260,000 pounds by 1,200 you find that you will only need a few hundred pounds of seed to do this. Now think what ten of these containers could do. Ten of these would do 2.6 million tons of food and twenty would do almost six million tons of food. And one container would only cost $10,000."

Carlson's plan doesn't end with feeding sprouts to the hungry. He understands that sprouts aren't the most nutritionally valuable crop available. He also acknowledges that sprouts would not be culturally acceptable in all parts of the world. His idea also includes the use of other staple crops such as mung beans. Once he is able to bring a reliable source of food to people, and show them how to produce the food themselves, his plan mushrooms into a bright new future for millions of people.

"First, you go into the devastated areas with the sprouts to make people strong enough to, then plant the vegetables and grains with open pollinated seeds (Amaranth, Quininoa, corns) with Sonic Bloom," continues Carlson, "Then they get to eat the vegetables and grains that are much more highly nutritious and have kept their stress resistance. (Experiments done with Seeds of Change and Sonic Bloom in the Sudan, Kenya, Ethiopia and Zimbabwe showed survival in 130-140° temperatures and 2 1/2 inches of rain.) Then, you put in fruit trees and if you watch my video (see end of article for more information) you see I'm getting fruit on 1st year trees. Things like three year old Santa Rosa beauty plums are getting 6,000 pounds of fruit on a three year old tree. Lastly, the reason I'm living on a nut farm, is we want to bring in nut trees. But, if you plant enough trees you also change the weather. The trees will change the precipitation in these areas to feed the people."

Carlson also understands that people fed with nutritious food from their own land will not only help those societies to live but to flourish. "Any child that undergoes malnutrition doesn't have the mental ability to be as smart as its parents." he says, "If you go in and bring all this food you're going to change the mental abilities thus allowing these people to lead themselves 'out of the land of babel'."

The Sonic Bloom plan does not end there. Carlson also believes his product can help to cure one of Earth's most detrimental

environmental ailments—deforestation. In Mexico Carlson has started a tropical hardwood nursery for rare tropical trees. He has also brought Sonic Bloom to Papua New Guinea, where he hopes to help improve the teak, ebony, and rosewood harvests while providing slash-and-burn farmers with alternatives to growing food in poor soil.

Carlson even includes the psychological and spiritual well-being of people in his plans. He feels that giving all people, no matter what their age or geographic location, the ability to grow crops successfully will add to their mental health. "The beauty is watching the twinkle in some 35-75 pound child's eyes when they raise a 400 pound pumpkin." states Carlson, "We believe that then they will always be involved in agriculture and their self-esteem and self-love will go up like crazy."

Dan Carlson has watched his Sonic Bloom create amazing transformations like this for years. Reports of double and triple-sized harvests come from as far away as Europe to as close as his own nut farm in River Falls, Wisconsin. Oliver Doubleday, a strawberry farmer in rural England consistently reports triple yields with Sonic Bloom. The Circle K Apple Orchard, just six miles from Carlson's farm, also reports triple-sized harvests.

In addition, the orchard is reporting an eight month shelf life and a vast increase in nutrients. "When we did our analysis we came up with 1750% more Zinc, 400% Iron, 326% more Chromium, and 126% more potassium. All of these things being key ingredients in longevity, health, and mental activity." The orchard also finds that the number of apples lost to disease and insects is reduced by over 80 percent. "This is not an unusual situation." says Carlson. "The Sonic Bloom system raises the trace element and complex sugar content of plants. Those changes make the plant much healthier and less susceptible to attack by diseases and insects."[2]

Carlson continues to make discoveries that leave even him in a state of awe. "One of our greatest breakthroughs to make everyone understand how easy it is to feed large amounts of people involved a sucker on a tomato. A sucker is normally a sterile branch which appears in between a side shoot and the main branch. Our tomato plants grow two inches a day so if we allow a sucker to grow for seven days it's about fourteen inches long. If we then cut it off, put it in the shade and spray it once a day with a 1/4 ounce per gallon

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[2] Kirkpatrick, Bruce, 1992. "Sonic Bloom, Here and Around the World." *Llewellyn's 1993 Lunar Organic Gardener*. Llewellyn Publications. St. Paul, MN,1992

solution of Sonic Bloom, in 10-14 days it becomes fully rooted and starts to grow two inches per day. 55 days later it is 7-9 feet tall. Now normal production on tomatoes is 90 days. We're doing this in less than 55 plus we're producing at least twice as much fruit in almost half the time."

Carlson's stories have not fallen on deaf ears. Not only are his sales and reputation growing, his international prestige is on the rise as well. "Because of my success in England I am going to be lecturing to Parliament and we have a major university that is doing some testing. I have just returned from Japan where I was the keynote speaker for the Bio-Research committee which consists of 8,000 organic farmers. The day before I lectured the people who had success with Sonic Bloom told the great body of organic farmers and researchers their success stories." The Japanese were so impressed with Carlson that he received an award from the Minister of Finance as well as news coverage in 25 of Japan's leading newspapers. The Bio-Research committee declared that Sonic Bloom is the best plant growth product they have found and will help distribute it across their country. Keeping up with Japan and England, China is also courting Carlson. He will be leaving in October 1993 to speak to Chinese officials about developing their agriculture.

Unfortunately, Carlson remains virtually ignored by the U.S. government as well as the American mainstream research community. "Our problem here is that we are paying farmers not to grow. If you watch my video I will show you 100% increases on many mainline crops. I'm a multi-billion dollar nightmare for our government because we are paying farmers not to grow while I am doubling yields." Common sense also suggests that without using pesticides, herbicides and other agri-business dependencies, Sonic Bloom will have the same "hard row to hoe" as solar energy and the light rail system. Nevertheless, Carlson remains the eternal optimist.

Of course, optimism is nothing new to Carlson. It took him twenty years to perfect the sound frequencies and nutrient combinations needed to make Sonic Bloom more than the average fertilizer. The drive for perfection came from his own close encounter with hunger. "In 1961 through 1963 I was in Korea on the DMZ and witnessed starvation and some devastating events that caused me to dedicate my life to solving the problems of world hunger."

In spite of his serious efforts and intentions, Carlson is a jovial man who is having a lot of fun with his success. World leaders aren't the only ones catching on to Sonic Bloom. Celebrities such as Harrison Ford, William Shatner, and Eddy Albert are also reaping the benefits of Carlson's product. John Denver's environmental group Windstar

has also been very supportive of Sonic Bloom. "They came out here (Carlson's farm) and helped me pick the nuts because after I sprayed them there were so many nuts I just couldn't get enough labor to pick them. Then they came back this summer and helped me plant more."

Carlson's success is also moving him into the world of television by way of the ever-popular and star-studded infomercial, the commercial advertising that lasts several minutes to a half hour. He hopes this new marketing strategy will propel Sonic Bloom into a future of bigger and better plants, and stronger and wiser people.

Like the plants that are sprayed and serenaded with Sonic Bloom, Carlson's product can do nothing else but grow. To get a glimpse of Sonic Bloom's worldwide success (after all, seeing is believing) Carlson distributes a 120 minute video filled with the amazing sights (and sounds) of his product. If you would like to see the video or would like more information about Sonic Bloom write to: Dan Carlson Scientific Enterprise, 708 - 119th Lane NE, Dept. LOG, Blaine, MN 55434 or call 612-757-8274. (Also see the ad at the back of this book.)

WINDSTAR VISION

Dedicated to a Healthful and Sustainable Future May-June 1993

Earth Changes

"Nature is our best teacher about change. We need to watch, listen and act."

By John Denver

Since my childhood I have always been interested in anthropology and archeology. I was enchanted by both myth and fact. It was about the time when I was in high school that I first heard and read the legends of Atlantis, Lemuria and Mu. Each of these legendary civilizations was an extraordinary place of abundance and accomplishment. Each was said to have disappeared, perhaps at a time of great Earth change. Atlantis was destroyed when it sank into what is now the area of the Atlantic Ocean; Lemuria and Mu each disappeared into what is now the Pacific. These are legends and apparently no scientific evidence supports that these civilizations existed or that they vanished as the stories say. But, as myths, they satisfy a yearning in the human heart.

However, it intrigues me that every culture of indigenous peoples and every major society, including those in the world today, has legends of prior civilizations. There are many versions—from the legends of the Hopi and Navajo to the stories in the Bible about Noah and the Ark. In all the versions of our beginnings, powerful indicators of Earth change are referenced.

Consider also the number of puzzling remnants of prior civilizations that we do find on Earth today. Archaeologists throughout the world are trying to create an understanding of cultures that no longer exist in fact, if at all. Scientists in the desert southwest gather pot shards into whole urns. As if by handling these pieces of life from another time, the researchers hope that the clay and colors will speak to them in the voices of the people who lived in ancient times. What happened to the Anasazi? What happened to the Mayans and Aztecs? What happened in Sumeria? What happened to those people who mastered form and function with such extraordinary skill that the Sphinx and Great Pyramids rose from the Earth to the sky? What happened to cause the total destruction of civilizations?

Of course we don't know, despite continuous efforts to weave together a more complete understanding. Evidence accumulates. Theories take form. Scientists are even starting to agree about some aspects that disrupt and destroy civilizations. Conditions associated with the environment are identified as major factors. Drought, soil degradation, deforestation, disease, population changes, depletion of food sources—all these are examples of environmental change that have been identified as factors affecting the disappearance of cultural groups and civilizations. Must we follow these paths?

From all my years in the out-of-doors, I marvel at changes in the natural world. And sometimes, I despair. Just as I am inspired by the beauty of a spring morning with dew on the early crocus, I see us choke the skies with the outpourings of more machines upon the land. Nature is our best teacher about change. Historic legends, whether from myth or fact, tell us to pay attention. We have all the wisdom we need around us. We need to watch, listen and act.

Consider Noah. God told him to build an ark and bring two of every creature aboard because a great flood was to occur. Noah did so. After the rains, Noah sent forth a dove three times, and on its final return, the bird held an olive branch of new life in its beak. The time of massive Earth change was over. It was time to begin again.

All around us we see signs of the mythic equivalent of a great flood forming. Ozone depletion, loss of biodiversity, habitat destruction, climate change—these are all signs that the entire Earth is in change. Some refuse to see these signs and choose to disbelieve. Many of these changes are clearly the result of the accumulation of human actions without thought of the consequences and the interlinking of Earth's life systems. We now clearly have the capacity to destroy life on Earth as we know it. We have the capacity to disappear as a civilization.

But we can choose to live differently and change the ways we have been living on Earth. It occurs to me that, like Noah, we need to be preparing for change. We need to take responsibility for our actions. We need to clear the skies for the white dove's journey to find signs of support for continuing life. We need to honor myth and fact to guide us into the future.

Sonic Bloom Speeds Growth of Food Crops

A real-life excerpt from Lewis Carroll's *Alice in Wonderland* can be found on a farm in River Falls, Wisconsin, where Minnesota Connection members felt they had shrunk in size amid lush, oversized vegetation. Corn, for instance, shoots 16-feet high, young evergreens grow 3-4 feet annually, one African violet plant flaunts 300 blooms of various colors, and huge strawberries, some weighing one quarter of a pound, grow from April to October.

This particular place emerges not from the pages of a fairy tale but from Dan Carlson's vision to provide food for the world's hungry people. As a soldier in Korea, Carlson saw a desperate mother cripple her oldest child so she could beg for food to feed the rest of her starving family. After his duty in the armed forces, Carlson attended the University of Minnesota where he experimented and developed a system to stimulate plant growth.

Sonic Bloom is what he calls his completely organic technique that enhances plant development through natural nutrients and musical frequencies that stimulate plant cell absorption. The system has been certified by the International Organic Growers and Buyers Association (OGBA).

The process involves two parts: First, an organic spray is applied to plants once a week between 5:30-9:00 a.m. The spray is comprised of 55 trace minerals, amino acids and seaweed. During the early morning, pores or stomata on plant leaves are particularly dilated to receive nutrients. Secondly, a cassette tape of pulsating tracks of sound frequencies, ranging between 3000 to 5000 Khz, is played to the plants. Such sounds resemble cricket or bird

chirps, which naturally provoke the stomata to open. The plant soundtrack stimulates the stomata to open even wider and for a longer period of time, thereby promoting the maximum absorption and translocation (distribution) of nutrients throughout the plant.

One of Carlson's first experiments with the Sonic Bloom system in 1979 was performed on a purple passion plant. During the first three months of treatment, the vine, which usually doesn't exceed a length of 24 inches, grew to 150 feet!

Since then, Carlson's Sonic Bloom system continues to prove itself as an effective application to promote plant growth, especially in adverse growing conditions. For example, one Florida orange grower is harvesting prime-quality fruit in an area where, previous to Sonic Bloom, the orchard was so pesticide-laden that birds stopped frequenting the area. With Sonic Bloom, the growers' total orange production increased by 66 percent. Not only did the orchard flourish, but its fruit, tested at the Garvey Center for the Improvement of Human Functioning, in Wichita, Kansas, contained 121 percent more natural vitamin C than oranges not treated with Sonic Bloom.

Sonic Bloom plants in general contain more nutrients simply because they absorb and translocate more nutrients. Carlson says, "Sonic Bloom helps plants realize their genetic potential." Because of the high nutrient content, most fruits and vegetables have a doubled or tripled shelf life.

Sonic Bloom could also have tremendous global implications in preserving endangered plant species. In Israel, scientists are using Sonic Bloom to keep 450 rare or endangered African trees from becoming extinct. To date, Carlson's system has worked better than any other fertilization program tried thus far.

In 1991, Carlson was asked by the Philippine Department of Plant Industry to work with Philippine farmers whose land and crops had been devastated by toxic ash spewed from Mt. Pinatubo's eruption. Presently, farmers there are awaiting registration of the product for large-scale commercial use.

More recently, Carlson is still spreading the word about Sonic Bloom to potential gro ers in Mongolia and t Ukraine. Dr. Hou Tian Zhe from Mongolia's Xinjiar Academy of Forestry studi with Carlson for a year. Takir Sonic Bloom back to Mongoli Hou has realized a 30-90 pe cent increase in yield of the te

ed food crops, such as wate melons and potatoes.

Sugar beet farmers in t Ukraine are experimenting wi Sonic Bloom and evaluating i potential to feed people in shorter time, with larger, long lasting, more nutritious pro ucts. Carlson plans to meet wi Ukrainian government officia this spring to discuss plans t manufacture the product.

Minnesota Connection me bers were turned on to Car son's endeavors when he pr sented a speech about Son Bloom at one of their meeting Since then, members ha toured Carlson's farm an helped weed and clean the fac ity. During an autumn weeker last year, they harvested enda gered American chestnuts ar butternuts. This spring th again plan to visit the farm.

If you would like more info mation about Sonic Bloom, 90-minute explanatory video available. Write to Dan Car son, Scientific Enterprises, Inc Hazel Hills Farm, RR 1, P.C Box 277, River Falls, Wiscons 54022 or call 715-425-1407.

–Jean Pier

Correction: The *Earthship* vide mentioned in the April/M Connections, was produced ar released by Dennis Weaver.

THE WINDSTAR FOUNDATION

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The Windstar Foundation is a publicly supported charity founded in 1976 by John Denver and Thomas Crum. Based on 1,000 acres in the Rocky Mountains of Colorado, Windstar is a research and education foundation. Through its Choices for the Future symposium, Windstar Connections, Windstar Vision newsletter, workshops and demonstration projects, Windstar offers individuals and organizations an opportunity to participate in the creation of a sustainable future. Contributions to the Windstar Foundation are tax-deductible.

All correspondence regarding The Windstar Foundation or any of its programs should be addressed to the Windstar Foundation, 2317 Snowmass Creek Road, Snowmass, Colorado 81654.

Members of The Windstar Foundation will receive six issues of World•Watch magazine which will include the Windstar Vision newsletter. Annual dues: $35.

CARACOL COMPANY

May 18, 1993

Mr. Jack Barger
BARGER INTERNATIONAL
1654 E. Board St.
Columbus, OH 43203

Dear Jack:

Dan Carlson asked me to write to you and tell of our activities in Mexico. Two years ago I formed Caracol Company to market the coffee grown by my partner, Jorge Ricardez, at his plantation, Cafetal Brasil. In this, our second year, we are also importing and selling coffees from plantations owned by other members of the Ricardez family. All of these plantations, or fincas as they are called in Mexico, are located in the Sierra de Miahuatlan, the southern coastal mountain range of the state of Oaxaca (pronounced Wah-HA-ka).

About a year ago I had the opportunity to visit Rancho Zimatan, the 4000+ acre tract of wilderness bordering the Zimatan River near the coastal resort of Huatulco that is owned by my partner's brother, Raul Ricardez. The ranch has over a half mile of frontage on this spring-fed, year-round river and several old fallow fields immediately adjoining. Before visiting the ranch I had sent Tompkins and Byrd's Secrets of the Soil and the Sonic Bloom video to Jorge and Raul, thinking they might be interested in applying Sonic Bloom to some agriculture venture on one of the family's properties in Oaxaca.

I never could have imagined what interest they would have! Jorge, immediately upon receiving a sound unit and a gallon of the nutrient solution, set off for his finca to expand his coffee tree seedling nursery to 10,000 plants and apply the Sonic Bloom system to them. He is now implementing plans to produce, with the aid of the small producers that populate the village that adjoins his finca, a 30,000 plant nursery. These plants will eventually be distributed for planting on the coffee farms of these same small producers. This is an ingenious way to help our neighbors in the Santa Maria Coixtepec area and to help improve the quality of the coffee we buy from them.

Raul, after receiving the Sonic Bloom information, organized about 25 men from the village of Petatengo (which adjoins his property) to create by hand a marvelous irrigation canal that runs the length of a 10-acre field along the Zimatan River. Upon completion of this canal, the field was planted with jalapeno seed. When the seedlings reached a height of about

WESTCOAST SALES OFFICE

five inches, the Sonic Bloom system was begun. The project has since been completed with great success. The plants were vigorous, of a dark green color and averaged nearly two feet in height, with many reaching 2½ feet. The yield, according to the agricultural consultant hired by Raul, was nearly double what one would expect from conventional jalapeno cultivation with an initial fertilization of the soil. In addition, all who have tried the mature chile assert that the taste is extraordinary. They are not hotter, but are clearly more flavorful and even crisper than those found in the markets there.

In-ground drying/smoking ovens were constructed at Rancho Zimatan and the crop of ripe, red jalapenos was turned into chilpotle peppers. Chipotles, being completely dried, keep very well and are increasingly sought after by salsa manufacturers in the American Southwest.

At about the time the jalapeno project was begun at Rancho Zimatan, another farm, owned by an old friend and associate of the Ricardez family, was brought under Sonic Bloom cultivation. This farm (of 12 acres) is near the village of La Laguna and the San Isidro River. It is about a mile from the Ocean and 10 miles north of Puerto Angel, set amid lagoons and orchards of papaya, mango, coconuts and banana. On these 12 acres were planted cantaloupe, watermelon, tomato, corn, jalapenos and squash. Although our associate didn't receive and start using the Sonic Bloom until his plants were well up, he was still able to see a dramatic difference. This was with only being able to do half the number of sprayings he would have liked to do. When I visited his place in January, he was harvesting cantaloupe and watermelon and the rest were nearing harvest. While in the field we sampled both types of melon and I can say that I have never in my life eaten any sweeter. In addition to being delectable, they were of a noticeable uniformity in size, and there was still a great deal of blossoming even as ripe melons were being harvested.

The same can be said of the tomatoes: Although they were too green to eat, there was a tremendous number of fully-formed, nearly ripe tomatoes. At the same time, there were too many blossoms to count. Also, they were quite uniform in size.

The corn results were similarly spectacular, with some plants over 7 feet high and with up to nine ears on a plant! These results were produced with the basic, locally available seed that everyone uses. The same can be said for all crops planted there at La Laguna.

The jalapeno results were similar to Rancho Zimatan's, and the squash plants had great spread and many blossoms.

Near Ocotlan, about a half hour from the city of Oaxaca, is another farm (of 80 acres and also owned by a family friend) where Sonic Bloom cultivation will begin upon the onset of the rainy season in July. We will plant 20 acres of Walla Walla sweet onion and asparagus seed given to us by Dan Carlson. We are excited about the possibilities of growing exotic vegetables in Mexico.

This is our involvement with Sonic Bloom thus far. Please let me know if I can be of further assistance.

VINCENT STANZIONE
A.P. 392
03901 ANTIGUA, GUATEMALA
CENTRAL AMERICA

JUNE 6, 1993

MR. DAN CARLSEN
SCIENTIFIC ENTERPRISE
708 119TH LANE
NORTHEAST BLAINE, MN 55434

DEAR DAN,

I AM WRITING TO YOU IN REGARD TO OUR PHONE CONVERSATION OF JUNE 1ST.

SUBJECT: SUCCESSFUL USE IN THE APPLICATION OF SONIC BLOOM ON:

1. FRUIT TREES
2. VEGETABLES
3. CORN AND BEAN

FRUIT TREES

EXCELLENT GROWTH ON SAPLINGS FROM 1 TO 3 YEARS, POSSIBLE PROBLEM OF TOO MUCH GROWTH WITH A NEED TO RADICALLY PRUNE BECAUSE OF SUCH RAMPANT GROWTH.

VEGETABLES

EXCELLENT GROWTH ON LEAF, HEAD AND COS LETTUCE VARITIES WITH NO NEED FOR PLAGUE CONTROL OR FUNGUS ROTTING.

BEAUTIFUL HEADING UP OF BROCOLLI AND NO INFESTATION OF APHIDS.

PARTICULARLY SWEET ROMA TOMATOES AGAIN WITH NO NEED FOR INSECTICIDE OR ANTI-FUNGAL APPLICATIONS.

ON OTHER VEGETABLES SUCH AS ONION, LEEK, GARLIC, PARSLEY AND STRING BEANS, SONIC BLOOM WAS NOT APPLIED BECAUSE OF WHAT I SAW AS THIS BEING A PROHIBITIVELY HIGH COST.

CORN AND BEAN

SONIC BLOOM WAS APPLIED TO THE NATIVE, GUATEMALAN HIGHLANDS, MAYAN BLUE CORN (REX UACH-BLUE FACED ONE) AND BLACK CLIMBING BEAN (AK' KINAQ-BLACK BEAN).

THE EARS OF CORN WERE PARTICULARLY FULL WITH NO DISEASE AND WITH AN INTENSE BLUE-BLACK RESONANCE IN COLOR AND VIBRATION.

THE BEANS HAD LONGER PODS WITH MORE BEANS PER POD AND WITH ALL BEANS BEING FULLER THAN ANY OF THE CROPS IN THE SURROUNDING AREA.

SINCE THE BEANS ARE GROWN ON THE CORN WE HAD TO CURTAIL THE NORMAL APPLICATION OF SONIC BLOOM TO THIS PARTICULAR FIELD OF CORN AND BEANS BECAUSE THE BEANS WERE PARTICULARLY WEIGHTY FOR THE CORN THAT HAD GROWN PERHAPS TOO HIGH.

I HOPE TO FIGURE OUT A WAY TO APPLY SONIC BLOOM SO AS NOT TO HAVE SO MUCH GROWTH OF FIBROUS MATERIAL IN THE PLANTS THEMSELVES.

NOTE OF INTEREST: THE APPLICATION OF SUCH AN ENLIGHTENED FERTILIZATION TECHNIQUE FROM NORTH AMERICA UPON SUCH ANCIENT CORN AND BEAN SEED STOCK FROM CENTRAL AMERICA HAS GIVEN ME A SENSE OF FULFILLMENT. MY QUEST IN THIS LIFETIME IS TO BRING THE "NORTHERN" AND" SOUTHERN" PARTS OF THIS HEMISPHERE TOGETHER IN PEACE AND GROWTH BOTH MATERIALLY AND SPIRITUALLY.

FACTS AND FIGURES

BECAUSE I HAVE HAD TO BUILD MY ADOBE HOUSE, A GREEN HOUSE, A POTTERY KILN, TEND SHEEP AND COWS, AND GET ALL OF MY LAND DEEDS IN ORDER, IT HAS BEEN IMPOSSIBLE TO ACTUALLY MONITOR A COMPARISON OF MY OWN AGRICULTURAL EFFORT WITH THAT OF OTHERS IN THE AREA IN AN APPROPRIATE CONTROLLED, SCIENTIFIC STYLE. ON ONE HAND, I APOLOGIZE AND ON THE OTHER, I ASK FOR YOUR UNDERSTANDING FOR MY SITUATION AS A HOMESTEADER AND STRANGER IN A STRANGE AND BEAUTIFUL LAND.

THANK YOU ONCE AGAIN FOR YOUR INTEREST IN MY PROJECT AND LIFE IN THE HIGHLANDS OF GUATEMALA. IT IS MY HOPE THAT WE WILL CONTINUE TO COMMUNICATE AND WORK TOGETHER IN THE YEARS AHEAD.

CON UN ABRAZO,

December 3, 1993

Dan Carlson Scientific Enterprises
Hazel Hills Research Station
River Falls, Wisconsin, 54022
(715) 425-1407

Dear Dan,

Enclosed is a video tape with some footage of our vineyards this year. We used Sonic Bloom on approximately 14 acres of Concord grapes this year and had an wonderful crop. We followed your recommended spray schedule and were rewarded with tremendous numbers of buds and a very good bud set.

The clusters developed well and reached an excellent sugar level approximately 12 days earlier than other grape crops in our area. Due to last year's cold, wet summer, many vineyards suffered from Delayed Bud Syndrome - but not us. This year was warm and wet causing overwhelming problems with mildews everywhere but in our vineyards. The grapes also withstood a number of freezes with temperatures down in the mid-twenties. It was a rough year for many grape growers in the Lake Michigan region but we sailed through every challenge.

The cane growth this year was also spectacular. We have been rewarded with beautiful, healthy, chocolate-colored canes for next year's crop. We intend to use Sonic Bloom again and expect another great year for grape growing. Thanks so much for your advice and a super product that does not pollute the Earth.

Yours truly,

Penny Kelly

Penny Kelly
Lily Hill Farm

Lily Hill Company 32250 - 88th Avenue Lawton, Mich. 49065 (616) 624-6022 Fax (616) 624-1969

September 17, 1993

Dan Carlson
Scientific Enterprises
Hazel Hills Research Farm
River Fall, WI 54022
(715) 425-1407
Fax - (715) 425-1727

Lily Hill COMPANY

Dear Dan,

I thought you might like to hear what has happened in our experiments with Sonic Bloom. Two years ago we bought your small garden kit and started using it twice a week on our office plants and trees. Within a short time everything began to grow with tremendous energy. They grew so muchwe were afraid there wouldn't be room for the people so I had to cut back the treatments to once a week, then to every other week, and now they are beautifully maintained just by a weekly watering with Sonic Bloom and a music/spray treatment every other month.

When the office plants did so well, we decided to begin using Sonic Bloom in our vineyards. We have two vineyards of about 7 acres each, totalling around 14 acres. Both are under contract to Welch Foods (of the grape jelly fame).

What We Have Learned Due To Mistakes and Things Out Of Our Control -

As beginners we have not done everything exactly as recommended. We were slow getting started and there was 8" to 10" of growth already on the canes before we got the first spray on. We also thought we could skip our regular fertilization as well as the spray program we usually follow to avoid trouble with phomopsis, black rot, downy mildew, powdery mildew and miscellaneous pests. In the end, at the serious recommendation of the National Grape Co-op consultant, we did add fertilizer very late, and eventually we had to spray for all of the above diseases/pests. But - in a wet, hot, humid year that old-timers around here are saying is "the worst year for black rot and mildew we've ever seen" we did manage to keep our spray costs about equal to other years.

What We Are Celebrating -

We have a front vineyard and a back vineyard. Up to now, the front has always been somewhat anemic in its fruit production. But this year it is loaded with grapes. The clusters are hanging so densely they look like socks hanging on a clothesline! The back vineyard, which has always been a good producer, looks like a jungle of grapes with an incredible amount of "new, healthy wood" for next year. We usually trim the vines using the Kniffen Method of trimming and aim for about 80-90 buds per vine. We did our usual trimming this year and yet we have counted between 150 and 170 buds per vine, some as high as 180 or more!!

The weeds under the trellis, which got off to an amazing start thanks to Sonic Bloom, were sprayed once, in late June, at half-strength using the *Sonic Doom* method and there still are *almost no weeds directly under the trellis.* Usually we have to weed spray at least two or three times, to control the weeds.

The grapes are ripening nicely and in the first sugar test which was taken today we are at 12.7% sugar in both the front and the back vineyard. There are several things different about this sugar count. The most noticeable is that the front vineyard is usually about one percentage

point behind the back in the sugar count. The other is that our vineyards are always about a point or two behind the rest of the vineyards in our area... we've never really figured out why. This year we are right up there, perhaps even a few tenths of a percent above the average. They are also filling out and getting plump and we are estimating approximately 5 - 6 tons per acre as opposed to our running average of 3 - 4 tons per acre.

Comments and Things of Note -

We have been visited by other grape farmers and have discovered that quite a few have lost a considerable percentage of their grapes due to mildew and other diseases. Some have lost as much as 50% to 80% in spite of continuous spraying. Our vines are extremely healthy and they do not seem to be bothered much by the leafhopper, mites or Japanese beetles here and there. Last year (1992) was a "year without a summer". The cold, wet weather, and absence of sun was extremely stressful to the plants. As a result, a great number of grape farmers suffered from a condition called "Delayed Bud Syndrome". This was serious enough for Welch/National Grape Co-op to put out a letter in June advising farmers that there was really nothing anyone could do. They emphasized that although the problem was severe, next year would be better if stress on the plant was minimized. We did not experience any of the DBS Syndrome and are enjoying one of the best crops we have ever had. This may be due to Sonic Bloom and we intend to continue spraying with Sonic Bloom next year.

I also used Sonic Bloom several times in my vegetable garden. In spite of the fact that we moved it to a new location in which 1/3 of the garden had no topsoil, that 30 cubic yards of woodchips were added to the second 1/3 and I only sprayed three or four times altogether, we have one of the most productive gardens we have ever had. The peas and the lettuce continued to produce right on through the hottest weather. But the thing that has been absolutely most amazing is the taste of the vegetables and their long shelf-life. I picked a large basket of peas in mid-July and put them in the refrigerator but did not get a chance to do anything with them. Due to scheduled commitments requiring me to travel, I was out of town from July 24 through Aug. 1.

When I came back and found the peas still in the frig, I was certain they were getting moldy and would be wasted. To my shock, they were as perfect as the day I had picked them. I froze a half-dozen pints at that point and put the rest back in the refrigerator to eat with our meals. We continued to eat those peas until they were fully 2 months old and they were as fresh and delicious as newly picked ones. Zucchini, tomatos, cucumber, peppers and corn have easily sat outside the refrigerator for a week and showed no signs of deterioration! My basil is the sweetest it has ever been, and two tomato plants that I grew indoors last fall and winter are now living happily in the garden, still producing heavily and nearly a year old.

We are more than pleased with the results and plan to continue using Sonic Bloom next year in the vegetable garden, and expand the use to the fruit garden. We'll let you know how it goes.

With regards,

Penny Kelly

Penny Kelly
Lily Hill Vineyards & Farm

U. S. Department of Agriculture
Insect Attractants and Biology
Research Laboratory
Gainesville, Florida

Scope: Philips 505 Scanning Electron Microscope

Angle: 45

Accelerating Voltage: 15 kV

Left Side Magnification: 312 X

Right Side Magnification 2000 X

This is a Scanning Electron Micrograph of a grape leaf from a plant treated with Sonic Bloom. Stomata density is substantially higher, and individual stoma are much more developed and defined.

U. S. Department of Agriculture
Insect Attractants and Biology Research Laboratory Gainesville, Florida

Scope: Philips 505 Scanning Electron Microscope

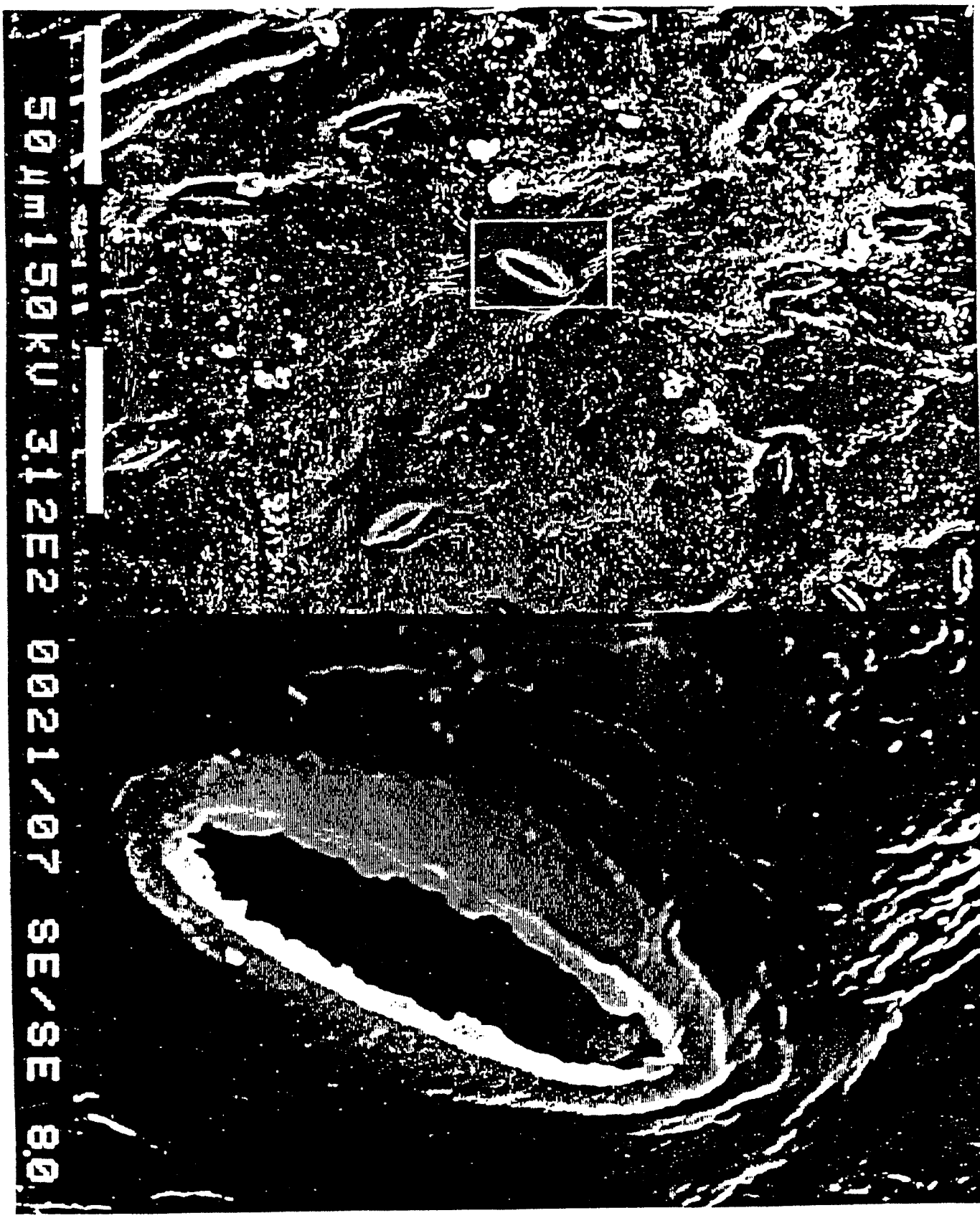
Angle: 45

Accelerating Voltage: 15 kV

Left Side Magnification: 312 X

Right Side Magnification 2000 X

This is a Scanning Electron Micrograph of a grape leaf from a plant not treated with Sonic Bloom. Stomata density is significantly lower than the treated leaf, and individual stoma are much less developed and defined.


50Am150KV 21E2 0021/07 SE/SE 80.

There is no doubt in my mind that Sonic Bloom used properly will enhance the growth of virtually any plant bush or tree. Flavor is also much sweeter.

QUALITY PRODUCE -- SATISFACTION GUARANTEED

- 100% CONTROLLED ENVIRONMENT
- NATURALLY GROWN
- SERENADED WITH MUSIC
- VINE RIPENED
- SUPERIOR NUTRITIONAL QUALITY
- BIG AND JUICY

To Whom it may concern:

I first met Dan Carlson in 1985 and began working with him using his growing process and product, sonic bloom. I experimented on my own vegetable garden and yard and enjoyed outstanding results in every area where the system was applied.

In 1990 my son and I established Melody Farms. We built two 30'x130' quonset type greenhouses for tomatoes and took over a 6 acre blueberry farm.

We have tried several varieties of tomatoes, the best being a 90 day beefsteak variety. From the time we plant seedlings and with normal weather conditions, in the greenhouse, we are harvesting in 70 days. We do not have grow-lights or heated floors which, in my opinion, are a "must" in order to achieve top production and quality. We play the music every day from sun-up to sun-down and spray with Sonic Bloom at least once a week.

I get 15,000 pounds per house per crop if Mother Nature co-operates. If one adds grow-lights and heated floors one would now have ideal control for growing and would appreciably increase one's yield.

We learned in out research that we can take suckers off the parent plant and start a new plant earlier than planting seed. The success ratio is very good; in quality soil medium 90% of the suckers will grow. Plants started this way with good growing conditions will put us in harvest in less than 60 days and will produce somewhat over 18,000 pounds per crop. These plants are stronger and have more bloom per fruit hand, many even get a double fruit hand. By that, I mean that another fruit hand grows out from the end of the first one.

Cucumbers are being harvested 45 days after planting with the music and Sonic Bloom. We must pick them daily or they will grow too long to fit into the packing box which is 20 inches wide. We have taken 7600 pounds in 30 days from one house and all being premium price from the consumer.

By using Sonic Bloom and music in the Blueberries we have had similar results. We use two sound units and it is interesting to note that the bushes grow towards the direction of the loudest sound. Our berries are always ready for picking 10 days to 2 weeks ahead of anyone else in the area. Many berries get the size of a nickel and are exceptionally sweet in flavor.

We use no chemical commercial fertilizers, herbicides or pesticides. We spray the plants with black strap molasses and hydrogen peroxide to deter the few pests which do occur.

Blackberries respond remarkably well to the Sonic Bloom system. The canes are higher than my head (I'm over 6 feet tall) and had blooms on them as big as a quarter. The berries get as big as your thumb and are sweet. They also grow towards the sound unit.

We have a row of pine trees which run across the property by the end of the greenhouse and the difference in the size of the trees close to the sound units is very noticeable, I spray them as well. Trees 150 feet down the row are much smaller; all are the same age and were the same size when they were set out there.

February 5,1993

Dan Carlson
Scientific Enterprises
708 119th Lane N.E.
Blane, Mn. 55434

Dear Dan:

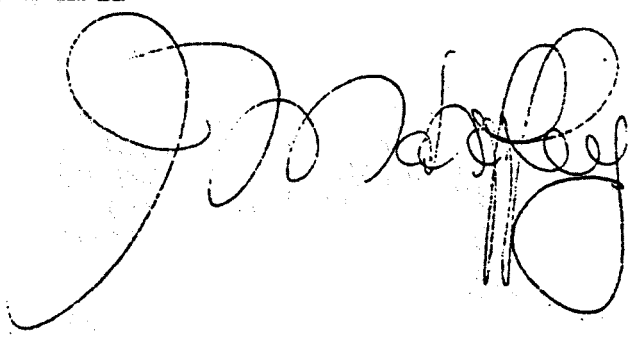
We have tested the Sonic Bloom concentrate on a four acre block of Ida Red Apples. During the growing season,we made six applications of the product on three year old trees. The results were quite impressive !

First, the yield was up 50% over the unsprayed trees. Most impressive to me, was the fact that when these apples were taken out of C.A. storage in April we were able to pack out 95% of the test bins.

I am looking forward to using your complete product (Sound & Solùtion) in a greenhouse and market garden this year.

Thank you for the wonderful product combination,

JoAnn Mahaffey
Stone Ground Farm, Ontario



September 17, 1986

Mr. Dan Carlson
Sonic Bloom
708, 119th Lane North East
Blaine, MN 55454

Dear Dan:

At last, I have some results from the lab on your oranges. Now that we have the procedure for the first one, I believe that we can do any others that you send in a much quicker fashion and with more detail.

One of the hold-ups was that the lab wanted to run them on the new High Performance Liquid Chromotography unit. This unit is the latest state-of-the-art unit that Waters has made. And being the latest, everything has not been ready when they had originally promised. We are still waiting for the columns to run the amino acids on this unit. These are supposed to be here in October and the procedure will be ready to go in November some time. The other reason we are so late is that the lab just kept dragging its feet. This is also solved.

Now, the results of the tests and a few comments about them.

Vitamin	Concentration	
	Treated	Untreated
C	30 mg/100gm	13 mg/100gm
A	33 ug/dl (91 UI)	0 ug/dl
E	2 ug/ml	2 ug/ml

The C is a little low by standards. This could be in part to our calibration and in part from the long storage process. The interesting thing is that the C is better than twice the amount in the treated orange than the untreated. The vitamin A is also dramatically different. As a comparison between treated and untreated, the numbers are valuable.

As I understand, things continue to go well for you and that yields are excellent where ever you use the product. One comment from here: I was talking with Shirley West about a week ago (who was not too wild about Sonic Bloom when we started) and she said, "If Doctor Riordan asks me to use Sonic Bloom again next year, I am ready." This is a complete turnaround for her.

Keep in touch.

Sincerely,

Richard Lewis
Director of Development

RL/ds

THE
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The TOMATO Club

VOLUME 1, NUMBER 6 AUGUST 1993

Sonic Bloom – Music May Really be the Universal Language

In the next fifty years, so claim the experts, the world's population will stand somewhere between 11 and 14 billion people. These estimates are shocking enough before you even consider the sad fact that, at the current 5.5 billion level, the globe is already overcrowded with Homo Sapiens.

There is definite correlation between animal life and plant life on this planet Earth to which not enough attention is directed. Simply put, more animals equate to less plants. And no other species of animals has emasculated plant populations with the vigor and disrespect than our very own. In a short span of no more than one-half million years we have turned great forests into deserts, cleared vegetation from billions of acres of once pristine land, caused the extinction of countless plant species and turned immeasurable hectares of rich soil into nonproductive and unusable wasteland.

To add salt to these wounds, we are now faced with a global dilemma where the median age of many third world nations is an incredible 15, the United States is approaching a total people count that matches what the entire world population was just 1,000 years ago, and older folk face extended longevity while younger ones make more babies. It is no surprise that population statistics have nowhere to go but up–and way up!

Even if we take great pains to curb the rate of population growth and are successful in our pursuit, there will still be almost twice as many people on this planet by the year 2043–a terrible thought when you consider how overcrowded many of us feel

continued on page 4

THE TOMATO CLUB

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Sonic Bloom – Music May Really be the Universal Language *continued from page 3*

right now. It's analogous to the national debt–sometimes things get so immense there's no stopping them. In their near infinite expansion, they begin to progress almost geometrically, consume everything around them and eventually become insolvable and uncontrollable. In astronomy, a black hole would fit this description to a tee. Getting back to Earth, the national debt and population explosion fit the description just as well (or should we say just as horribly?). But let's concentrate on population because that's what much of this story is about (it's about tomatoes too–we'll get to that in a moment).

We cannot feed all our billions now. How do we feed two or three times the current number on a planet whose size is fixed, whose land mass has a better chance of shrinking than expanding, whose soil is becoming more and more tainted, eroded and worthless and whose trees, which help make the soil and air rich, are disappearing faster than humans reproduce? Obviously with less usable land and more mouths to feed we must find dramatic ways to increase our harvests. Admittedly, researchers and agronomists have made significant progress in the last 50 years but will have to become "Houdinis" in the next fifty to keep up with the nutritional needs of a highly progenitive and consuming species.

Not all may be that dim, however. Advances in genetics, agronomy and plant sciences have accelerated and undoubtedly will abate the potential severity of the picture just painted. Research is discovering much more about plant life as it is about all aspects of our world and the universe which surrounds it. And one of the most striking discoveries about plants is that they appear to like music which, after an admittedly long introduction, brings us to the crux of this discourse.

Sonic Bloom – Well, it may not be music specifically but plants appear to be affected by high sound frequencies characteristically transmitted by many musical sounds. **Dan Carlson**, researcher, plant breeder and nut farmer, started experimenting on the effects of high frequency sound on plants over 20 years ago. It was hinted in a few textbooks even then, that the vibratory force of certain sonic frequencies allowed plants to "breathe" better and increased their ability to absorb more minerals and nutrients necessary for optimum growth. Sound affected the **stomata**, tiny holes or pores on the leaf surface, primarily located on the underside of each leaf. Not much more was known at that time, however, so Carlson spent several years experimenting on the effects of different sound frequencies. With the help of a musicologist and the laborious task of "trial and error" testing, he finally arrived at a sound frequency of 3,000 to 5,000 Khz, a range most compatible to the widest variety of plants.

Dan Carlson, Sonic Bloom founder and researcher, also runs Hazel Hills Nut Farm which has developed and produces dozens of new nut varieties (seedlings available). He claims governments outside the U.S.A. have been more interested and supportive of Sonic Bloom probably because this country currently produces an abundance of food and gets excited about things only when a "catch-up" atmosphere develops.

Concomitant with his sonic investigations, he spent considerable time as well in developing a foliar feeding formula which is the second part of his two-tier program. Getting the stomata to open as widely as possible and to stay open longer, provided for a much greater absorption potential but the question then was, what should the plants be fed under these changed physiological conditions? After many more man-hours of tedious testing, Carlson concocted an organic foliar spray which includes amino acids, seaweed derivatives and 55 trace elements. This combination of greater food intake (through the stomata) and a foliar feeding solution which includes just about everything a plant needs to thrive and reach its genetic potential, has produced some truly astonishing results. According to Carlson, hundreds of farmers and gardeners have verified his findings and have acclaimed Sonic Bloom's cultural values.

Let's get back to Carlson for a moment. One of the first indications that he was onto something was an early experiment in 1979 with a purple passion plant. This plant, which generally does not grow beyond two feet, reached 150 feet during the first three months of treatment. During a period of two and one-half years, and under the "duo" of music and his foliar spray, the plant reached a length of 1,300 feet which, incidentally, is documented in the Guiness Book of World Records.

Let's review a very small sample of what other farmers, gardeners and researchers found with Sonic Bloom:

- Stone Ground Farm in Ontario, Canada, tested Sonic Bloom in 1992 on a 4-acre block of Ida Red Apples. Untreated apples of the same variety were close by to afford a good control group comparison. The yield was up 50% over the unsprayed trees.
- A test conducted by Bio Research Farms in [redacted] registered an increased yield of soybeans from 37 to 75 bushels per acre.
- The Olive Garvey Center for the Improvement of Human Functioning in Wichita, Kansas, tested a shipment of treated Florida grown oranges. The vitamin C content was a whopping 121% above the norm.

• [redacted]' gardeners began using Sonic Bloom in his rose garden at Sudley Castle in 1992. The 100,000 tourists who visit the castle each year can now see, on average, [redacted] roses on each branch when there used to be just five.

Other Pluses – These are just a few examples of the success stories that Carlson has reported from all over the world and they go beyond just size of harvest or number of fruit or flowers. We already touched on vitamin and nutrient levels which increase dramatically. Watering needs can be reduced substantially since larger and deeper roots develop enabling them to tap additional reserves of ground water. Tests in arid environments have shown a 50-60% reduction in watering requirements in some cases. Crops become more uniform in size (usually bigger) and shelf life increases dramatically. Fruits, grains and vegetables are more disease resistant and even insect problems are diminished, most likely because of heavier sugar content which adversely affects these critters' digestive tracts. Crop maturity is generally shortened, up to 50 days in some cases, while heavy flowering continues, frequently resulting in a second harvest. In addition to all the above, almost everyone who offers testimony, regardless of the crop, contends that what they grow tastes better and is more flavorful. In addition to all these advantages, there is still more to report before we conclude the Sonic Bloom story.

Genetic Elasticity – Plants undergoing the Sonic Bloom treatment afford some exciting changes that cannot be fully explained botanically. Simply, in many cases, the treated plant can pass on its cultural improvements to its offspring even if the offspring are left untreated. Kidney beans, for example, usually produce 3 to 4 beans per pod. Treated with Sonic Bloom, this often increases to 4 and 5. The offspring of this plant will produce 4 and 5 pods too but, if treated with music and formula, may increase to 5 and 6 pods. Tests so far have brought these generational increments up 8 and 9 beans per pod and there is no reason to believe the limit has been reached. More research in this area must be conducted but results to date are very encouraging indeed.

Even the time to germinate seeds has been reduced with Sonic Bloom. Seeds bathed in Carlson's solution for just one day while exposed to his taped repertoire of delightful music, have germinated in one-third to one-half the normal time. Under these very conditions, there have been reports of germination taking place overnight.

We began this discourse on a "population explosion" theme and it is obvious to see how it relates to the body of this dissertation. Incidentally, we didn't have space to cover trees but Carlson's combination of melody and spray appears to accelerate the growth of these "great plants" as well, which may help alleviate the continued slaughter of forests and their grandest inhabitants. The fact is, however, fifty years is a long time away and this writer and most of his readers will not be around to suffer the "population" consequences. By then, your editor will have already celebrated his centennial plus some additional years he prefers not to reveal. Of course, all of good conscience and caring must be concerned with their children's future as well as their grandchildren's. Let's hope they can solve the population problem and thus inherit a better world. In the meantime, let's get back to now!

Sonic Bloom is available today. It has no retail distribution yet, but can be purchased through the mail. It's so simple to use that all you need to know is how to use a cassette player and squirt a spray container. It comes in two forms–one for the backyard gardener which is a $60 kit (plus $4 shipping) and includes a 20-ounce bottle of foliar spray concentrate and a cassette tape of the most delightful music that both you and your plants can enjoy. The supply of concentrate is to be diluted by one teaspoon to one quart of water so, for most gardeners, there is an ample supply for at least one and possibly two seasons. For small farmers, a gallon of concentrate is sold for $250 and a sound system is available for $125. This package is designed for 1/5 acre to 5 acre plots. For those who require larger area needs, you can contact Carlson directly for specific costs and details.

The CLUB cannot verify all the claims made by others on behalf of Sonic Bloom and we admit some of this sounds almost too good to be true. However, the few testimonials presented here have been documented with enough supportive information to conclude that they are not fraudulent or fictitious. If some are exaggerated by those who offer testimony (and we are not saying that they are) there is no way for us to make judgment on this kind of speculation or possibility. We have reviewed an 80-minute videotape where dozens and dozens of farmers, researchers and gardeners, who grow everything from fruit to nuts, testify that Sonic Bloom works and produces substantial results. As far as we are concerned, the sheer number of testimonials from respected farmers, governments, etc., around the world adds credence to the Sonic Bloom story. For $24 you can order a copy of this tape for your own evaluation. Incidentally, the CLUB took the initiative to personally confer with a Sonic Bloom tomato farmer so please be sure to read **An Interview with a Tomato Farmer** which follows this presentation.

For more information on Sonic Bloom write to Dan Carlson Scientific Enterprises, Inc., 708-119th Lane, N.E., Blaine, Minnesota 55434, or call (715) 425-1407. And remember, when you play your music, more than just the neighbors may be listening.

An Interview with a Tomato Farmer

Charles Dodge runs a small farm in Mountain Home, Arkansas. His crops are sold roadside and his Melody Farms (a perfect name for a Sonic Bloom user) consists of a 5-acre plot for blueberries and two, 4,000-square-foot "quonset hut" type greenhouses–one for his cucumbers and the other for tomatoes. We interviewed Charlie on June 23, 1993 to get a specific opinion on Sonic Bloom's effect on tomatoes. Although his greenhouses provide a controlled environment, there are plenty of statistics on greenhouse crops and viable comparisons can be made. Here are the Q&A's as they occurred in sequence:

Q. How long have you used Sonic Bloom?

A. I started in either 1984 or 1985. Offhand, I can't remember the exact year but it's a good 8 or 9 years now.

Q. How many tomato plants do you grow and what varieties?

A. I use one of my 4,000-square-foot greenhouses for tomatoes. This greenhouse is stocked with about 1,000 plants (mostly grown from suckers) and just about all are beefsteak varieties.

Q. Do you use Sonic Bloom on all your tomatoes?

A. I use Sonic Bloom on all my tomatoes as well as all my cucumbers and blueberries. In fact, I use it on some of the trees on my property too.

Q. What are the noticeable differences with Sonic Bloom in terms of the flowering of your tomato plants?

A. Flowering is overwhelming. We get 9-10 flowers on one shoot which is way above the norm.

Q. Size of fruit?

A. My estimate is that the Sonic Bloom treated tomatoes are 20-30% larger than what they would be without it.

Q. Quantity of fruit per plant?

A. Here again, I would estimate the increase to be in the 20-30% range. You must remember, we remove a significant number of flowers. We grow our tomatoes from suckers and we are in our 18th generation of sucker propagation. After the 10th generation, an interesting development occurred. Flower shoots form with a cluster of 9-10 flowers. However, in many cases, another shoot develops at the end of the first cluster adding another 4-5 flowers. The hand (stem) that supports this load could never handle the weight of all those maturing tomatoes, so we generally cut back that second (extended) shoot.

Q. Overall harvest?

A. The average tomato crop from a 4,000-square-foot greenhouse is in the 9,000 to 10,000 pound range. I have had crops hit 19,000 pounds but that's not a consistent result so I am going to be very conservative. Without any degree of exaggeration, I know my tomato crops are minimally 30-40% higher with Sonic Bloom. Personally, I would bet it is even higher but I will stick with a lower estimate so no one could possibly dispute my claims.

Q. Maturity rate?

A. Sonic Bloom tomatoes ripen about the same time as untreated ones but the big difference here is shelf life. Once picked, tomatoes stay unspoiled for at least twice as long–possibly three times as long. When you're selling roadside, this is a real plus.

Q. Taste?

A. The simplest word I could use to describe the taste of my tomatoes is superb. People come from far distances to purchase my tomatoes and, I might add, I get similar taste praise for my cucumbers and blueberries as well.

Q. Diseases?

A. I have no problems whatsoever with tomato diseases.

Q. Watering needs?

A. My watering needs increase with Sonic Bloom. The plants get so big and the fruit they produce increase substantially. These giants simply need more water.

Q. What would you say about Sonic Bloom overall?

A. Everything it touches grows better. I know this is a tomato newsletter but let me tell you about my cucumbers. I planted 500 cucumbers in one of my greenhouses. It took 40 days from seed to harvest. From the 41st day and for the next 36 days I picked 7,600 pounds of cucumbers. I have 4 young apple trees on my property that I planted three years ago. I don't care who the experts are–they will all tell you the trees are 7-10 years old. Everyone who gardens without Sonic Bloom is working against themselves–tomatoes included!

STOMATA

On every leaf there are thousands upon thousands of small pores or openings called stomata (singular, stoma). These tiny structures, less than 1/1,000 of an inch, are the only openings in the leaf. They allow water to pass out of the leaf (transpiration) and gasses, notably carbon dioxide, to move into the leaf. The carbon dioxide is transformed into sugars through the complicated process of photosynthesis. During dry conditions, leaves begin to wilt and the stomata will close. This prevents the plant from drying out completely but unfortunately carbon dioxide will be prevented from entering the leaf which reduces photosynthesis. Hence the plant survives but grows more slowly due to a decrease in sugar production. Theoretically, if you could slow the movement of water from the leaf just enough to prevent drying but still allow the stomata to remain open, photosynthesis would continue, sugars would be produced, and yields would increase. Researchers around the world continue to experiment to make plants more efficient to feed an ever increasing population. *–Stephen Reiners, Ph.D.*

Sonic Bloom

An Interview With Its Creator: Dan Carlson

by Dale Lucht and Esther Turner

In the early 1960's a young GI, stationed in Korea, witnessed a mother lay her young child beneath the tires of an Army truck, crushing his legs. She did it so she could get money from the government to feed her children. The GI's name was Dan Carlson, a young Minnesota recruit, who, after witnessing that sacrifice, decided to devote his life to wiping out hunger.

How many people as young adults, make an oath like that, and then are sidetracked? But Dan Carlson didn't get off the track. He went to college and studied horticulture and agriculture. As a result of Dan's commitment, he developed s present business "Sonic Bloom". Sonic Bloom is more than a cute name, but is actually a revolutionary new technique to make plants grow and grow abundantly and beautifully!

While in college, Carlson concluded that if plants could be fed through their leaves, then it wouldn't matter if the soil were poor. In leaves there are tiny pores called stomata which take in carbon dioxide and water from the air and give off oxygen. His theory was to feed the plants through the stomata with a mixture of nutrients. The trick was to get the stomata to open up when they were being sprayed.

At this time he stumbled on a record called "Growing Plants Successfully in the Home" by George Milstein. That gave him the idea of using music to open the stomata upon demand. Carlson enlisted Michael Holtz, a Minneapolis music teacher, to aid him in developing music to go along with oscillating "cricket chirping" that Carlson had developed. Holtz realized that its pitch was consonant with early-morning bird chirping. They blended the chirping and musical tones into one sound which form a command that stimulates the plant's stomata to open and absorb the offered fertilization. Together, the stimulating harmonics and growth producing nutrients produce exceptional results. This blended recording is now available on cassette and is furnished in the Sonic Bloom Kit.

As our car entered the long driveway to his Nut Farm near Riverfalls, WI, we heard the unusual sounds of chirping! As we pulled up to the house, we were immediately met by Dan. After our 4 hour drive, it was especially nice to be greeted with his warm smile and hardy welcome!

How is it that when you first talk to someone, and before you meet them you already know that you will "connect" with them personally. I had this feeling about Dan Carlson. We had spoken several times by phone before I decided that I would like to know more about him and his product "Sonic Bloom". In those conversations, I could sense something intriguing about him. Call it intuition, but I could feel a devotion and sincerity in his voice that caught my attention.

Dan bent down and picked up a hickory nut that was just starting to sprout and gave it to me. "Here, you can start your own tree from the nut farm!" The three of us immediately meshed and I knew this was going to be more than an interview but an adventure.

"Dan, the first thing I have to ask is . . . What is all that chirping?" Dan laughed and went on to explain the way he uses sound to promote plant growth. He's been playing his music for the nut trees on the farm and is reproducing nuts from those endangered trees successfully with Sonic Bloom. As we talked, I learned that Dan is a nut tree expert who has personally cultivated and matured the following varieties on

his farm: Chestnut, Horse Chestnut, Butternut, Beechnut and Heartnut. I learned that there are more than one variety of Walnut and Hickory Nut and that some develop more "meat" such as the Weshcke Walnut.

Dan has a way about him that puts you at ease and makes you feel comfortable. I felt as if I was talking with an old friend. His warm smile and eyes display a quiet strength; a strength which motivates him to fulfill his life long goal to assist in eradicating the hunger of the world.

We walked over to his favorite spot on the farm. A clearing amongst the nut trees, surrounded by wild flowers with their vibrant colors sparkling in the sun. He requested that we sit on an old tree trunk. This is the spot where Dan goes to collect himself during those difficult times and as I looked at him, I could feel the compassion this man has for life and Nature.

Dan shared the fact that he does a lot of negotiating for business from around the world. Recently, he's had representatives from England, Mexico and Japan come to his farm at Riverfalls. He had them stay in his log cabin not far from this special spot. Dan loves to take his guests out into nature because it removes the formal atmosphere and helps everyone to relax. Looking around at this spot, I can understand why he feels this way. In 1980, Carlson incorporated, and now has patents in 35 countries. And what are the results? A Pennsylvania alfalfa grower wins every contest, both for growth and nutrition. A cauliflower box which normally contains a dozen heads, only holds four heads of "Sonic Bloom" cauliflower heads. Soybean plants produce up to 300 pods per plant (30 to 35 is normal). (The beans treated in Wisconsin contained 27% protein against a normal 15%.) Dill plants over four feet tall. Calla lilies over six feet tall. Bell pepper plants bearing over 50 peppers per plant.

Sonic Bloom's ingredients are "generally recognized as safe", says Carlson, and have been approved by different organic growers associations. Also, the shelf life of Sonic Bloom produce is longer because there is more nutrition and trace minerals in each head of lettuce, tomato or watermelon.

Another benefit from Sonic Bloom is that, because the plant takes its nutrients through its leaves and is absorbed throughout the whole plant, including its roots, the nutritional value of the soil actually improves.

Gabriel Howearth moved to San Juan Pueblo, New Mexico in 1984. Among other things, Howearth introduced amaranth, a high protein grain. The soil was alkaline clay-loam or adobe-sandy with a PH ranging from 7.7 to 7.9. Sonic Bloom increased the average yield from 1600 to 2600 pounds per acre and reduced the maturity time by 15 days. It's obvious that Carlson's main focus is still on feeding the hungry, as well as growing food on poor soil.

He is also involved in an experiment in Israel where they are trying to increase production of endangered African trees.

Another interesting project Dan is working on is with the Chinese government dealing with the province of Sinhiang of Inner Mongolia. The Chinese government has sent representatives to Riverfalls to work with Dan on improving their crop yields. He is showing them he can grow plants in the worst areas of the world. His rewards come from the awareness that, "He is starting to feed people!"

He is also treating yew trees with Sonic Bloom. There is an extract from the bark that is showing promise in curing cancer. With Sonic Bloom, he is able to get the taxol into the needles; thus eliminating the need to kill the tree to obtain the taxol. In experiments he has been able to triple production of the taxol. Always the humanitarian, he says, "That means three times more people can be helped."

He recently returned from the Philippines where he was asked to advise them on what can now be done after the devastating volcanic eruptions. Many times the soil is improved as in what happened at Mt. St. Helens in the United States. But the Mt. Pinatubo

eruption contained sulfur dioxide, which is poisonous.

Dan showed us pictures from the Philippines with 15 feet of ash on the ground covering all life in the mountains. A million and a half people were relocated in Manila from the June 14, 1991 disaster. A local university leader arranged to bring Dan in on a 4-wheel drive caravan to this devastated area where they are trying to recover and grow new vegetation. He went there to show them how his technique grows new plants. The special music aids in the absorption of nutrients and allows the plants to translocate the nutrients down into the soil and become accustomed to the toxins. He has been working with reclaiming soil from volcanic devastation for a few years now, with great success.

Dan's witty sense of humor showed when he talked about how he views reclaiming devastated soil. He calls his attitude the "Robin Hood Approach", where he robs from the rich (brings in nutrients) and gives to the poor (the depleated soil). Dan giggled with the thought.

Carlson said that not only did it affect the Philippines, but it also threw vast amounts of sulfur dioxide iinto the upper atmosphere and we may be affected by it in the future.

One current event Dan is extremely excited about is the annual Chelsea Flower Show in England. He has been invited to the biggest horticultural show in the world. This 23 acre flower show is called the "Show of Shows"! Dan is thrilled with his invitation, for it represents a recognition for his work and products. On display will be his own rose bushes which yield 67 - 70 flowers per bush as opposed to 8 - 10 from a normal rose plant. In listening to Dan, I could hear the sound of a deep satisfaction in his voice as he said, "This show gives me the chance to share my joy with the world!"

Not all of his experiments are of a serious nature. Years ago his wife allowed him to try Sonic Bloom on her passion plant. Although it normally grows to about 18 inches, the more often he treated it, the more it grew. By the time the Guiness Book of World Records came to measure it, the plant was over 1300 feet long.

When we visited him at his nut farm, near River Falls, WI., Carlson's knowledge and love of the land and trees were very apparent. The farm is an experiment, as well as a relaxation for this dynamic man.

One would think that the nut farm was his full time occupation. But, this is not so. His full time work is still "Sonic Bloom". Even after 30 years he is still excited by his quest.

Dale Lucht has a BS in Agricultural Journalism. He is interested in Native American traditions including sweat lodges, pipe ceremonies, and the medicine wheel.

Esther Turner is the Account Executive for NEW AVENUES and owner of CONCEPT CONNECTIONS.
She worked for Madison Magazine, along with the Janesville Gazette. She is the mother of two college-age children, Heidi and Toby and cat Reiko.

October 25, 1991

Tim Gillaspie, Vice President
D.C.S.E., Inc.
708 - 119th Lane, N.E.
Blaine, MN 55434

Dear Tim:

The Organic Growers and Buyers Association Certification Committee has reviewed and approved Sonic Bloom for use by those requesting OGBA approved products. This approval is not an endorsement, but an indication that your product meets OGBA Standards.

Our approved products are always in a process of review and subject to OFPANA guidelines and Federal Standards as they are developed.

Your product will appear on our Approved Product List.

Sincerely,

Yvonne W. Buckley

Yvonne W. Buckley, Executive Director
ORGANIC GROWERS AND BUYERS ASSOCIATION

YB/scm

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SONIC NEWS

Spring 1995 Volume 1 Issue 1

Bio Synergy Australia Pty. Ltd. • P.O. Box 430, Noosa Heads, Q, 4567 • Ph./Fax: (074) 49 1837

Bloomers Celebrate Successes

Welcome to the first edition of our newsletter! Spring is just around the corner, so this update may be timely for those growers planning their strategy for the coming season.

There has been a lot to report from our past few months. The many successes flowing in from throughout Australasia are proving extremely satisfying. These growers are essentially pioneers with this new technology, and we feel they truly deserve all the success they have achieved.

Regular contact with clients has highlighted the fact that Sonic Bloom does involve a learning curve, and we believe that we can shorten the learning experience by providing regular updates and sharing growers' experiences.

This will hopefully ensure that all Sonic Bloom clients are receiving maximum benefit from this unique product. In this context we would really appreciate any information that you may feel inclined to share.

The media has embraced the concept, and in recent months coverage has been phenomenal, particularly since the local results have been so good.

"These growers are essentially pioneers with this new technology, and we feel they truly deserve all the success they have achieved."

The remarkable commercial results achieved during this first year suggest that Sonic Bloom now appears poised to become a potent force in Australian horticulture. We are celebrating the acquisition of marketing rights for a further five States. Our decision to expand was based upon both these results and excellent re-orders. □

Australasian Successes On Film "Shooting The Bloom"

An Australian film crew recently toured Queensland, Northern New South Wales and New Zealand to interview commercial growers, and capture their successes on film. Many thanks to those generous pioneers who were willing to share their discoveries.

A portion of this film has been edited, but tragically the film-makers involved lost their home, studio and equipment to a mysterious house fire several weeks ago. The master copies of much of the Sonic Bloom footage were destroyed in the fire. One unedited copy remains from which we will salvage what we can. We sincerely thank the film-makers and wish them a rapid recovery from this disaster. After editing we should have local crop footage for the following: **Grapes, zucchinis, mandarins, flowers, lemons, silverbeet, macadamias, mangoes, paw paws, eucalypts, soybeans, sugar cane, persimmons, capsicums, strawberries, organic vegetables and palms.** We will advise you when these videos are available. □

Commercial Flowers - Bloom At It's Best

One example we encountered during the filming, was the case of a very good grower who experimented with Sonic Bloom and was pleasantly surprised with the extent of his gains. This New South Wales commercial flower grower was already achieving excellent yields and good turn-around time.

Despite what appeared to be near maximum performance, this progressive grower still began a Sonic Bloom treatment programme. These were his rewards:

* He has not only achieved double production figures with chrysanthemums, but he has reduced his maturity time from 10 weeks down to 6 weeks.
* He is now able to achieve sufficient stem length with asters to avoid the normal use of grow lights in winter.
* He is spraying a lot less than normal because of the reduction of pest and disease problems.
* The overall faster turn-around time in his greenhouses is now providing him with one extra crop per year.
* Finally, his eucalypts, which are grown as a foliage crop, have produced 14 ft. of growth in just nine months!

For a successful and experienced grower these results are simply outstanding. ◻

The Best Get Better

There have been so many different benefits attributed to Sonic Bloom by these first year growers. To the best of my knowledge there has never been a product that could provide such a wide variety of benefits. One trend that is becoming apparent is this: The better the growing conditions, the bigger the improvements provided by Sonic Bloom. In short - the better the grower, the better the result.

By contrast, those growers using the system as a problem solver or miracle cure have not achieved the same level of success. There may be some temporary and sometimes quite remarkable results in these cases, but in general the original problem, the reason for previous poor performance, should always be confronted. This may involve soil testing, leaf analysis and / or expert advice. ◻

The Fear Merchants

Having had the opportunity to witness the horticultural scene in general, it is hard not to notice the negative approach employed by the majority of agricultural companies. There is the overwhelming impression in the advertising literature that growing success is solely based upon desperate stop-gap techniques. The prevailing sentiment seems to be: "If you don't do this, then this will happen." Fear becomes the motivating factor in farm management. When the country is crying out for a holistic, preventative approach to agriculture we seem trapped in a system where all of our strategies are geared toward treating symptoms. We throw our chemical cocktails, in ever increasing amounts at ever increasing problems and rarely ask why. ◻

"If you don't do this, then this will happen." Fear becomes the motivating factor ...

Ag-Shows Benefit Us All

We have exhibited at all of the major Ag-Shows this season. Thanks to all of those who took the time to drop in and meet us, these shows have proven a real pleasure. We seize the opportunity to learn as much as possible about the many and varied growing enterprises with which we are involved.

We really appreciate the help and information provided by so many of you. Hopefully we've also been able to provide some handy tips to some of you. It has been gratifying to have received so much positive feed-back from Sonic Bloom clients during these shows. None of us can recall having encountered a single dissatisfied grower during the show circuit.

It has been interesting to observe the reduction in scepticism, now that we are getting some runs on the board. The mere fact that we are reappearing at many of the shows for a second year, when ag-business involves so many fly-by-nighters, appears sufficient to enhance our credibility in some eyes. The last shows of the season are Rockhampton and Toowoomba in early September. See you there! ◻

A leading Qld. strawberry grower reaps the Sonic rewards. His California "Parker" variety produced counts of up to 60 flowers and fruit per plant!

Sonic Super Seeds

Our travels have revealed that some growers growing from seed have not yet tried the Sonic Bloom seed treatment technique. There are tremendous benefits to be had from this treatment and it really is quite simple.

Apart from one or two exceptions the technique involves soaking the seed in a 500:1 solution of Sonic Bloom and water while playing the sound for eight hours. Seeds that are difficult to handle, like lettuce or flowers, can be planted into cell trays and thoroughly watered with the 500:1 solution. Once again, eight hours of sound stimulation will provide remarkable results. Apart from earlier germination and a much better germination rate the seedlings themselves are provided with a vigorous kick-start.

While on the subject of seeds, we must stress the value of saving seeds from Sonic Bloom treated parent plants. These seeds will normally grow into superior plants to the parents, especially if further treated with Sonic Bloom. Even hybrids have been shown to display this "geometric progression" ◻

The Cutting Edge

Cuttings involve the same dilution rate as seeds. It is always better to take cuttings from a Sonic Bloom treated parent plant where possible. If not then try applying the spray to the plant a few days prior to taking cuttings. This should help the cutting establish itself better.

Cuttings should be sprayed once a week with a 500:1 solution of Sonic Bloom until established. They can then be sprayed every 7 to 10 days at a 250:1 dilution rate. ◻

Spray Programmes Are Not Bibles

Spray programmes are only intended as a general guideline. Even crop specific programmes only involve suggested cost effective spray rates. Some of our astute growers have realised this and were able to obtain desired fruit size, higher brix levels and induced maturity by applying additional sprays in the weeks before harvest. This sort of fine tuning comes with experience and is also determined by the dollar value of the crop. Small crops and vine crops, for example, are high dollar value crops which allow extra sprays, especially considering that the cost of Sonic Bloom treatment usually represents less than 3% of the total gross yield value.

We anticipate producing a complete Sonic Bloom spray programme booklet which will contain all the various spray programmes, as well as spraying hints, etc.. This should simplify things for all growers and could be particularly useful for those growers who diversify into other crops in the future. ◻

A record lemon crop in a North Coast citrus orchard - good, even sized fruit

Sonic Doom - A Cleaner Kill

It appears that not all herbicide users are taking advantage of the **Sonic Doom** method. This technique involves a reduction of herbicide usage by at least 50%. In fact, we have new trial reports from the USA, conducted by the prestigious Acres Magazine, which document success at levels as low as 25% of the standard label rate. Here is your chance to save considerable amounts of money and to take better care of your environment.

You should already have the instructions to use this method of weed-killing, but the main points to remember are these.

* Run the sound unit in the immediate area to be sprayed for **45 minutes** prior to application of spray.
* Add a little Sonic Bloom nutrient to the herbicide (this assists absorption as it tricks the plant into feeding).
* Continue to operate the sound during spraying and for one hour afterwards.

Some of the benefits include a total kill of even hard to kill, mature weeds, and it doesn't matter if it rains one hour after application.

The Sonic Doom technique has proven an ideal simple trial to demonstrate the increased absorption of the Sonic Bloom system ◻

Trees - A Kick Start

While the spray programme for mature trees involves a 5 or 7 spray option, it is different with seedlings and young trees. There are considerable benefits to be gained from monthly sprays during the growing season. Many growers are reporting a double growth rate when using this programme. The economics of monthly sprays for young trees are good because of their size. A total cost of $70 per acre per year is common ◻

Home Garden Hints

While we have largely concentrated on the commercial clients so far in this update we shall always reserve this page specifically for our home gardeners.

It became apparent, during research for the recent television coverage, that there are several factors that should be addressed with regard to the Sonic Bloom Home and Garden Kits. When phoning around for filmable results amongst some of our clients we discovered that despite good initial results some gardeners had "shed-shelved" the kits because they did not feel they had time to provide the daily sound stimulation they believe necessary for success. There are some important facts that may help resurrect some of these abandoned kits which we will cover here.

"The Sonic Bloom play, spray and grow need only involve as little as one hour per week."

The absolute maximum result can be expected from daily sound stimulation - a daily dose of "sonic music" dramatically increases absorption of dew, which contains free floating nutrients capable of providing an increased growth response. However, the main point of the music is to use it as a tool to increase the uptake of the Sonic Bloom nutrient.

If you only use the sound before, during and after spraying you will still achieve impressive results. It doesn't have to become a time consuming chore in busy lives. The Sonic Bloom play, spray and grow need only involve as little as one hour per week.

The fine mist sprayer included in the Home and Garden Kit is really only intended for use with indoor plants or the occasional outdoor favourite. It is really not the ideal equipment for larger blocks. I met a woman at one of the shows who was spraying an entire 1/2 acre garden with this toy! She complained of a sore spraying hand - I'm still recovering from her handshake. She had developed a Schwarzenegger sized right hand which dwarfed her petite, feminine left hand. The upside was that she no longer needed a nutcracker for macadamias. Seriously, though, a larger pump up sprayer or back pack is more suitable and a lot faster for larger areas.

There are some handy hints which can help take the human element out of providing sound stimulation, and these include:

* **240 Volt timers** are available for as little as $18 from larger department stores and electronic shops. These units will turn your sound system on automatically each morning and serenade your garden while you sleep.

* Little **metal outdoor speakers** are actually ideal for the sound. They can be hung from a tree in the growing area and be connected to your lounge room stereo to transmit your automatic, daily sound dose.

* **Garage Sales** are the ideal place to find very cheap second-hand stereo speakers and tape decks. I recently purchased a Sony reverse play portable stereo in perfect working order for just $15 at one of these sales!

* **A reverse play cassette deck** is important if you wish to employ the Sonic Bloom seed treatment technique. Soaking the seeds in a 500 l nutrient solution and playing the sound for eight hours can be difficult if you have to constantly turn over the cassette. Similarly, the automatic, daily sound dose can be extended if the cassette replays itself. Once again, this equipment needn't be expensive. One of our clients uses an old reverse play car stereo set up in his shed.

Essentially we are trying to ensure that these Home and Garden Kits are viewed as an asset for yourself and your family. Here is the opportunity to produce an abundance of champagne vegetables, productive fruit trees, glorious flowers and luxuriant house plants. **Seize it, don't shelve it!** □

Evelyn's Paradise

One of our most successful home gardeners is Evelyn Green of Mt. Tamborine. She owns a spectacular mountain top property where she has created Eden-like surroundings with the help of Sonic Bloom. Her vegetable garden is so productive that it enables her to provide a neighbouring restaurant with fresh produce daily.

The restaurant, "Songbirds", has won several awards based on the incredible taste of their salads and vegetables. I really recommend a visit if you are in that area. □

Monster lettuces, grown at a Sunshine Coast home garden - not only huge, but tremendously tasty, pest free and with twice the shelf-life.

Bloom's Best - Great Jokes revisited

We will regularly feature our favourites on pages 5 and 6 for your enjoyment

Three Sydney Harbour Bridge painters were perched precariously on a girder, 300 ft. above the bridge traffic, about to begin lunch.

They included an American named Hank, an Australian named Shane and an Irishman named Paddy. Hank was the first to open his lunch box: "It's goddamned salami again!" he snarled. "30 years I've been married and everyday I get the same sandwiches. I hate salami! I tell you both now! - If I open this box and find the same thing tomorrow, I'll be over the side!"

Shane and Paddy nodded agreement and opened their boxes. "Bloody Vegemite!" screeched Shane, "25 years! - And she still doesn't know what I hate! Okay, mate, if there is no change tomorrow I'll jump with you!" Paddy held up his sandwich with a look of total disgust. "A Potato sandwich again! All me life they've been feeding me the stuff. What do they think I am, some sort of spud sucking moron. Okay, boyos, I'm with you!"

The next day arrived. The boys had done their best to provide the necessary hints for a lunch menu change. Hank opened his box, held up a sandwich, looked over at his workmates in disbelief and, with a fading scream of "Salami - you biiiiiiiiiiiiiiiiitch!" he plunged to his death.

Shane opened his box and his face dropped at the sight of the familiar black goo. Being a man of his word he farewelled his mate and took the big jump. Paddy slowly opened his box. He sniffed around the edges for a while and then finally revealed the contents, and there they were - two pieces of white bread wrapped around some inch thick spud slabs.

He looked down at the squish marks on the bridge road below and then back at the spud snack. You could have bottled that look of horror as he flung the offending monstrosity over the side and quickly followed with a silent swan dive to the concrete kiss.

Three days later, at the joint funeral, the three grieving widows where sharing their sorrow. "If I'd only known what he was feeling," wailed Hank's wife. "I made him a salami sandwich on our first date, and he said he loved it. How would I know he had changed?"

"I know, I know," sobbed Shane's wife, "I made him vegemite sandwiches on our honeymoon, and he raved about them. Why didn't he just tell me?" They both turned to Paddy's wife - "It's a real mystery to me, too," she said. "Paddy always made his own lunch." □

You are in terrible shape," the doctor told his patient, "you are a heart attack waiting to happen, and unless you make some drastic changes in your lifestyle you'll be dead within a month." "Jeez, Doc!" exclaimed the devastated patient, "What do you want me to do?"

"Well," said the doctor, "first you must get your wife to cook you nourishing, healthy meals. Then you've got to cut right back on your working hours. Tell your wife you have to budget carefully, so you won't have any money worries, cut down on your spending and have her keep the kids quiet while you are at home, so you can relax and put your feet up. No mowing the lawn, no doing the shopping and absolutely no helping your wife with the housework. It's either that or your wife will be coffin shopping by the end of next month."

"Gee, that sort of medicine will slide down pretty easy, after 20 years of hard labour," smiled the patient, "but it seem's an awful lot to ask of my wife all at once. Perhaps you could break the ice and tell her exactly what you've just told me?" "That shouldn't be a problem," offered the doctor.

The man arrived home and opened the door, almost excited about the coming changes. His wife rushed to him. "The doctor just rang," she said, "Oh you poor thing! Only one month left to live!" □

Tom was visiting his mate, Mick, who was in hospital and bandaged from head to toe. "What the hell happened to you, Mick?" he asked. "Did you get hit by a bus?" "No, mate," Mick replied, "A walkman did this to me." "You mean one of them tiny little radios? How come?"

"Well," said Mick, "it was like this, see ... I bought the wife a walkman for her birthday, and she loved it so much she had the headphones on all the time. Got up my nose a bit, I can tell you. She never said a word, just listened to music all day long. No conversation, she couldn't hear a word I said."

"Anyway, last night, when I got home from the pub, I thought I might as well tell her a few home truths, seeing as she wouldn't hear me. "Yes, you old battle-axe," I said as I came in the door, "here I am, late and off my face, and I don't give a damn, you fat, ugly bag of chookpoo."

And you know what? I forgot to get whatever it was you asked me to buy on my way home. What was it, eh? Crack-filler for your ugly face? Vanishing cream for your mother? Or some more food that you can turn into inedible muck, you silly, old cow?"

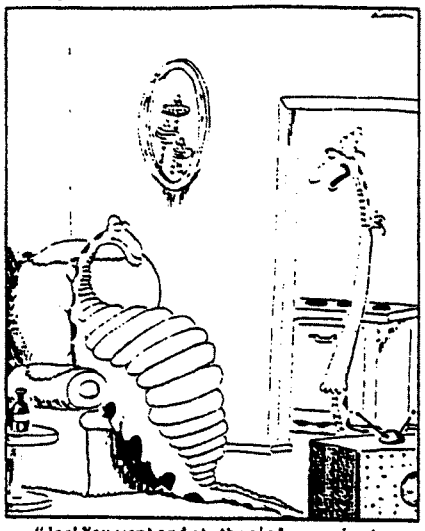
"A glaring face greeted me: "No, love, - new batteries for my walkman!" □

A struggling farmer in a battered, old hat arrived in town and went straight to the bank. "I'd like to see the manager," he said. "I'm sorry, Sir, but I regret to tell you that the manager died of a heart attack this morning."

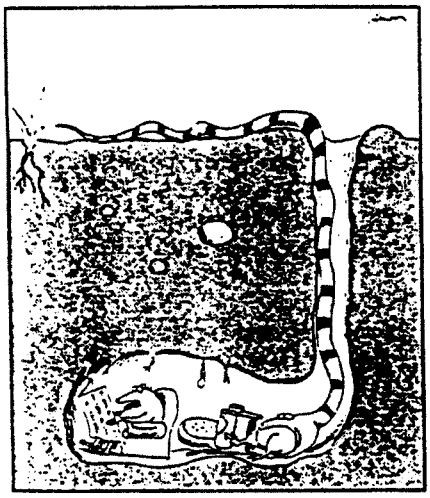
The next day the farmer arrived at the bank again. "I'd like to see the manager," he said. "The manager is dead," the clerk answered. "I told you yesterday." But the following day the battered hat was back. "Sir, I've told you," said the clerk, "he's dead! Why on earth do you keep asking?"

"Oh," said the farmer, "I just like to hear you say it." □

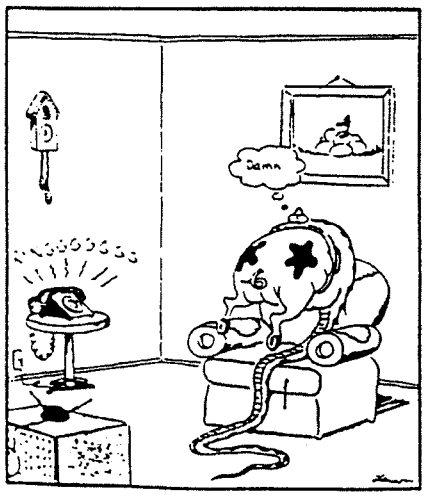
A Snake Trilogy
Gary Larson's Unique Humour



"Joe! You went and ate the pig I was going to serve this evening to the Macintyres?... Well, you just disgorge it – it should still be OK."



"Well, I'll be darned. Says here 70 percent of all accidents happen in the hole."



A fertiliser salesman arrived at a farmer's property to push the latest brew. The farmer was sitting on his verandah having lunch, as the salesman approached. The salesman, looking for an opening line, noticed a physically handicapped pig sitting beside the farmer.

"Good Morning," said the salesman. "Yep," said the farmer who didn't mince words. "I notice your pet pig has a leg missing. What on earth happened to him?" questioned the salesman.

"This pig, let me tell you about this pig," said the farmer. "Three weeks ago we had a break-out from the local prison. Three desperadoes arrived here while I was out. They cornered the Missus in the washhouse. Now, these creeps hadn't seen a woman for years and she was a goner.

Suddenly this pig here tears into the room, snarling and squealing like a rabid razor back. The tough boys ran off like scared rabbits. This pig is one special animal," he said affectionately, patting the animal as he spoke.

"That's amazing," said the salesman, "but how did he lose that leg?"

"This pig, let me tell you about this pig," repeated the farmer. "Two weeks ago the Missus left the window open in the baby's room. A bit of a breeze came up and the curtain blew up on to the kero-heater. The sound of the squeals woke us. We got the other kids out, but couldn't get through the blaze to save the baby.

Then this pig comes running through the flames, dragging the baby by it's jumpsuit, still gooing and gaaing like a beauty, she was. This little pet had even turned on the pump and dragged up the hoses, so we were able to save the house. This pig is one special animal," he repeated.

"Wow," said the salesman, but what about the missing leg?"

"This pig, let me tell you about this pig. Last week the kids were down by the dam playing. The young girl fell in , so the older two jumped in to save her. The problem was that none of the little blighters had ever learnt how to swim. I would have saved them, but I can't swim meself. There were just six little hands poking up out of that muddy water when the pig jumped in - saved them all, he did. Yep. This is one special animal."

"Yeah," said the salesman, but how did he lose that leg?"

"Well," said the farmer, reaching down again and stroking the pig. "If you had a pig this good, would you eat him all at once?" □

The father of two boys was worried about his two sons. One was a complete pessimist, the other an incurable optimist. Their attitudes were so extreme that the father decided that something had to be done. "I've decided that I'll give you an early birthday present tomorrow," announced the father.

The following morning the pessimist found his room bursting with video games, bikes, roller blades and all the latest high-tech toys. The optimist was told his present was to be found in the garage. Upon opening the garage door the boy discovered a huge pile of fresh horsepoo.

The father waited for an hour and then checked out his little levelling experiment. He found the pessimist sitting staring at the toys, crying uncontrollably. "Why aren't you playing with your new toys?" demanded the father. "If I'll play with them then they will only break, and I'll have nothing to do" the lad wailed.

Shaking his head the father went out to the garage, where he found the optimist son shoulder-deep in steaming dung. "What on earth are you doing," the father cried. "Oh, Daddy, Daddy," the boy beamed, "I just know there's a pony in here somewhere!" □

The young wive, pregnant with her first child, was making one of her regular visits to the doctor. Everything was in order, and when the examination was over, the young wife shyly asked: "Um, my husband want's me to ask you ..."

"I know, I know," the doctor said, placing a reassuring hand on her shoulder. "I get asked that question all the time - and believe me - there are no problems with sex until later in the pregnancy." "No, that's not it," the young wife interrupted. "My husband wanted to know, if it was okay for me to keep on hand-mowing the acreage." □

The Golden Rule -

"Never Apply Anything At All, Except Sonic Bloom, While The Sound Unit Is On"

We have often noticed raised eyebrows when we have tried to impress this point upon clients: The obvious assumption is that this rule represents some sort of trickery to ensure continued sales of the Sonic Bloom nutrient. After 15 months of local experience we can assure the sceptics that there is now a variety of local evidence which supports the integrity of this claim.

The rule breakers have paid the price with consequences ranging from slowed growth to total death. (It seems a bit of a harsh penalty, I must admit, to face dwarfism or the grim reaper, just for experimenting, but that's how it is). No, seriously though, I'm talking crops, not people here.

I don't blame people for experimenting. I would possibly do the same myself if I didn't know better. But the point is that there really has been no research done on the use of other nutrients, or pesticides and fungicides, in conjunction with the sound. ◻

To Lease Or Not To Lease

It's probably a good time to point out that the main reason that the sound units are leased rather than sold outright is because the lease involves a minimum nutrient purchase.

"I don't blame people for experimenting, I would possibly do the same thing myself if I didn't know better."

This helps encourage the use of only the Sonic Bloom nutrient, and in turn this ensures good results with the system.

Dan Carlson, the system's inventor, initially sold the units outright. He found that often clients would use his carefully balanced nutrient the first season and achieve impressive results. The second season a percentage of growers would try an alternative foliar spray with the sound. They invariably achieved very little or a negative result.

In rural situations everyone is literally "looking over the fence" when a new technology is involved. When results are not forthcoming the grower involved rarely tells anyone that he abused the system by using another nutrient. Consequently there is always the likelihood of Sonic Bloom unfairly acquiring a bad reputation. The lease arrangement helps prevent this situation. It is a nuisance for us from a business point of view, because so much money is tied up in the sound units. It takes us 2 1/2 years to recover the cost of these units, but at least the integrity of the system is protected. ◻

The Rule Rules

Back to the Golden Rule - it's important to remember that the Sonic Bloom system is totally unique in that it increases the plant's absorption by up to 700%. This means that fungicides, etc. are going to enter the plant in greater amounts than was ever intended by the manufacturer. The same applies to liquid fertilisers. Using the sound units with liquid fertiliser is a real gamble. **Sonic Bloom is not a fertiliser, but rather a growth enhancer**. Most foliar fertilisers have far higher nitrogen levels. We have witnessed cases of sour fruit arising from too much foliar absorption of nitrogen. The only time we have supported using the sound unit with anything other than Sonic Bloom is for the weed-killing method called "Sonic Doom". ◻

The Capsicum Calamity

A graphic example of the dangers of misusing the sound comes from New Zealand. A commercial capsicum grower, who has been experiencing phenomenal success with Sonic Bloom, decided to experiment to possibly uncover yet another cost-saving feature of the system.

He figured that if he applied fungicide at a reduced rate to allow for the increased absorption, he would reduce chemical costs. He sprayed all of his plants in one of his greenhouses with a new organic fungicide, mixed at below label strength. Two weeks later every plant in the house was dead. The sound had turned the fungicide systemic, and it became as deadly as Round-up.

This grower, who had experienced an 80% yield increase with Sonic Bloom, rightly blamed himself for the disaster. However, there is a lesson here for all of us. ◻

The perfect sound unit set-up - solar panel, timer, deep cell battery and a 60 acre unit, 16 ft. high

Bloom Busters - Are You Getting The Best From Bloom? If Not, Why Not? Here Are The Answers:

Common Mistakes By First Time Users

* **Not running the sound for at least 20 minutes prior to spraying** (45 minutes is the optimum time.
* **Not mounting the sound unit on the tractor when spraying** (or mobilising the unit in the case of the 5 acre units). The importance of maximum sound at the time of spraying cannot be overemphasised.
* **Not mounting the sound unit at the recommended height** to provide full coverage.
* **Not mixing the nutrient correctly** (always shake the nutrient before use, add the nutrient to an empty tank and add water with pressure.
* **Applying fungicides, pesticides or other foliar fertilisers with the sound running.**
* **Spraying during unsuitable conditions.** Wind, rain, too cold or at the wrong time of the day, thus not allowing maximum absorption.
* **Spraying seeds and newly emerging seedlings with the incorrect dilution rate.** 500:1 is the correct rate, which is half the normal strength.
* **Not spraying to minimum guidelines.** There still exists a "magic beanstalk" mentality where people expect miracles from one or two sprays. If the programme specifies 5 or 6 sprays stick to it, and you will really know what you can achieve.
* **Not treating seeds** with Sonic Bloom prior to germination. There are tremendous gains to be had with rapid germination - high seed strike rates and earlier maturity at this vital stage.
* Not **saving seeds** or cuttings from treated plants for the next crop.
* **Using Sonic Bloom as a fertiliser replacement.** Sonic Bloom is an organic plant growth enhancer, not a fertiliser. The increase in foliage and root mass and heavier bearing with fruit and nuts often means that existing ground fertilisers are utilised more effectively.
* **Using water from a rusty tank** or container. The iron content neutralises the nutrient.
* Using the sound units in temperatures exceeding 32° Celsius. The open stomata can cause the plant to lose moisture, and the system becomes counterproductive.
* **Using water with a high pH-level.** The ideal level is between 6 and 7. Occasionally we encounter growers with levels of 8 to 10. In these cases the pH-level must be lowered to obtain maximum benefit from Sonic Bloom.
* **Operating the sound units for more than 12 hours per day.** The plants need a resting period. ◻

Use By Date

Sonic Bloom is totally organic and consequently will not keep indefinitely. After twelve months the nutrient can become up to 10% less effective. Storing the nutrient in a cool place out of direct sunlight helps. If you have nutrient which is 12 months old, we urge you to increase the application rate, e.g. a 6 spray programme can become an 8 spray programme, but don't increase the strength of the dilution rate. Avoid storing containers directly on concrete in order to maximise the shelf-life of the nutrient. ◻

Setting Up And Positioning Sound Units

The sound unit should be mounted on a pole which allows easy access to remove the unit for tractor mounting at the time of spraying. The ideal situation involves a separate sound unit for tractor mounting, but this is not always economically feasible. Often water pipe is bolted to a post at about 5 ft. high. The bolts can be loosened and the 10 ft. upper arm can be swung down to access the sound unit at spray time.

The best technique to decide perfect positioning is to simply walk around the outer limits of the treatment area. If you can hear the sound then it will be creating the desired effect.

Timers and solar panels can be both time savers, and they can ensure that the units operate in suitable conditions. **Heinz Hempel from Ausolar** in Brisbane has designed a range of panels and timers specifically for Sonic Bloom at a special price. He can be contacted by phoning (07) 888 5051. ◻

Cycads - even the world's slowest growing plants doubled their growth rate at Peter Heibloem's glorious Eudlo Cycad Gardens.

Sound Harvest - A Sweet Reward

The First Crops Are In And There Are Many Smiling Faces

The successes in this first year have been many and varied. A brief summary of some of the results (many of which are included in the new video) should provide an indication of the significance of this remarkable product. They include:

* **Mangoes:** A Gladstone grower reports the biggest, most saleable mango crop yet produced, despite the drought.

* **Macadamias:** A client from Amamoor, Qld, reports an excellent crop from unirrigated trees in an extremely dry year (Nearby growers in a similar situation lost a large percentage of their crop to the drought).

* **Grapes:** A New Zealand grower from the South Island reported triple yields of high quality fruit and incredibly rapid growth with young vines.

* **Watermelons:** Very early germination, extremely vigorous runners and a record crop in the drought were the rewards for a Chinchilla farmer.

* **Soybeans:** A Northern Rivers N.S.W. grower achieved a 350 % increase in pod counts.

* **Flowers:** An Alstonville commercial grower reported 150 % yield increases in chrysanthemums. Production time for other species was reduced by 40 %.

* **Lucerne:** Clients from Toowoomba and the Darling Downs report bigger crops in a shorter time.

* **Zucchinis:** A grower from Tamborine Village in South East Queensland was excited by 100 % germination with seed that had previously provided only 40 % germination and treated seedlings were far more advanced. The yield he achieved greatly exceeded that of previous years, despite drought conditions. This grower actually called a few days ago to tell us of his recent successes. His name is Alan McDougall, and he reported another remarkable zucchini crop with no irrigation or watering at all. He has been running the sound unit every night to benefit from the environmental moisture. He now calls his sound unit "the irrigator". This report suggests that the potential for Sonic Bloom in drought stricken areas is phenomenal.

* **Citrus:** A Sunshine Coast organic orchardist achieved 300 % yield increases and early maturity compared to his control plot.

* **Herbs:** South Australian lab tests have revealed a 400 % potency increase in Sonic Bloom treated medicinal herbs.

* **Exotic Tropical fruit:** An orchardist from Winellie in the Northern Territory reports dramatic results with every species he has tested. **Jack fruit**, for example, increased production from a poor crop last season to a record yield this season.

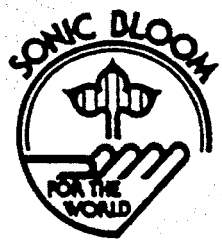
* **Persimmons:** Normally take four years to fruit; a grower from Waimuku in New Zealand reports fruit on 1 year old trees and his mature trees fruited earlier and more abundantly.

* **Roses:** A North Coast commercial grower reports exceptional growth and flower production equivalent to summer figures in ***mid winter (!)***. He also reports that since beginning the Sonic Bloom treatment, he now finds that he has virtually no short stems. This has all happened after just 7 weeks of treatment. □

Barry Shah from the Northern Territory sent us this photograph. This jackfruit tree had just four fruit last season, after only three sprays this was the result (38 fruit had already been removed before the photo).

Nutrient Analysis

We would like to encourage growers to do a nutrient analysis test on their treated fruit and vegetables and compare them with untreated produce. We would appreciate any findings you would like to share with us. Higher brix levels have already been reported by many growers. □



Dan Carlson Scientific Enterprises, Inc.

708 - 119th Lane N.E., Blaine, MN 55434
Phone: 612-757-8274 Fax: 715-425-1727

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QUANT.	DESCRIPTION	PRICE	AMOUNT	
	Extra Large Garden Kit - 20 oz. nutrient gives you 40 gallons of spray with cassette tape and misting head.	$ 60.00		
	20 oz. Nutrient Refill	$ 50.00		
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INNOVATION

AGRONOMIE

Bonnes vibrations

L'agronomie tire son épingle du jeu dans la course à l'innovation. Ecosonic et Médiamine, chacun dans son genre, sont deux très petites entreprises créées autour d'un projet innovant. Ni l'une ni l'autre n'a fait l'objet de dépôt de brevet, entrant plutôt dans le cadre de catégories évoquées par Hélène Salaville de l'Inpi. Leur démarrage n'en a pas pour autant été plus facile.

On en parle parfois au sujet des plantes d'appartement qui auraient une plus grande propension à s'épanouir au son de la musique. Yannick Van Doorne, ingénieur agronome installé à Châtillon/Chalaronne, a pris cette influence des séquences sonores sur les organismes vivants très au sérieux. Il en a fait son métier.

Surnommé le «bio» de sa promo, Yannick Van Doorne a hésité un temps avant de mener à son terme sa formation d'ingénieur agronome à Gand, en Belgique. «*J'ai été choqué d'apprendre que les pommes de terre, par exemple, étaient traitées après chaque pluie et non deux ou trois fois dans la saison, comme je l'imaginais*». Il choisit finalement de rester dans le système, se disant qu'il ne pourrait ainsi se voir reprocher de ne rien y connaître en agronomie, s'il réussissait un jour à mettre au point des techniques de culture alternatives.

Pour mémoriser rapidement les formules chimiques avec lesquelles il n'était pas en sympathie, il va puiser des techniques dans un livre consacré à l'espionnage. Il y tombe sur un chapitre consacré à l'effet de la musique sur la mémoire et sur les plantes. Il creuse le sujet, accumule peu à peu les références scientifiques. Si la physique quantique connaît bien le phénomène d'échange d'énergie entre la matière et les fréquences sonores (on connaît tous le verre de cristal qui se brise au son d'une voix ultra aiguë), la biologie n'a, pour sa part, jamais cherché à explorer cette voie.

En dernière année, il a choisi une option en agriculture tropicale qui est enseignée à la faculté de Gand. Il y rencontre un jeune enseignant bienveillant, qui va lui permettre de mener au laboratoire et dans les serres

crée une SARL en réunissant une dizaine d'actionnaires autour de la table. Il apprend aussi à accepter que le démarrage de son activité passe d'abord par d'autres produits. C'est ainsi que la SARL Ecosonic a fait ses premiers pas avec la commercialisation d'un système de traitement électromagnétique de l'eau d'irrigation, un produit d'origine suisse qui a aussi pour effet de stimuler enracinement, défenses naturelles et croissance des plantes. «*Le principe n'est pas nouveau puisqu'il était déjà employé au début du siècle dernier contre l'entartrage des canalisations des habitations. Il a été, par hasard, appliqué à l'agriculture et est exploité depuis*». Avec son fournisseur, il travaille aussi à la mise au point d'un autre système de traitement des cultures, qui serait en fait une améliora-

En quelques années, Yannick Van Doorne aura autant appris sur les hommes que sur les plantes.

ne voix ultra aiguë), la biologie n'a, pour sa part, jamais cherché à explorer cette voie.

En dernière année, il a choisi une option en agriculture tropicale qui est enseignée à la faculté de Gand. Il y rencontre un jeune enseignant bienveillant, qui va lui permettre de mener, au laboratoire et dans les serres de la fac, les expériences de son mémoire de fin d'études. Exposés six minutes à une séquence sonore, des plants de tomate vont croître de 20 % supplémentaires sur une même période. Il tente aussi d'agir sur la consommation d'eau (croissance identique avec deux fois moins d'eau), sur l'extension des cellules, etc. «*Plutôt que de stimuler avec un gène, on utilise le son pour agir sur les protéines de croissance de la plante*», résume-t-il.

Les résultats sont là mais sa soutenance va être un fiasco. Directeur de recherche et membres du jury mal à l'aise, personne ne veut le suivre dans son raisonnement. Il est recalé. Autour de lui, ses camarades de promotion l'encourageaient à ne prendre aucun risque, à décrocher son diplôme pour mener ensuite sa carrière comme bon lui semble. «*J'étais convaincu qu'en me soumettant tout de suite, je n'aurais ensuite plus l'énergie pour faire autre chose. Parce que la vie vous rattrape, vous entraîne dans sa spirale travail, famille, crédits,... et puis rien ne se passe*». Lui, a choisi le camp de l'autonomie matérielle (il a toujours travaillé en parallèle à ses études) et de la persévérance. Il représente son travail l'année suivante, après avoir refait quelques expériences. L'ambiance n'est plus la même le jour de la soutenance, le public est plus nombreux, intéressé. Il décroche son diplôme d'ingénieur... sans pour autant avoir décroché le soutien de ses pairs, comme on va le voir.

Il s'est déclaré en indépendant et vit de petits boulots, de travaux de jardin,... Il est un jour contacté par un physicien suisse, ancien élève du prix Nobel de physique français Louis de Broglie, qui a travaillé sur les fréquences. Il l'invite à gagner la Suisse pour y développer son entreprise. Il s'installe alors dans le pays de Gex. La structure d'accompagnement à la création de star-up, qui prend en main son dossier, appelle son ancienne école pour s'assurer du sérieux de son travail. Mais là-bas, personne n'en a soit disant entendu parler. Son projet tombe à l'eau.

Il vient alors à Châtillon/Chalaronne, bien situé selon lui et qui exige surtout un niveau de vie moins élevé.

«*J'étais jeune et j'avais finalement peu d'expérience*», reconnait-il. Il prend contact avec Centre Ain initiatives et part suivre la formation à la création d'entreprise proposée par l'EM Lyon. Il peaufine son projet, apprend le mode de fonctionnement des institutions françaises et

En quelques années, Yannick Van Doorne aura autant appris sur les hommes que sur les plantes.

tion d'un produit existant déjà en Espagne (financement PTR possible).

Ecosonic s'enracine donc doucement, même si, pour Yannick Van Doorne, tout cela est un peu loin de son sujet de mémoire. Néanmoins, les contacts qu'il établit ici et là lui permettent de commencer à se faire connaître. Car en plus des épreuves propres à tout créateur d'entreprise, Yannick Van Doorne doit affronter les réticences liées à son approche qui, pour le moins, bouscule l'ordre établi.

NB

Maïs, vigne, tomates se portent bien

Séquences musicales décodées qui aident des tomates hollandaises à lutter contre une épidémie virale, augmentation du taux de sucre de l'ordre de 5 % d'une parcelle de vigne suisse mal exposée, les travaux de Yannick Van Doorne font des «miracles».

Mais ce que l'on décrit aisément, depuis plusieurs décennies maintenant, dans un langage rationnel était instinctivement pratiqué par les Indiens d'Amérique centrale, pour permettre à leurs plantations de maïs, par exemple, de résister aux grandes sécheresses.

Optimisation des plantations, moindre utilisation d'engrais, pesticides et fongicides, économie de consommation d'eau,...on comprend pourquoi la technique de résonance électromagnétique suscite tant de résistances. Mais à l'heure des grands dangers pour la planète, ne serait-il pas temps?

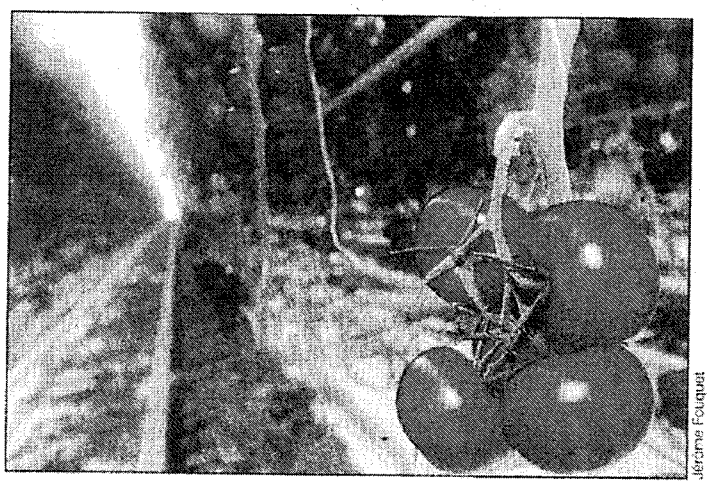
Des rosiers qui poussaient sans faire de bois ont aussi retrouver leur vigueur.

Erratum

Dans notre édition du 21 juillet dernier, nous avons malencontreusement donné par erreur le prénom «Fabienne» à Patricia Dornier, chargée de mission économie de proximité pour la SAEM Promobourg. Toutes nos excuses, pour cette coquille, à la principale intéressée ainsi qu'à nos lecteurs.

Des rendements améliorés

Des ondes au service des plantes



Jérôme Fouquet

Au Japon, par exemple, un émetteur d'ondes sonores est utilisé pour accroître le taux de sucre des tomates et leur donner meilleur goût.

Un appareil, émettant des ondes électromagnétiques au travers de l'eau d'irrigation, stimulerait la croissance et la résistance des plantes. Agriculture fiction ? Un maraîcher suisse y croit dur comme fer.

On connaissait certaines vaches dorlotées par la musique de Brahms ou de Mozart. Pourquoi pas des ondes bénéfiques au blé ou à l'orge ? L'idée paraît saugrenue, mais Yannick Van Doorne y croit fermement. Cet ingénieur industriel en agronomie est en train de créer une société, Ecosonic, afin de commercialiser un appareil, l'*Aqua-4D*, émettant des ondes électromagnétiques sur l'eau d'irrigation des plantes. Leur croissance et leur résistance s'en trouveraient stimulées.

Maraîcher en Suisse sur une exploitation de 12 ha, Maurice Dussey a installé cet appareil sur la moitié de ses surfaces. **« En 1999, j'avais un problème important d'insectes sur mes salades. Mes rendements avaient plongé. C'est pourquoi, je me suis tourné vers cette technique qui m'a permis d'augmenter mes rendements de 30 % »**, raconte-t-il. Différentes applications sont développées à travers le monde. Au Japon, par exemple, un émetteur d'ondes sonores est utilisé pour accroître le taux de sucre des tomates et leur donner meilleur goût. Il serait possible d'accroître la résistance à la sécheresse des plantes ou de favoriser la conservation des fruits et légumes.

La technologie des ondes électromagnétiques en est encore à ses balbutiements. Si elle fait ses preuves, elle ouvre une voie écologique pour répondre à la fois au besoin de production et au respect de l'environnement. De quoi répondre aux attentes de toute la filière agricole et agroalimentaire, du paysan au consommateur.

Marion IVALDI.

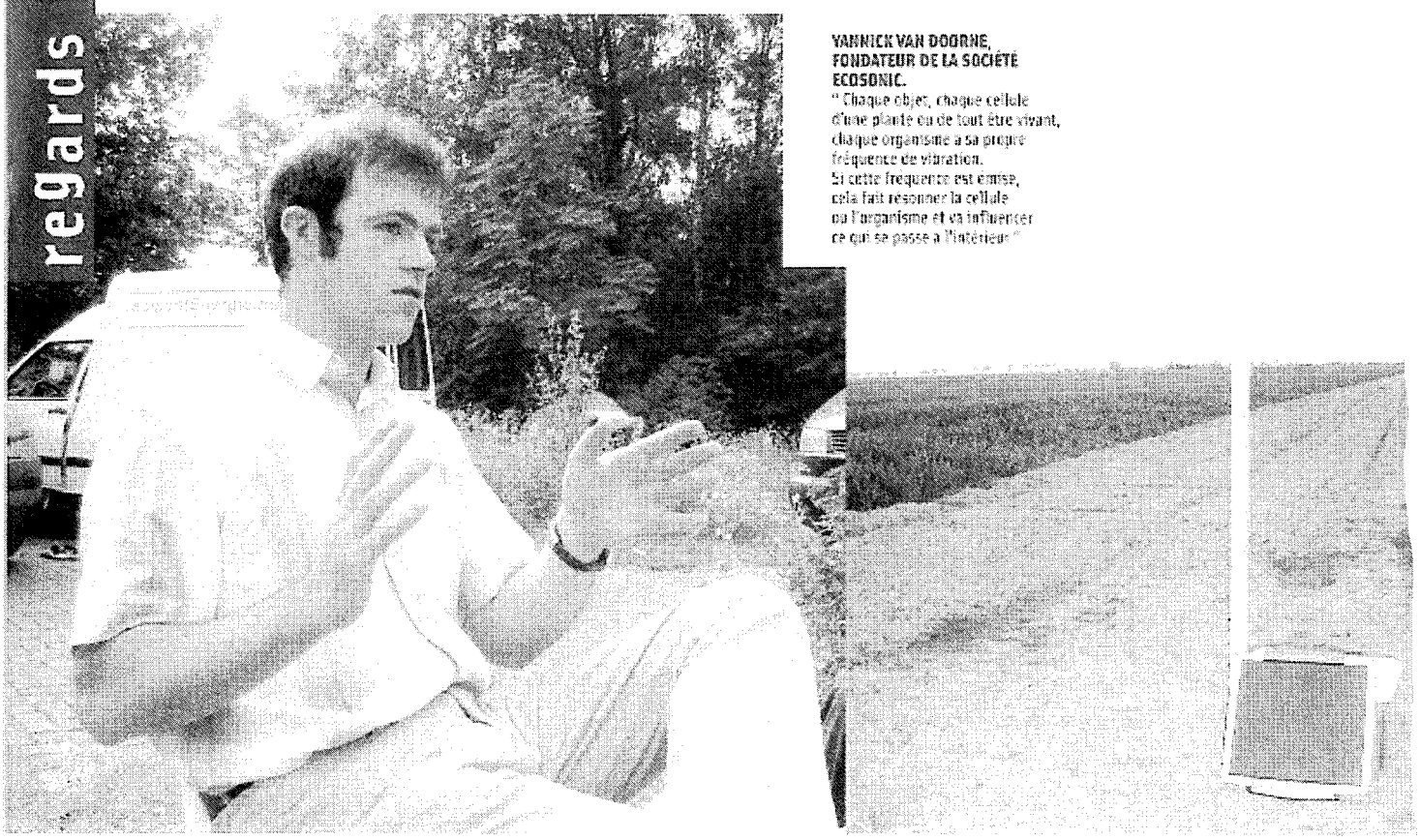
Source :
http://www.agriholland.nl/nieuws/artikel.html?id=1629&sid=6f0eb85cda35c08a58adda4a3f029340

07/08/1998

Tomaten houden van Vivaldi

Langzaam maar zeker komen ook in Griekenland de ecologische teelten tot ontwikkeling.
Het zijn vooral jonge en nieuwe boeren die de traditionele methoden vervangen door een milieu- en consumentvriendelijke aanpak. Diverse producten worden aldus geteeld, vooralsnog kleinschalig, w.o. katoen, paprika's, druiven en tomaten.
Naast natuurlijke bestuiving en bestrijding van schadelijke insecten heeft nu de muzikale groeibegeleiding zijn intrede gedaan. In een kas bij Nea Epidaurus (N.O. Peloponnesus) met een totale oppervlakte van 0,3 ha ontwikkelen zich op de klanken van Vivaldi, Chopin en Beethoven prachtige ecologische tomaten, goed van vorm en uitstekend van smaak. Een dagelijkse doses van zeven uur muziek zou de vruchtontwikkeling stimuleren. De opbrengst per stremma (0,1 ha.) met 6.500 planten beloopt 10 ton.
De regering stimuleert dergelijke experimenten, die passen in de campagne voor kwaliteitsverbetering van de producten en versterking van de concurrentiepositie.

LBActualiteiten 31/07/98



YANNICK VAN DOORNE, FONDATEUR DE LA SOCIÉTÉ ECOSONIC.
" Chaque objet, chaque cellule d'une plante ou de tout être vivant, chaque organisme a sa propre fréquence de vibration. Si cette fréquence est émise, cela fait résonner la cellule ou l'organisme et va influencer ce qui se passe à l'intérieur. "

De la musique pour soigner les vignes

EXPÉRIENCE ➲ La musique adoucirait-elle aussi la vigne ? Oui, selon Yannick Van Doorne qui installe au vignoble des hauts-parleurs afin de stimuler la production de protéines permettant de lutter, entre autres, contre les maladies fongiques. Vivaldi avait tout compris !

Quand il composa son " Printemps ", Vivaldi savait-il qu'avec sa musique il allait toucher au plus intime des êtres vivants ? Hasard, coïncidence ou parfaite communion avec la nature ? Près de quatre siècles plus tard, on a découvert que le fameux concerto recèle une succession de notes qui a le pouvoir d'activer, au cœur des plantes, la production d'une protéine correspondant à la fécondité. Tandis que chez l'homme, ces quelques notes de musique favorisent la production d'actine, une autre protéine essentielle pour l'architecture et le fonctionnement des muscles. Et voilà pourquoi Yannick Van Doorne, fondateur de la société Ecosonic (Ain), installe des haut-parleurs dans les vignes. " *À la fin de mes études d'ingénieur agronome en Belgique, je cherchais pour mon mémoire un sujet traitant de techniques alternatives aux produits chimiques pour lutter contre les maladies des plantes et c'est ainsi que je me suis intéressé à l'influence de la musique sur les végétaux.* "

Bien avant Vivaldi, les chamans de la forêt amazonienne avaient déjà découvert que des chants, modulés sur une certaine fréquence, pouvaient accélérer chez une plante particulière la production de substances médicamenteuses. Et à chaque plante, son chant. " *Chaque objet, chaque cellule d'une plante ou de tout être vivant, chaque organisme a sa propre fréquence de vibration. Si cette fréquence est émise, cela fait résonner la cellule ou l'organisme et va influencer ce qui se passe à l'intérieur* ", explique Yannick Van Doorne. Ainsi a-t-on pu expliquer pourquoi les harmoniques printanières de Vivaldi pouvaient stimuler l'activité reproductrice des plantes : les protéines d'un gène codant la synthèse d'une substance à l'intérieur d'un être vivant vibrent à certaines séquences sonores. En émettant celles-ci, on peut influencer l'expression du gène et donc le métabolisme de la plante. Sachant qu'une séquence sonore correspond à une protéine. " *On a retrouvé ces mêmes homologies entre les codes des protéines et les chants des indiens amazoniens obtenus après être entrés en transe à la recherche de l'esprit de la plante. Ce qui ne peut être dû au hasard puisque selon les probabilités, on a une chance sur plusieurs millions de trouver la bonne séquence. Aujourd'hui, c'est une technique très pointue qui nécessite d'avoir accès aux codes génétiques des protéines pour ensuite développer les séquences sonores correspondantes qui vont catalyser, stimuler, interagir ou éliminer les molécules ciblées. Chaque séquence va ainsi véhiculer une information.* "

INSTALLATION AU VIGNOBLE
Un à cinq haut-parleurs par hectare

YANNICK VAN DOORNE A CRÉÉ SA SOCIÉTÉ, ECOSONIC, il y a trois ans. Il se charge de produire les séquences sonores adéquates au problème rencontré et assure l'installation des haut-parleurs au vignoble. Ceux-ci ont été étudiés pour résister aux intempéries. Si la réalisation des séquences sonores n'est guère coûteuse, il faut compter plusieurs milliers d'euros pour disposer d'un équipement solide, durable et programmable voire même à distance via un téléphone portable ou internet. Les haut-parleurs sont disposés dans la parcelle de la façon la plus homogène possible à raison d'un à cinq par hectare en fonction de la topographie des lieux. L'intensité sonore émise varie selon les besoins. Il faut toutefois une intensité minimale mais qui ne dépasse pas les 100 décibels soit l'équivalent du bruit émis par un tracteur agricole. Il suffit en général de diffuser ces séquences quelques minutes par jour. Cette technique nécessite le respect d'un certain nombre de préconisations. Il est fortement déconseillé de s'exposer régulièrement aux mélodies diffusées puisque certaines peuvent influer sur le métabolisme humain.

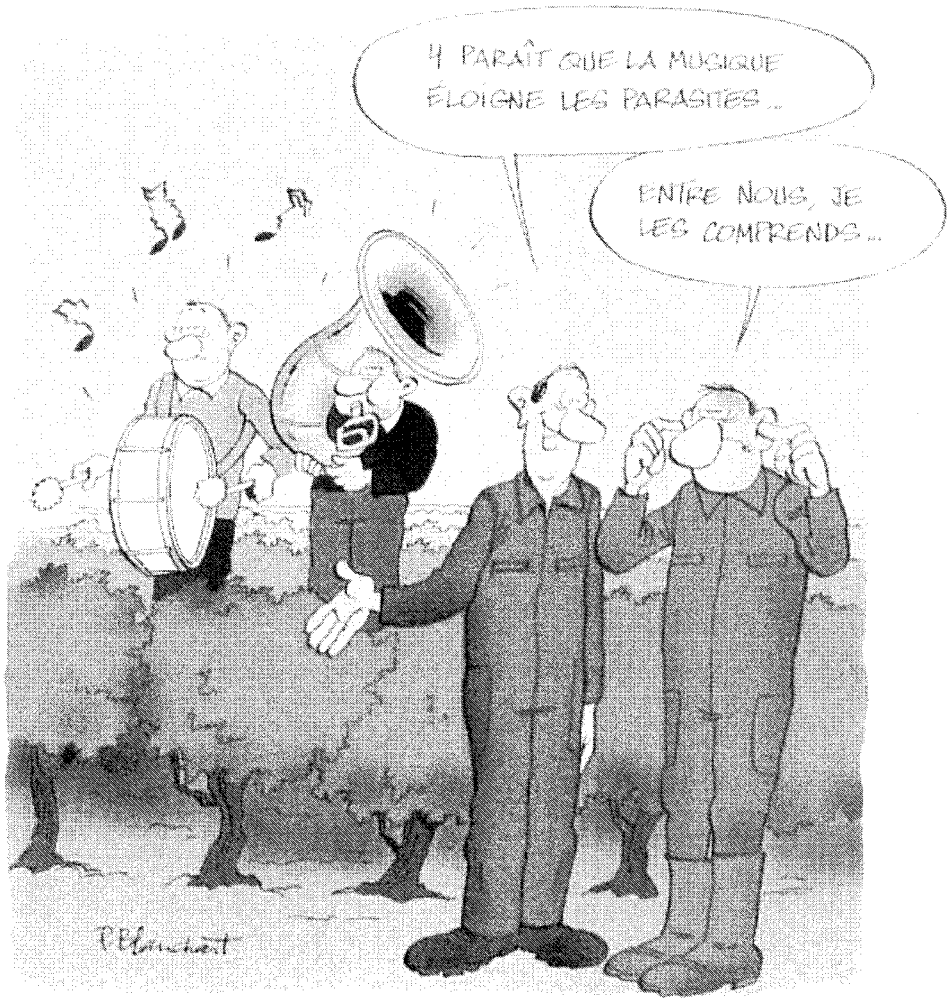
Ecosonic : www.ecosonic.net

> **En Suisse, trois années de suite, nous avons obtenu sur une même parcelle une augmentation du taux de sucre comprise entre 5 et 10 %**

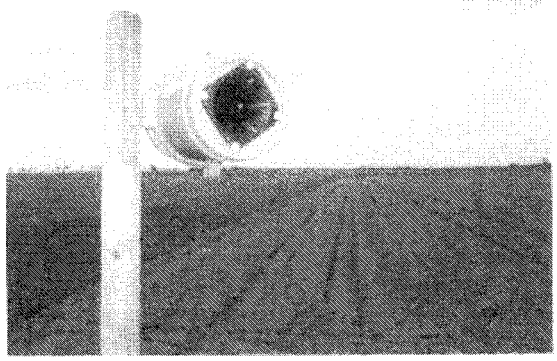
" Des compositions musicales comparables à des chants d'oiseaux "

Yannick Van Doorne travaille avec des musiciens pour réaliser ces séquences sonores dont certaines, par exemple, celles qui stimulent l'ouverture des stomates des feuilles, ressemblent à des chants d'oiseaux. " *L'art rejoint la science. Ce sont des compositions musicales très complexes, souvent mélodieuses mais impossibles à retranscrire. À une protéine, correspondent souvent plusieurs milliers de notes de musique.* " Et c'est ainsi que des haut-parleurs vont diffuser ces mélodies qui vont permettre de lutter contre le botrytis en stimulant chez la vigne la production de protéines de défense naturelle comme le resvératrol ou les flavonoïdes, d'accroître le taux de sucre dans les baies en influençant la synthèse d'enzymes, de traiter les maladies à virus comme les maladies du bois ou à phytoplasme comme la flavescence dorée, d'accroître l'absorption foliaire, d'éloigner les insectes, d'accroître la résistance de la vigne à la sécheresse... " *Cette technique permettrait de trouver des solutions contre toutes les maladies et de façon tout à fait écologique. La diffusion des séquences doit seulement être faite régulièrement. Pour augmenter le taux de sucre, par exemple, l'installation sonore doit être mise en place un mois ou deux avant la récolte et les séquences sonores doivent être diffusées une fois par jour.* " Yannick Van Doorne regrette qu'aucun organisme de recherche ne se soit investi dans ce domaine. " *Dans une conception classique, c'est difficile à accepter.* " Pourtant, il y a des résultats, affirme-t-il. " *En Suisse, trois années de suite, nous avons obtenu sur une même parcelle une augmentation du taux de sucre comprise entre 5 et 10 %.* " Certains ont déjà tenté l'aventure en France, en Suisse, au Canada mais reste à convaincre un plus grand nombre de vignerons que cette méthode 100 % naturelle marche. Peut-être qu'avec une séquence sonore bien inspirée...

CLAUDINE GALBRUN



Vos vignas ont-elles l'oreille musicale ?

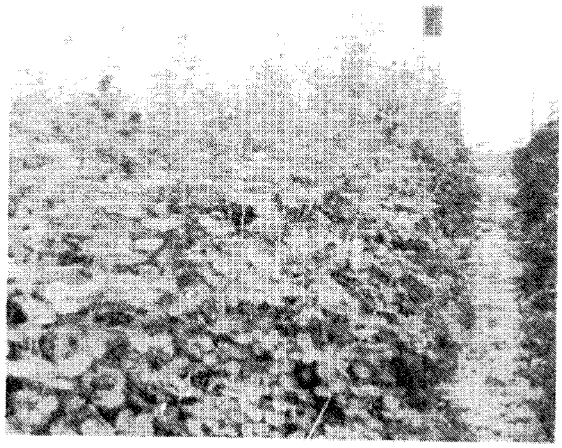


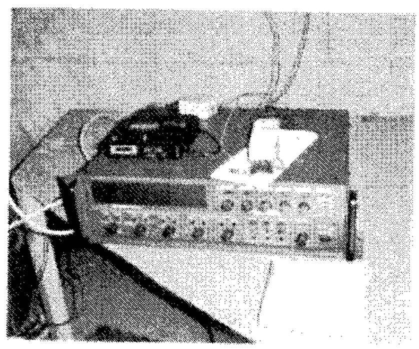
Les raisins mûriraient plus vite avec Mozart

Les bienfaits antigel de la musique

VIEILLES CROYANCES ET NOUVELLES EXPÉRIENCES...

Déjà dans la Bible, plusieurs textes font référence à la musique qui « adoucit » les mœurs et à son effet sédatif. Autre civilisation, et même intérêt pour la musique : dans les textes sacrés indiens, Krishna laisse jouer de la musique afin que la végétation de ses jardins soit de plus en plus luxuriante... Une méthode que l'on retrouve également consignée dans de vieux écrits japonais et coréens. Le docteur Singh, botaniste, il est vrai controversé, fut l'un des premiers au 20e siècle à s'intéresser d'un point de vue scientifique à la question. En 1963, il entreprend de faire écouter de la musique aux plantes et constate une croissance plus rapide et des plants plus robustes. Huit ans plus tard, c'est une Américaine, Dorothy Retallack, qui se lance dans une série d'expérimentations. Musicienne et biologiste, cette virtuose du piano décide de jouer pour ces plantes qu'elle a réunies dans une même pièce. Elle teste alors différents styles de musique et observe les conséquences sur ses plants. Après 2 ans de travail, elle conclut que la musique orientale, les Raga jouée par des instruments à cordes, double la production. Elle met aussi en évidence l'apport bénéfique de la musique classique et notamment les morceaux de Bach. Certaines musiques violentes, au contraire, type hard ou acide, provoqueraient à court ou long terme des lésions irréversibles (2). Plus scientifique : de 1990 à 1993, le groupe de recherche du botaniste Jean-Marie Pelt, alors président de l'Institut européen d'écologie, a voulu vérifier ses affirmations. Conclusion : oui, les plantes sont sensibles à la musique. Avec une observation : elles se dirigent vers la source musicale et elles n'ont pas de goûts standards. De leur côté, les Canadiens Weinberger et Measures constatent un effet positif sur la croissance du blé en hiver. En France, Joël Sternheimer est l'un des premiers à s'intéresser au phénomène et définit une sorte de mise en musique des protéines. Il formalise le lien entre musique et plantes. Aujourd'hui, plusieurs agronomes continuent les travaux sur ce sujet en se tournant, comme Yannick Van Doorne et sa société Ecosonic (infos : ecosonic.net) vers une application pratique de ces théories.





Élevées avec un complément musical, les plantes semblent plus vigoureuses.

Ci-contre : machine ecosonic

Jean-Marie Zerr à Dangolsheim

La vigne en musique

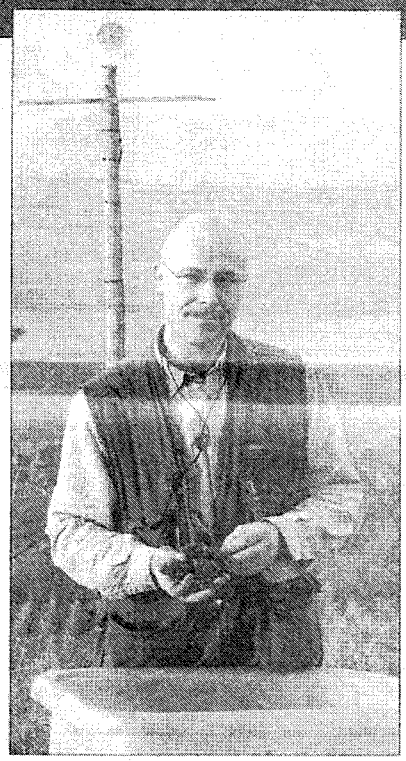
Jean-Marie Zerr à Dangolsheim

La vigne en musique

Jean-Marie Zerr, viticulteur à Dangolsheim, diffuse de la musique dans ses vignes. Un moyen, selon lui, d'améliorer la qualité des raisins. La presse s'est largement emparée de ce sujet insolite il y a deux semaines.

Les travaux s'appuient sur des études scientifiques, notamment celles de Joel Sternheimer, physicien français réputé.

Quelques applications sont proposées par la société Écosonic : www.ecosonic.net



Jean-Marie Zerr stimule certaines expressions de la vigne par des ondes sonores (Photos Marie Faggiano).

Insolite s'il en est, le sujet de l'impact des notes de musique (ondes sonores) sur le métabolisme biologique a largement été couvert par la presse régionale et nationale il y a deux semaines chez Jean-Marie Zerr, viticulteur à Dangolsheim et coopérateur de la cave du roi Dagobert à Traenheim. Opération marketing ? Probable, mais la coopérative n'a pas jugé bon de vinifier le vin à part et d'en faire "une cuvée pour musiciens".

En tout état de cause, Jean-Marie Zerr s'appuie sur de véritables études scientifiques de chercheurs qui observent l'effet des ondes acoustiques sur le métabolisme vivant. Plus précisément sur les travaux de Joël Sternheimer, docteur en physique à 23 ans et mathématicien français, qui a exercé ses talents aux Etats-Unis à Princeton en physique nucléaire au côté d'un certain Robert Oppenheimer avant de revenir en France. Ce dernier et Louis De Broglie, autre physicien réputé, lui conseillent de devenir chercheur indépendant, écrit-il sur son blog. Ce qu'il fait en alliant sa passion de la musique aux sciences biologiques dès le début des années 1970. Il décrit comment des ondes acoustiques *"constituent un mode de régulation de la synthèse protéique"*. Il multiplie ainsi des expériences en exposant des cultures cellulaires ou de bactéries à des ondes acoustiques, observe l'expression des gènes et la synthèse de protéines. Et même mieux, il met en équation mathématique ce phénomène. Des travaux qui déroutent la communauté scientifique, mais qui sont pris très au sérieux.

Dans une conférence à la foire écobiologique de Rouffach en 2002, Joël Sternheimer présente ces travaux. Mais il faut bien le dire, son langage scientifique demeure difficilement abordable pour le commun des mortels. Néanmoins, les études de ce chercheur trouvent aujourd'hui quelques applications. Ainsi est née la société Ecosonic. Yannick Van Doorne, ingénieur en biotechnologies, a par exemple exposé des tomates à des séquences sonores pour stimuler une protéine - l'extensine - responsable de l'allongement des cellules. Résultat, les cultures de tomates exposées aux ondes sont 30 cm plus longues que les témoins. Autre application, l'application d'une séquence sonore pour modifier l'expression du gène TAS14, lié à la résistance au stress hydrique. Yannick Van Doorne prétend diminuer ainsi les besoins en eau des cultures. Et quelques mémoires d'ingénieurs ont été publiés sur la question.

Chez Jean-Marie Zerr, l'usage de la musique et d'ondes sonores aurait permis d'améliorer la qualité aromatique des raisins. Reste à vérifier auprès des viticulteurs de Dangolsheim exploitant des vignes attenantes si les raisins se sont montrés plus aromatiques.

D. L

16 NOVEMBRE 2007. 41°

Jean-Marie Zerr

Il y a trois semaines, Jean-Marie Zerr, viticulteur à Dangolsheim, défraie la chronique avec ses vignes où il diffuse de la musique. Insolite, le sujet n'a pas échappé à la presse régionale et nationale qui s'en est fait largement l'écho. Supercherie ? Non, affirme ce viticulteur passionné par des techniques naturelles de culture qui se lance dans la viticulture biologique et les TCS pour ses cultures céréalières. Et de très sérieux scientifiques se penchent sur l'effet des ondes acoustiques sur le métabolisme. Certaines séquences sonores pourraient aider la vigne à lutter contre des stress abiotiques, comme le manque d'eau. Jean-Marie Zerr a donc installé une série de haut-parleurs sur la colline de Dangolsheim, et vendangé tardivement d'excellents gewurztraminers. Il faut dire que le millésime s'est prêté idéalement à des vendanges tardives de haute qualité. Il faudra attendre des millésimes moins favorables pour vérifier la réelle efficacité de cette méthode.

Lire en page 39

Baby erstickte in der Tiefkühltruhe

Mutter zu Haftstrafe verurteilt

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HARTHEIM (BZ). Der CDU-Aufnahmeantrag des Hartheimer Bürgermeisters Martin Singler sorgt für Ärger in der Partei: Der Landtagsabgeordnete Gundolf Fleischer hat den Vorstand der CDU im Kreis Breisgau-Hochschwarzwald aufgefordert, den Antrag abzulehnen. Der bislang parteilose Singler sagte, er wolle in die CDU eintreten, weil er sich davon Vorteile für seine Gemeinde erhoffe. Darüber ist Fleischer empört: Die CDU behandle alle Gemeinden gleich, so der Abgeordnete. Es bedürfe eines gehörigen Stücks Dreistigkeit, wenn ein Bürgermeister mit dieser Begründung in die Partei eintreten wolle.

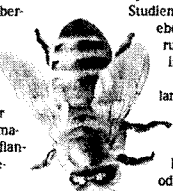
Nie wieder Clothianidin

Berufsimker wollen gegen Zulassung der Maisbeize klagen

VON UNSERER MITARBEITERIN SILVIA FALLER

FREIBURG. Der Deutsche Berufs- und Erwerbsimkerbund (DBIB) will gerichtlich gegen das Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BLV) vorgehen, sollte die Behörde die Zulassung des Maisbeizmittels Clothianidin wieder aktivieren. „Wir meinen, dass die bisherigen Prüfverfahren mit denen die Wirkungen von Pflanzenschutzmitteln auf Bienen und die Umwelt untersucht werden, unzureichend sind", erklärt Christoph Koch, Imker aus Oppenau im Ortenaukreis und DBIB-Vorstandsmitglied.

Er und seine Berufskollegen sind der Ansicht, dass die Behörden – darunter das baden-württembergische Ministerium Ländlicher Raum (MLR) das die Anwendung des umstrittenen Insektengifts im Gebiet Lahr angeordnet hatte – das Bienensterben zum Anlass nehmen sollten, nicht nur das Zulassungsverfahren, sondern auch die Anbaupraktiken zu überdenken. Im April und Mai dieses Jahres waren im Oberrheingebiet rund 11 000 Bienenvölker eingegangen. Das Beizmittel haftete nicht ausreichend stark an den Saatkörnern, weshalb giftiger Abriebstaub aus den Sämaschinen auf blühende Pflanzen gelangte (die BZ berichtete). Angewandt wurde das Clothianidin, weil im Sommer 2007 der Maiswurzelbohrer aufgetreten war. Dieser Schädling ist meldepflichtig.



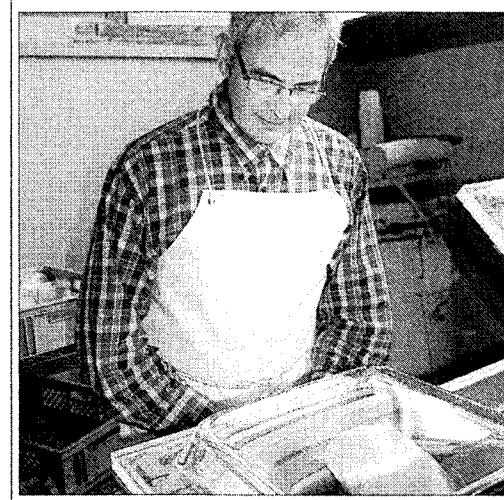
Am 24. Mai hat das Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz die Anwendung für die Dauer von sechs Monaten verboten. Doch ob dieses Verbot bestehen bleibt, ist noch offen. „Die Gespräche mit der Beizmittelindustrie und den Sämaschinenherstellern laufen noch", erklärt BVL-Sprecher Jochen Heimberg. Zwei Ansätze werden verfolgt, informiert Utz Klages, Sprecher von Bayer Crop Science. Einerseits werde die Qualitätskontrolle beim Beizprozess verbessert, zum andern könnten Sämaschinen so nachgerüstet werden, dass der Staub nicht mehr entweiche.

Der DBIB und auch der Landesverband Badischer Imker wollen darauf nicht vertrauen. Abgesehen davon werfen sie der Landesregierung vor, Erkenntnisse aus Italien nicht berücksichtigt zu haben. Bereits im Jahr 2002 waren in den Regionen Lombardei und Venetien Bienenvergiftungen durch Clothianidin und verwandte Wirkstoffe festgestellt worden. Der Befund war zwei Jahre später bei einer internationalen Fachtagung veröffentlicht worden, bei der auch ein Bienenwissenschaftler aus Baden-Württemberg teilgenommen hatte.

Diesem Vorwurf hält Joachim Hauck, Leiter der Abteilung Landwirtschaft im Stuttgarter Agrarministerium entgegen: „Es war ein Verdacht, der geäußert wurde, es gab keine wissenschaftlich fundierten Belege. Sonst wäre die italienische Regierung verpflichtet gewesen, den EU-Behörden die Bienenvergiftungen zu melden und auch wir hätten Kenntnis davon gehabt." Tatsächlich sind in Italien erst in den Jahren 2007 und 2008 behördliche Studien angelaufen; die italienische ebenso wie die deutsche Regierung hatte die Anwendung erst in diesem Jahr verboten.

Sollte das Verbot in Deutschland bestehen bleiben, gibt es die Möglichkeit, in Gebieten, in denen der Maiswurzelbohrer vorkommt, Fruchtwechsel vorzuschreiben oder mit Spezialschleppern während des Wachstums Insektizide auszubringen. Einige wenige Tiere wurden im Sommer 2008 in Mahlberg im Ortenaukreis und ein einzelner Käfer bei Leutkirch im Allgäu registriert. „Wir warten die Entscheidung des BVL ab, bevor wir eine Entscheidung treffen", sagt Joachim Hauck. Die Beizung sei im Vergleich zu anderen Pflanzenschutzmethoden sehr effizient, weil nur geringe Wirkstoffmengen benötigt werden und kein Sprühnebel entstehe. „Die Korrelation zwischen mangelnder Beizqualität und der Ausbringungspraxis einerseits und dem Bienensterben andererseits ist jedoch eine Tatsache, die wir nicht ausblenden", sagt er.

MENSCHEN VON HIER



Arsène Bingert hat ein wachsames Auge auf die Sauerkraut-Produktion.

Choucroute schießt mit Vivaldi ins Kraut

Arsène Bingert produziert nach anthroposophischen Ideen

ERSTEIN. Bis Ende Dezember wird im Elsass der Kohl für das „Choucroute" geerntet. Beim Gedeihen des Sauerkrauts von Arsène Bingert in Erstein wirken auch die großen Komponisten klassischer Musik mit.

In der kleinen Scheune riecht es säuerlich. Auf dem Metalltisch in der Mitte thront ein Berg Sauerkraut. Arsène Bingert schichtet ihn von einer Ecke des Tisches in die nächste. Zwei Frauen wiegen Portionen ab und füllen sie in Eimerchen. Eigentlich ist nichts Ungewöhnliches daran. Trotzdem schütteln die Bauern aus der Gegend den Kopf über Bingert: „Des isch doch a Zauberer".

Arsène Bingert stellt biologisch-dynamisches Sauerkraut her. „Wir wollten noch umweltverträglicher arbeiten als ein Bio-Betrieb", sagt der 57-Jährige, der sogar die Grundsätze des Anthroposophen Rudolf Steiner berücksichtigt. Bingert verwendet nur selbsthergestellten Dünger, beim Pflanzen und Ernten richtet er sich nach den Mondphasen. Auf seinen Feldern hat er fünf Menhire (Hinkelsteine) aufgestellt und getauft. Sie sollen den Kohl vor elektromagnetischen Strahlen schützen. Er rückt ihm auch nicht mit der chemischen Keule zu Leibe, sondern mit den Meistern der Klassik. Mozart, Vivaldi auf den Feldern gespielt, verbesserten den Ertrag der Pflanzen. Durch die Scheune wabern gregorianische Gesänge. „Mit religiösen Klängen erhöhe ich die Spiritualität der Produkte. Sie bekommen mehr positive Energie. Das macht sie noch gesünder."

„Eine harmonische Musik beeinflusst die Stoffwechselvorgänge in der Pflanze. Sie wächst schneller, und das Sauerkraut schmeckt besser.", erklärt Yannick Van Doorne. Der Agraringenieur aus Belgien hat den Einfluss von Musik auf Pflanzen studiert und kümmert sich seit Februar um Bingerts Kohl. „Das Ganze ist wie bei einem Kristallglas. Die richtige physikalische Frequenz kann das Glas zum Vibrieren oder sogar zum Platzen bringen. So kann man auf molekularer Ebene mit Musik das Leben einer Pflanze beeinflussen, bestimmte Bakterien stimulieren oder andere zerstören."

Bakterien entwickeln sich vor allem dann, wenn Kohl zu Sauerkraut verarbeitet wird. Sie wandeln den Zucker der Pflanze in Milchsäure um. Van Doorne hat mit einem Computerprogramm eine kurze Melodie komponiert, die gezielt dieses Bakterienwachstum beschleunigen soll. „Die Töne entsprechen genau der Dichte oder Masse der Moleküle, aus denen die Bakterien bestehen", erklärt er. Die Melodie bekommt der geschnittene Kohl, der in Fässern zu Sauerkraut heranreift, einmal am Tag für wenige Minuten zu hören. Sie soll dabei helfen, das Sauerkraut länger zu konservieren.

Die Wissenschaft bleibt skeptisch

Wissenschaftlich ist die Wirkung von Musik auf den Kohl noch nicht bewiesen. „ Das klingt alles hochspekulativ", sagt der Freiburger Biologieprofessor Edgar Wagner. Ganz ausschließen will er einen Zusammenhang aber nicht. „Pflanzen sind sehr sensibel für allerlei Signale aus der Umwelt." Arsène Bingert weiß, dass viele der biologisch-dynamischen Landwirtschaft skeptisch gegenüberstehen. Die Bezeichnung Zauberer ist noch harmlos. „Ich weiß, dass sich viele über mich lustig machen. Das stört mich nicht weiter. Spätestens wenn die Menschen krank werden, merken sie, dass sie etwas ändern müssen." Bis dahin feilt er weiter an der richtigen Musik für seinen Kohl: In der nächsten Saison will er an jeder Etappe der Sauerkrautproduktion die richtige Musik parat haben. Los geht's im Frühling von Vivaldi. *Joana Jäschke*

Am Computer wird die Sauerkraut-Musik komponiert. FOTOS: JOANA JÄSCHKE

„Der schlanke Staat ist ein starker Staat"

IM BZ-GESPRÄCH: Die FDP-Landesvorsitzende Birgit Homburger über die LBBW und die Finanzkrise

VON UNSEREM REDAKTEUR WULF RÜSKAMP

FREIBURG. Um die Landesbank Baden-Württemberg (LBBW) aus ihrer Krise zu retten, ist die FDP im Land für alle bisher diskutierten Lösungen offen. Birgit Homburger, die Landesvorsitzende der Liberalen im Land, hält es aber für unerlässlich, dass die LBBW zuvor alle vorhandenen Risiken aus ihren bisherigen Geschäften offenlegt. Im Gespräch mit der Badischen Zeitung, das während der Verhandlungen zur Rettung der LBBW stattfand, kritisierte sie die Informationspolitik des Bankvorstands, der sich mit dem späten Eingeständnis erheblich größerer Risiken als bisher bekannt gründlich blamiert habe.

Versäumnisse der Politik in der Kontrolle der Landesbank sieht sie nicht: Die Politik könne nicht für Dinge verantwortlich gemacht werden, von denen sie nichts wisse. Und noch in der jüngsten Vertreterversammlung, an der Wirtschaftsminister Ernst Pfister (FDP) teilgenommen habe, sei über die jetzt bekannten gewordenen Geschäftsrisiken nichts berichtet worden. Deshalb habe Pfister jetzt zu Recht die Informationspolitik des Vorstands entsprechend scharf kritisiert, so Homburger.

Birgit Homburger FOTO: GRABHERR

Die Landesvorsitzende bewirbt sich heute beim Delegiertentag der FDP in Freiburg erneut um den Spitzenplatz auf der Landesliste zur Bundestagswahl. Sie muss, ebenso wie die acht folgenden Bewerber – allesamt Bundestagsabgeordnete – keine Gegenkandidatur befürchten. Kein Wunder also, wenn sie sagt, die FDP zeige inhaltliche und personelle Geschlossenheit. Auch die derzeitige Finanz- und Bankenkrise schade nicht der Akzeptanz der Partei, obwohl, wie sie zugibt, in der gegenwärtigen Finanzkrise die ordnungspolitischen Grundsätze der FDP hintangestellt werden müssten: Auch die Liberalen sehen die Notwendigkeit staatlicher Hilfen für die Banken. Zugleich beweise sich in dieser Situation, sagt Birgit Homburger, dass der schlanke Staat ein starker Staat sei. „Diese Krise ist keine Krise der sozialen Marktwirtschaft, sondern es waren zuerst staatliche Banken, die in Schwierigkeiten geraten sind. Das zeigt: Der Staat ist nicht der bessere Banker." Die FDP sei schon vor der Krise für eine straffe Bankenaufsicht durch die Bundesbank eingetreten.

Über die künftige Struktur der Landesbanken müsse nachgedacht werden, so Homburger. Einer Fusion der LBBW mit der Bayerischen Landesbank will sich die FDP nicht in den Weg stellen – aber zuvor müssten alle in der Bayern-LB noch verborgenen Risiken auf den Tisch. Das Ziel eines Landeshaushalts ohne Neuverschuldung will sie nicht ohne weiteres aufgeben – „das bleibt ein zentrales Ziel". Doch ob es einzuhalten sei, hänge vom Ausgang der Finanzkrise ab.

Un vin au petit goût de Bach, avec des notes de Vivaldi et un zeste de Gluck

LE MONDE | 28.09.05 | 14h31 • Mis à jour le 28.09.05 | 14h31
ROME de notre correspondant

La musique de Mozart, de Bach ou de Tchaïkovski a-t-elle une influence sur la qualité du vin ? C'est une hypothèse que des chercheurs de l'université de Florence envisagent sérieusement, après avoir étudié de près l'expérience menée par un viticulteur toscan. Giancarlo Cignozzi, ancien avocat devenu propriétaire viticole, produit le fameux brunello de Montalcino, un vin rouge d'exception apprécié dans le monde entier. Depuis qu'il a sonorisé son vignoble avec des dizaines d'enceintes acoustiques, cet original trouve que sa vigne pousse avec davantage de vigueur. Elle est moins malade que celle de ses voisins, et son raisin mûrit plus vite.

Impressions confirmées par les premiers travaux du professeur Stefano Mancuso, spécialiste italien de neurobiologie végétale, qui a commencé à reproduire en laboratoire les essais en plein champ du viticulteur mélomane : *"Les effets de la musique, ou plutôt des fréquences sonores, sur la croissance de la plante sont remarquables."*

Il y a quatre ans que Giancarlo Cignozzi élève sa vigne en musique, après avoir découvert sur Internet des études chinoises et coréennes démontrant l'impact d'un fond sonore musical sur certaines plantes. Il a voulu essayer sur ses sarments. *"En hiver, quand les vignes dorment, j'utilise de la musique sacrée Haydn, Haendel, La Flûte enchantée de Mozart, un peu de Gluck"*, a-t-il expliqué au quotidien La Stampa. Au printemps, à l'apparition des premières feuilles, il *"attaque avec de la musique baroque : beaucoup de Bach, beaucoup de Vivaldi"*.

Juin et juillet résonnent de *"concertos pour piano et de symphonies"*. Enfin, le final, fin août-début septembre, au plus fort de la maturation, est réservé

à *"Tchaïkovski avec orchestre de 120 éléments"*. Ainsi s'écoulent les quatre saisons de Cignozzi, dans le petit village de Montalcino.

"Je ne sais pas si mon vin est meilleur", reconnaît-il honnêtement. Mais il est sûr que les parcelles les plus exposées à la musique sont les moins touchées par les parasites, les bactéries, la moisissure.

Les 20 000 euros dépensés pour équiper son vignoble avec l'aide d'un ami ingénieur du son ont été largement compensés, affirme-t-il, par les économies réalisées sur les achats de fongicides et d'insecticides.

Pour le professeur Mancuso, il est trop tôt pour donner un jugement définitif sur cette musicothérapie appliquée au vin. Si les séries de tests menées actuellement par ses équipes aboutissent, il entrevoit *"une nouvelle voie pour l'agriculture biologique, en particulier pour les produits de qualité"*. Reste la pollution sonore : les effluves de grande musique ont tendance à soûler le voisinage, qui a déjà protesté à plusieurs reprises.

Jean-Jacques Bozonnet
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Mercredi 12 septembre 2007 à 00:10 - China Daily

Un agriculteur chinois dit avoir nettement amélioré les volumes et la qualité de sa production maraîchère en faisant écouter à ses légumes de la musique classique, rapportent mardi les médias nationaux chinois.

"Les plantes et les animaux peuvent ressentir la musique parce qu'ils sont des choses vivantes", a expliqué Ye Fei au quotidien China Daily.

Ce fermier de la province de Zhejiang, dans l'est de la Chine, diffuse alternativement à ses cultures la Symphonie pastorale de Beethoven, le matin, et des mélodies plus douces, jouées au piano, l'après-midi, précise l'article.

Depuis mars dernier, date à laquelle il a installé des haut-parleurs dans ses dix serres, cinq variétés de légumes sur les 15 qu'il cultive ont poussé beaucoup plus vite que par le passé, assure-t-il.

Les experts agricoles demeurent néanmoins sceptiques. "Il est assez compréhensible d'utiliser de la musique sur les vaches pour améliorer la production de lait, mais ces techniques sur les légumes n'en sont encore qu'au stade de l'évaluation", a précisé Wang Yuhong, chercheur à l'Académie des sciences agricoles de Ningbo.

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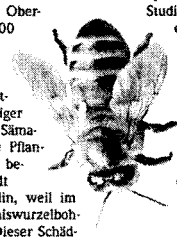
VON UNSERER MITARBEITERIN SILVIA FALLER

FREIBURG. Der Deutsche Berufs- und Erwerbsimkerbund (DBIB) will gerichtlich gegen das Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BLV) vorgehen, sollte die Behörde die Zulassung des Maisbeizmittels Clothianidin wieder aktivieren. „Wir meinen, dass die bisherigen Prüfverfahren mit denen die Wirkungen von Pflanzenschutzmitteln auf Bienen und die Umwelt untersucht werden, unzureichend sind", erklärt Christoph Koch, Imker aus Oppenau im Ortenaukreis und DBIB-Vorstandsmitglied.

Er und seine Berufskollegen sind der Ansicht, dass die Behörden – darunter das baden-württembergische Ministerium Ländlicher Raum (MLR) das die Anwendung des umstrittenen Insektengifts im Gebiet Lahr angeordnet hatte – das Bienensterben zum Anlass nehmen sollten, nicht nur das Zulassungsverfahren, sondern auch die Anbaupraktiken zu überdenken. Im April und Mai dieses Jahres waren im Oberrheingebiet rund 11 000 Bienenvölker eingegangen. Das Beizmittel haftete nicht ausreichend stark an den Saatkörnern, weshalb giftiger Abriebstaub aus den Sämaschinen auf blühende Pflanzen gelangte (die BZ berichtete). Angewandt wurde das Clothianidin, weil im Sommer 2007 der Maiswurzelbohrer aufgetreten war. Dieser Schädling ist meldepflichtig.



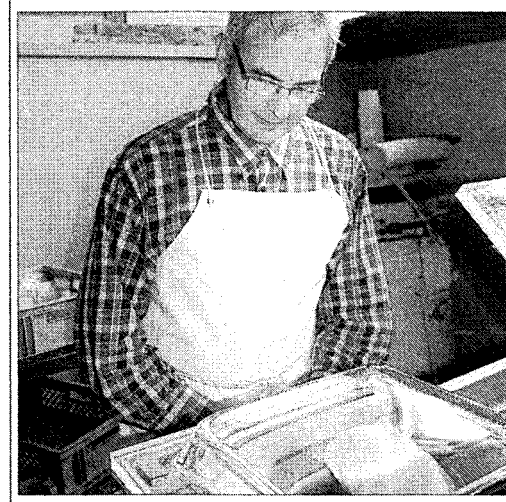
Am 24. Mai hat das Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz die Anwendung für die Dauer von sechs Monaten verboten. Doch ob dieses Verbot bestehen bleibt, ist noch offen. „Die Gespräche mit der Beizmittelindustrie und den Sämaschinenherstellern laufen noch", erklärt BVL-Sprecher Jochen Heimberg. Zwei Ansätze werden verfolgt, informiert Utz Klages, Sprecher von Bayer Crop Science. Einerseits werde die Qualitätskontrolle beim Beizprozess verbessert, zum andern könnten Sämaschinen so nachgerüstet werden, dass der Staub nicht mehr entweiche.

Der DBIB und auch der Landesverband Badischer Imker wollen darauf nicht vertrauen. Abgesehen davon werfen sie der Landesregierung vor, Erkenntnisse aus Italien nicht berücksichtigt zu haben. Bereits im Jahr 2002 waren in den Regionen Lombardei und Venetien Bienenvergiftungen durch Clothianidin und verwandte Wirkstoffe festgestellt worden. Der Befund war zwei Jahre später bei einer internationalen Fachtagung veröffentlicht worden, bei der auch ein Bienenwissenschaftler aus Baden-Württemberg teilgenommen hatte.

Diesem Vorwurf hält Joachim Hauck, Leiter der Abteilung Landwirtschaft im Stuttgarter Agrarministerium entgegen: „Es war ein Verdacht, der geäußert wurde, es gab keine wissenschaftlich fundierten Belege. Sonst wäre die italienische Regierung verpflichtet gewesen, den EU-Behörden die Bienenvergiftungen zu melden und auch wir hätten Kenntnis davon gehabt." Tatsächlich sind in Italien erst in den Jahren 2007 und 2008 behördliche Studien angelaufen; die italienische ebenso wie die deutsche Regierung hatte die Anwendung erst in diesem Jahr verboten.

Sollte das Verbot in Deutschland bestehen bleiben, gibt es die Möglichkeit, in Gebieten, in denen der Maiswurzelbohrer vorkommt, Fruchtwechsel vorzuschreiben oder mit Spezialschleppern während des Wachstums Insektizide auszubringen. Einige wenige Tiere wurden im Sommer 2008 in Mahlberg im Ortenaukreis und ein einzelner Käfer bei Leutkirch im Allgäu registriert. „Wir warten die Entscheidung des BVL ab, bevor wir eine Entscheidung treffen", sagt Joachim Hauck. Die Beizung sei im Vergleich zu anderen Pflanzenschutzmethoden sehr effizient, weil nur geringe Wirkstoffmengen benötigt werden und kein Sprühnebel entstehe. „Die Korrelation zwischen mangelnder Beizqualität und der Ausbringungspraxis einerseits und dem Bienensterben andererseits ist jedoch eine Tatsache, die wir nicht ausblenden", sagt er.

MENSCHEN VON HIER



Arsène Bingert hat ein wachsames Auge auf die Sauerkraut-Produktion.

Choucroute schießt mit Vivaldi ins Kraut

Arsène Bingert produziert nach anthroposophischen Ideen

ERSTEIN. Bis Ende Dezember wird im Elsass der Kohl für das „Choucroute" geerntet. Beim Gedeihen des Sauerkrauts von Arsène Bingert in Erstein wirken auch die großen Komponisten klassischer Musik mit.

In der kleinen Scheune riecht es säuerlich. Auf dem Metalltisch in der Mitte thront ein Berg Sauerkraut. Arsène Bingert schichtet ihn von einer Ecke des Tisches in die nächste. Zwei Frauen wiegen Portionen ab und füllen sie in Eimerchen. Eigentlich ist nichts Ungewöhnliches daran. Trotzdem schütteln die Bauern aus der Gegend den Kopf über Bingert: „Des isch doch a Zauberer".

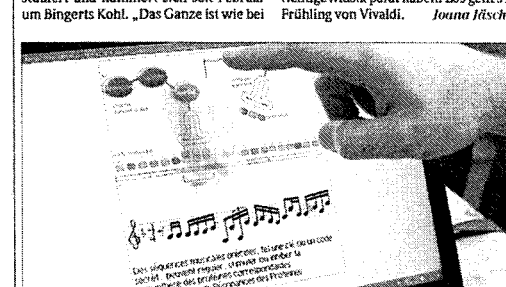
Arsène Bingert stellt biologisch-dynamisches Sauerkraut her. „Wir wollten noch umweltverträglicher arbeiten als ein Bio-Betrieb", sagt der 57-Jährige, der sogar die Grundsätze des Anthroposophen Rudolf Steiner berücksichtigt. Bingert verwendet nur selbsthergestellten Dünger, beim Pflanzen und Ernten richtet er sich nach den Mondphasen. Auf seinen Feldern hat er fünf Menhire (Hinkelsteine) aufgestellt und getauft. Sie sollen den Kohl vor elektromagnetischen Strahlen schützen. Er rückt ihm auch nicht mit der chemischen Keule zu Leibe, sondern mit den Meistern der Klassik. Mozart, Vivaldi auf den Feldern gespielt, verbesserten den Ertrag der Pflanzen. Durch die Scheune wabern gregorianische Gesänge. „Mit religiösen Klängen erhöhe ich die Spiritualität der Produkte. Sie bekommen mehr positive Energie. Das macht sie noch gesünder."

„Eine harmonische Musik beeinflusst die Stoffwechselvorgänge in der Pflanze. Sie wächst schneller, und das Sauerkraut schmeckt besser.", erklärt Yannick Van Doorne. Der Agraringenieur aus Belgien hat den Einfluss von Musik auf Pflanzen studiert und kümmert sich seit Februar um Bingerts Kohl. „Das Ganze ist wie bei einem Kristallglas. Die richtige physikalische Frequenz kann das Glas zum Vibrieren oder sogar zum Platzen bringen. So kann man auf molekularer Ebene mit Musik das Leben einer Pflanze beeinflussen, bestimmte Bakterien stimulieren oder andere zerstören."

Bakterien entwickeln sich vor allem dann, wenn Kohl zu Sauerkraut verarbeitet wird. Sie wandeln den Zucker der Pflanze in Milchsäure um. Van Doorne hat mit einem Computerprogramm eine kurze Melodie komponiert, die gezielt dieses Bakterienwachstum beschleunigen soll. „Die Töne entsprechen genau der Dichte oder Masse der Moleküle, aus denen die Bakterien bestehen", erklärt er. Die Melodie bekommt der geschnittene Kohl, der in Fässern zu Sauerkraut heranreift, einmal am Tag für wenige Minuten zu hören. Sie soll dabei helfen, das Sauerkraut länger zu konservieren.

Die Wissenschaft bleibt skeptisch

Wissenschaftlich ist die Wirkung von Musik auf den Kohl noch nicht bewiesen. „ Das klingt alles hochspekulativ", sagt der Freiburger Biologieprofessor Edgar Wagner. Ganz ausschließen will er einen Zusammenhang aber nicht. „Pflanzen sind sehr sensibel für allerlei Signale aus der Umwelt." Arsène Bingert weiß, dass viele der biologisch-dynamischen Landwirtschaft skeptisch gegenüberstehen. Die Bezeichnung Zauberer ist noch harmlos. „Ich weiß, dass sich viele über mich lustig machen. Das stört mich nicht weiter. Spätestens wenn die Menschen krank werden, merken sie, dass sie etwas ändern müssen." Bis dahin feilt er weiter an der richtigen Musik für seinen Kohl: In der nächsten Saison will er an jeder Etappe der Sauerkrautproduktion die richtige Musik parat haben. Los geht's im Frühling von Vivaldi. *Joana Jäschke*



Am Computer wird die Sauerkraut-Musik komponiert. FOTOS: JOANA JÄSCHKE

„Der schlanke Staat ist ein starker Staat"

IM BZ-GESPRÄCH: Die FDP-Landesvorsitzende Birgit Homburger über die LBBW und die Finanzkrise

VON UNSEREM REDAKTEUR WULF RUSKAMP

FREIBURG. Um die Landesbank Baden-Württemberg (LBBW) aus ihrer Krise zu retten, ist die FDP im Land für alle bisher diskutierten Lösungen offen. Birgit Homburger, die Landesvorsitzende der Liberalen im Land, hält es aber für unerlässlich, dass die LBBW zuvor alle vorhandenen Risiken aus ihren bisherigen Geschäften offenlegt. Im Gespräch mit der Badischen Zeitung, das während der Verhandlungen zur Rettung der LBBW stattfand, kritisierte sie die Informationspolitik des Bankvorstands, der sich mit dem späten Eingeständnis erheblich größerer Risiken als bisher bekannt gründlich blamiert habe.

Versäumnisse der Politik in der Kontrolle der Landesbank sieht sie nicht: Die Politik könne nicht für Dinge verantwortlich gemacht werden, von denen sie nichts wisse. Und noch in der jüngsten Vertreterversammlung, an der Wirtschaftsminister Ernst Pfister (FDP) teilgenommen habe, sei über die jetzt bekannten gewordenen Geschäftsrisiken nichts berichtet worden. Deshalb habe Pfister jetzt zu Recht die Informationspolitik des Vorstands entsprechend scharf kritisiert, so Homburger.

Birgit Homburger FOTO: GRABHERR

Die Landesvorsitzende bewirbt sich heute beim Delegiertentag der FDP in Freiburg erneut um den Spitzenplatz auf der Landesliste zur Bundestagswahl. Sie muss, ebenso wie die acht folgenden Bewerber – allesamt Bundestagsabgeordnete – keine Gegenkandidatur befürchten. Kein Wunder also, wenn sie sagt, die FDP zeige inhaltliche und personelle Geschlossenheit. Auch die derzeitige Finanz- und Bankenkrise schade nicht der Akzeptanz der Partei, obwohl, wie sie zugibt, in der gegenwärtigen Finanzkrise die ordnungspolitischen Grundsätze der FDP hintangestellt werden müssten: Auch die Liberalen sehen die Notwendigkeit staatlicher Hilfen für die Banken. Zugleich beweise sich in dieser Situation, sagt Birgit Homburger, dass der schlanke Staat ein starker Staat sei. „Diese Krise ist keine Krise der sozialen Marktwirtschaft, sondern es waren zuerst staatliche Banken, die in Schwierigkeiten geraten sind. Das zeigt: Der Staat ist nicht der bessere Banker." Die FDP sei schon vor der Krise für eine straffe Bankenaufsicht durch die Bundesbank eingetreten.

Über die künftige Struktur der Landesbanken müsse nachgedacht werden, so Homburger. Einer Fusion der LBBW mit der Bayerischen Landesbank will sich die FDP nicht in den Weg stellen – aber zuvor müssten alle in der Bayern-LB noch verborgenen Risiken auf den Tisch. Das Ziel eines Landeshaushalts ohne Neuverschuldung will sie nicht ohne weiteres aufgeben – „das bleibt ein zentrales Ziel". Doch ob es einzuhalten sei, hänge vom Ausgang der Finanzkrise ab.

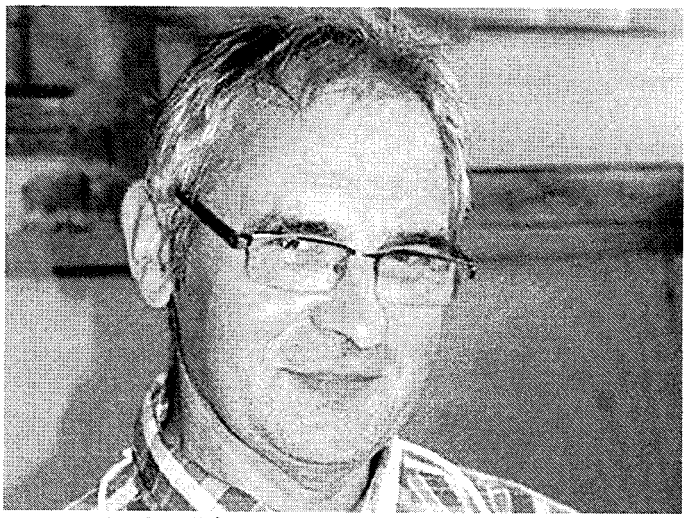
Badische Zeitung

Montag, 24. November 2008

Biodynamisches Choucroute

Der Sauerkraut-Versteher

Bis Ende November wird im Elsass der Kohl für die regional Spezialität, das Choucroute, geerntet. Beim Gedeihen des Sauerkrauts von Arsène Bingert in Erstein, etwa 25 Kilometer südlich von Straßburg, wirken auch die großen Komponisten der klassischen Musik mit.



Arsène Bingert baut Sauerkraut nach anthroposophischen Grundsätzen an. | Foto: Jonaa Jäscke

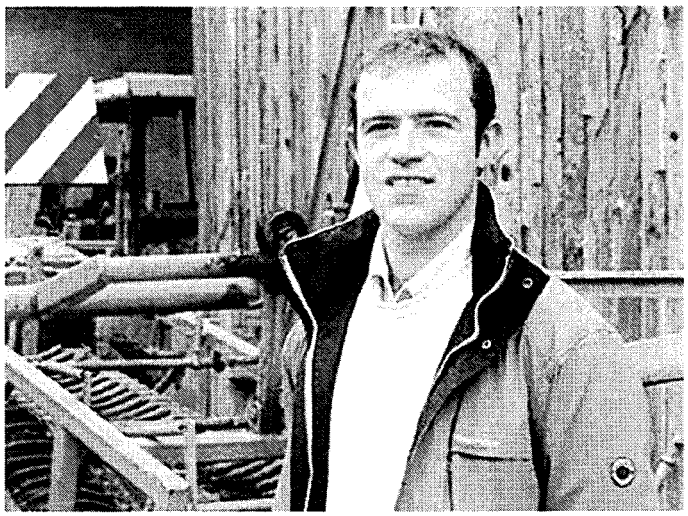
In der kleinen unscheinbaren Scheune riecht es säuerlich. Auf dem Metalltisch in der Mitte thront ein Berg Sauerkraut. Arsène Bingert schichtet ihn von einer Ecke des Tisches in die nächste. Zwei Frauen wiegen Portionen ab und füllen sie in grüne Eimerchen. Auf den ersten Blick ist nichts Ungewöhnliches daran. Trotzdem schütteln die Bauern aus der Gegend den Kopf über Bingert und schimpfen: "Des isch doch a Zauberer".

Mondphasen und Menhire

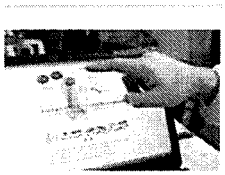
Arsène Bingert stellt biologisch-dynamisches Sauerkraut her. "Wir wollten noch umweltverträglicher arbeiten als ein Bio-Betrieb", sagt der 57-Jährige. Bereits vor über 30 Jahren hatte er sich dem Bio-Landbau verschrieben. Damals war "Bio" in erster Linie eine Abkürzung für ein naturwissenschaftliches Schulfach und kein Gütesiegel. Im Jahr 2000 ist er dann zum biodynamischen Anbau übergegangen. Dahinter steckt ein Konzept, das auf den spirituellen Grundsätzen des Anthroposophen Rudolf Steiner beruht.

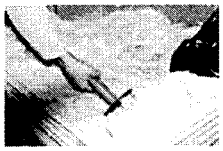
Bingert verwendet nur selbsthergestellten Dünger, beim Pflanzen und Ernten richtet er sich nach den Mondphasen. Auf seinen Feldern hat er fünf große Menhire, also Hinkelsteine, aufgestellt und getauft. Sie sollen den Kohl vor elektromagnetischen Strahlen, beispielsweise durch Funkmasten, schützen. Er rückt seinem Kohl nicht mit der chemischen Keule zu Leibe,

sondern mit den Meistern der Klassik. Mozart, Vivaldi, ab und zu auf den Feldern gespielt, verbesserten den Ertrag der sonst sehr empfindlichen Pflanzen.



Yannick Van Doorne, Agraringenieur aus Belgien, programmiert die Klänge, mit denen das Gemüse beschallt wird. Foto: Joana Jäschke






Positive Energie

Durch die Scheune, in der er seinen Kohl zu Sauerkraut verarbeitet, wabern nun andächtig gregorianische Gesänge. "Mit diesen religiösen Klängen erhöhe ich die Spiritualität der Produkte. Sie bekommen mehr positive Energie. Das macht sie noch gesünder. "

"Eine harmonische Musik beeinflusst die Stoffwechselvorgänge in der Pflanze. Sie wächst schneller und das Sauerkraut schmeckt besser und gesünder.", erklärt Yannick Van Doorne. Der Agraringenieur aus Belgien hat den Einfluss von Musik auf Pflanzen studiert und kümmert sich seit Februar um Bingerts Kohl. "Das ganze ist ähnlich wie mit einem Kristallglas. Die richtige physikalische Frequenz kann das Glas zum Vibrieren oder sogar zum Platzen bringen. So kann man auf molekularer Ebene mit Musik das Leben einer Pflanze beeinflussen, zum Beispiel bestimmte Bakterien stimulieren oder andere zerstören."

Exakt abgestimmte Melodien

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beschleunigen soll. "Die einzelnen Töne entsprechen genau der Dichte oder Masse der Moleküle, aus denen die Bakterien bestehen", erklärt er. Diese Melodie bekommt der klein geschnittene Kohl, der in großen Fässern zu Sauerkraut heranreift, einmal am Tag für wenige Minuten zu hören. Sie soll dabei helfen, das Sauerkraut länger und natürlicher zu konservieren.

Wissenschaft ist skeptisch

Wissenschaftlich ist die Wirkung von Musik auf den Kohl noch nicht bewiesen. " Das klingt alles hochspekulativ", sagt der Freiburger Biologieprofessor Edgar Wagner. Ausschließen will er einen Zusammenhang zwischen Melodien und Pflanzenwachstum aber nicht vollständig. "Pflanzen sind sehr sensibel für allerlei Signale aus der Umwelt. Sie reagieren ja auch auf Licht oder Wind. Aber alles andere müsste man aber erst mit wissenschaftlichen Experimenten überprüfen."

Arsène Bingert weiß, dass viele der biologisch-dynamischen Landwirtschaft skeptisch gegenüberstehen. Die Bezeichnung als Zauberer ist noch harmlos. "Ich weiß, dass sich viele über mich lustig machen. Das stört mich nicht weiter. Ich ignoriere sie, weil ich keine Lust habe, meine Energie an negative Sachen zu verschwenden. Gutes braucht eben seine Zeit. So war das beim Biolandbau auch. Spätestens wenn die Menschen krank werden, merken sie, dass sie etwas ändern müssen."
Bis dahin feilt er weiter an der richtigen Musik für seinen Kohl: In der nächsten Saison will er von der Saat bis zum Sauerkraut – an jeder Etappe der Verarbeitung - die richtige Musik parat haben. Los geht's im Frühjahr – passend zur Jahreszeit mit dem "Frühling" von Vivaldi.

http://www.badische-zeitung.de/der-sauerkraut-versteher

Südwest

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21. November 2008 13:08 Uhr

von: Joana Jäschke

Musicothérapie pour choux

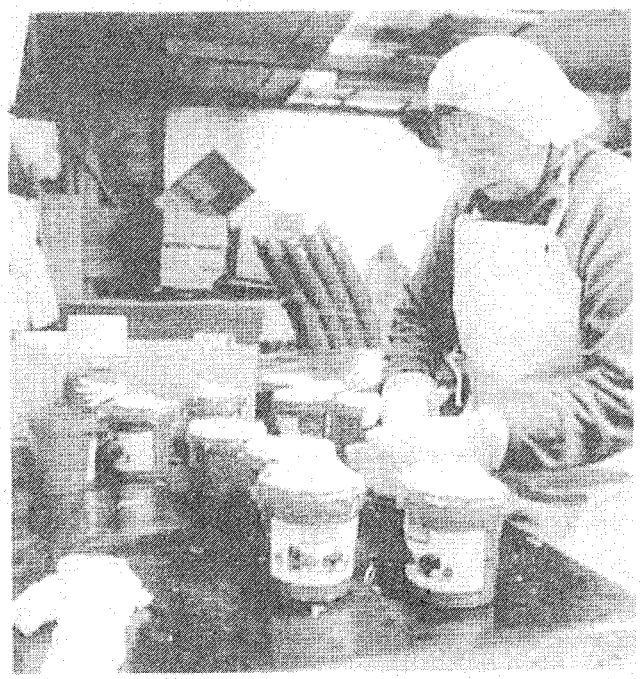
On est en pleine période de récolte du chou à choucroute en Alsace jusqu'à début décembre. Ce n'est pas seulement d'une bonne terre et d'eau dont ont besoin les choux pour bien grandir. Au domaine Bingert, on s'aide d'une technique originale : la musicothérapie.

C'est un chou disparu en Alsace qui pousse ici à Erstein : le Quintal d'Alsace. Une variété ancienne jamais hybridée (c'est-à-dire croisée avec d'autres) qui pousse sans engrais dans un sol nourri au compost. «*Un goût fort et subtil*», selon Arsène Bingert, l'exploitant agricole. Comme il est très fragile, il supporte mal la mécanisation : «*On perd 30 % du chou au moment de la récolte.*»

«On peut stimuler l'enzyme qui transforme le sucre du chou en acide lactique»

Alors Arsène Bingert choucroute ses choux une fois récoltés. Il s'intéresse à la musicothérapie pour améliorer la qualité de ses légumes. Tout a commencé par des expériences personnelles : «*Je diffuse Mozart et Vivaldi dans mes champs la nuit*». Par la suite, le rendement s'est amélioré.

Il a fait alors appel à Yannick Van Doorne, un ingénieur agronome belge, qui a étudié l'influence de la musique sur la croissance des plantes. Une technique déjà employée dans des vignes alsaciennes. L'ingénieur est donc venu se pencher sur les choux du domaine Bingert.



Dans le Bas-Rhin, le chou à choucroute représente 750 hectares, soit la moitié de la surface agricole consacrée aux légumes. Ici, la mise en pot. (Photo DNA – Jean-Christophe Born)

Alors comment la musique peut-elle influencer la pousse des légumes ? «*Comme un verre de cristal : on peut le faire vibrer et même exploser si on connaît la fréquence physique de la matière*, explique Yannick Van Doorne. *Au niveau moléculaire des légumes, c'est pareil, on peut influencer la vie des bactéries, stimuler l'une ou détruire une autre.*» L'ingénieur établit d'abord des mesures avec des appareils scientifiques. Et après, il crée une séquence musicale par ordinateur.

À l'oreille, on entend une succession de notes comme une petite mélodie. «*Une séquence qui fonctionne comme un code sur les choux*.» Elle est diffusée quelques minutes par jour à un volume sonore moyen, via des haut-parleurs devant les pots à choucroute, une fois les choux râpés et mis dans la saumure. Un atelier (*lire encadré*) est d'ailleurs organisé samedi 11 octobre par l'association de culture biodynamique d'Alsace et de Lorraine (340 membres) qui s'intéresse de près au chou du domaine Bingert. Ici, en effet, on pratique la biodynamie, un mode de culture des fruits et légumes 100 % naturel, pas d'engrais chimique, utilisation du calendrier lunaire…

Yannick Van Doorne crée donc des séquences sonores pour stimuler la fermentation du chou après la récolte. «*On peut stimuler l'enzyme qui transforme le sucre du chou en acide lactique.*» jusqu'à doubler la longueur de conservation du chou selon l'ingénieur.

Le printemps prochain, l'expérience devrait être étendue aux champs. Une technique qui ne fait pas l'unanimité des milieux scientifiques mais qui obtient des résultats : meilleur goût et meilleure conservation. Avec des haut-parleurs placés au milieu des champs, on devrait voir se développer les concertos pour choux majeurs.

Florent Potier

Un atelier de mise en pot

Le chou semé en mai est donc arrivé à maturité pour se mélanger au lard et aux saucisses afin de former le plus connu des plats alsaciens. C'est pourquoi l'association de culture biodynamique d'Alsace et de Lorraine organise **samedi 11 octobre** un atelier de mise en pot de la choucroute, à la ferme Bingert d'Erstein. Réservé aux membres de l'association, l'atelier débutera par une séance de râpe du chou à la main sous la direction avisée de Philippe Courcur, vice-président de l'association.

«*Je coupe d'abord la partie centrale du chou qu'on ne peut pas manger*, démontre, chou à la main, Philippe. *Puis on passe le chou à la râpe à cinq lames. Après, chacun ajoute les ingrédients qu'il souhaite : sel, laurier, genièvre…*»

Ensuite, les participants mettront la choucroute en pot selon une technique ancestrale : la lacto-fermentation. Au contact du sel pendant cinq à sept semaines, à l'abri de l'air et de l'acidité, le chou peut se garder pendant des années.

Les sons au service de l'agrobiologie,

applications, découvertes et perspectives

Par Yannick Van Doorne (ECOSONIC)

S'est tenue au département d'agriculture et de sciences de biotechnologie de l'école supérieure de Gand en Belgique, le 22 juin 2000, la soutenance d'une thèse intitulée "l'influence de fréquences sonores variables sur la croissance et le développement des plantes" (traduit du Néerlandais). L'objectif de ce travail est de promouvoir et de proposer des technologies écologiques, utilisables aussi bien dans l'agriculture conventionnelle que dans l'agriculture biologique et économiquement rentable pour améliorer la production bio du point de vue qualitatif et quantitatif.

La thèse s'appuie sur une bibliographie internationale des recherches sur l'influence des ondes sonores sur la croissance et le développement des plantes. Une expérience fut menée au sein des serres de l'université de Gand afin de vérifier l'influence de certaines séquences sonores spécifiques sur des plants de tomates. La thèse décrit les découvertes principales dont découlent de nombreuses applications pour l'agriculture et la biotechnologie.

Découvertes

Résonance des organites cellulaires

On sait en physique quantique que chaque structure, petite ou grande, possède une fréquence de résonance. C'est une propriété que l'on retrouve aussi pour les cellules des plantes et les microstructures ou organites dont elles sont composées telles que les mitochondries et les chloroplastes. Des tests ont démontré que sous l'effet de fréquences sonores adéquates, même de faible intensité, ces structures cellulaires peuvent entrer en résonance, ce qui a pour conséquence d'altérer le fonctionnement même de la cellule, positivement ou négativement, selon la dose, la fréquence et l'intensité.

Ainsi plusieurs expériences sur des pousses de blé ont permis par un traitement journalier d'une fréquence sonore spécifique audible entre 5 et 12 kHz d'augmenter la croissance et le poids de matière sèche (x 2 à 3 selon la fréquence utilisée) [Weinberger et al.'68]. La quantité d'énergie correspondant aux fréquences sonores administrées est de l'ordre de un milliardième de ce qui serait nécessaire pour briser une liaison chimique, mais elle est suffisante pour faire entrer en résonance des organites cellulaires. Les chercheurs suggèrent que des changements dans les processus biochimiques et biophysiques peuvent se produire respectivement dans et autour des organites cellulaires en résonance. Un test simple, sous un microscope, permet de constater une accélération du

mouvement du liquide cellulaire des cellules végétales soumises à un traitement sonore spécifique. Ces découvertes et expériences montrent que certains traitements sonores peuvent stimuler le métabolisme, la croissance et le développement général des plantes.

Résonance des stomates

L'expérience nous montre aussi que des cavités munies d'une ouverture de l'ordre de grandeur de quelques micromètres possèdent une fréquence de résonance dans la gamme audible. De telles cavités se retrouvent sur les plantes : les stomates, lieu des échanges gazeux entre la plante et le milieu extérieur. Situées sur la surface des feuilles, ces cavités sont munies d'un système d'ouverture et de fermeture ingénieux qui permet à la plante de réguler son degré d'ouverture en fonction de la température, l'humidité et l'heure de la journée. Certaines fréquences sonores permettent de créer des résonances avec les stomates et d'agir sur ces fonctions. On peut ainsi sensiblement augmenter la capacité d'absorption des plantes pour les produits pulvérisés ou l'humidité de la rosée du matin. Les fréquences sonores possédant les propriétés de stimuler la capacité d'absorption des plantes se retrouvent dans des gammes audibles.

Génodique

La génodique est le nom donné au domaine de recherche principalement issu de la découverte de Jöel Sterheimer, physicien et chercheur indépendant : des séquences sonores spécifiques peuvent influencer l'expression du potentiel génétique des plantes par la synthèse des protéines. Ces séquences sonores spécifiques appelées aussi "séquences sonores épigénétiques" sont en fait une succession de fréquences calculées contenant une information entrant en résonance avec la synthèse des protéines dans les cellules d'un organisme vivant. Ces découvertes sont issues des recherches en physique quantique et des lois d'ordre harmonique et vibratoire dans l'organisation de la matière.

En physique, on constate que des séquences sonores induisent des altérations parallèles dans le champ électromagnétique qui peuvent agir par des ondes d'échelles sur la synthèse des protéines correspondantes. Des expériences en plein champ et en milieu contrôlé ont démontré cette action. La technique permet d'influencer, d'inhiber ou de stimuler la synthèse d'une protéine par un facteur allant jusqu'à 20, selon le découvreur de l'application. Ainsi des séquences sonores spécifiques correspondant à des protéines des plantes permettent d'interagir avec les processus de la croissance et du développement. Ces applications permettent par exemple d'augmenter substantiellement les résistances des plantes aux maladies.

Il existerait des homologies entre des séquences spécifiques propres à des protéines et des suites de fréquences que l'on peut retrouver dans certains chants d'oiseaux de nos campagnes et même dans certaines compositions humaines, chants shamaniques, chants agraires et musiques traditionnelles issues de nos campagnes.

Quelques expériences

L'extensine

L'expérience fut menée dans une serre non-chauffée, à l'université de Gand, de fin janvier à fin mars 2000, avec un groupe de 30 plants de tomates, disposés en trois rangées dans des pots devant un haut parleur et un groupe témoin de 20 plants situés à l'autre extrémité de la serre. Les conditions de cultures sont identiques. Le traitement sonore consistait en une application de séquences sonores spécifiques administrées durant six minutes chaque jour à une puissance de 50 décibels avec pour objectif de stimuler la croissance des cellules des plantes sans augmenter leur vitesse de développement, par stimulation de certaines protéines spécifiques telles que les extensines.

L'action spécifique du traitement par des séquences sonores a été vérifiée en mesurant le nombre d'internoeuds et la croissance des plants : le nombre d'internoeuds était identique entre les deux groupes et les plantes traitées étaient plus grandes (20% plus grandes) au même stade de développement que les plants témoins. L'augmentation de taille de la plante est directement liée à l'augmentation de la taille des cellules elles-mêmes.

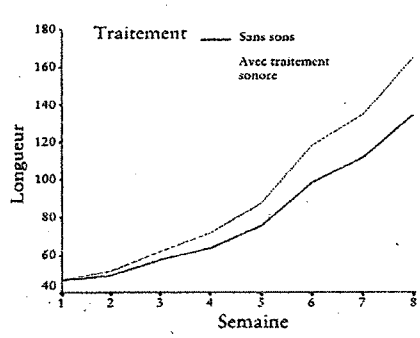
Résistance à la sécheresse

Au Sénégal, en 1996, une expérience conduite chez un producteur sur des pieds de tomates a permis de multiplier la récolte des plants traités par la passage de séquences sonores épigénétiques par deux par rapport aux plants témoins, les deux groupes se situant dans les mêmes conditions extrêmes de sécheresse et de prédation.

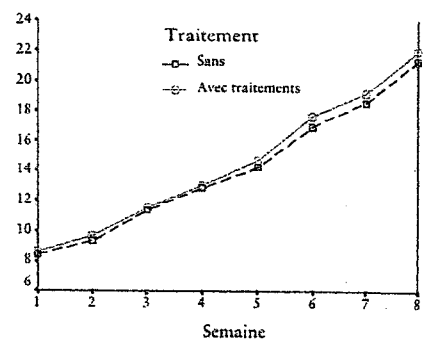
De multiples applications ...

La technique génodique est protégée par un brevet. Elle permet de mettre en œuvre toutes les protéodies (séquences sonores épigénétiques) dont on a prouvé l'effet par expériences et notamment celles citées ci-dessus. Les applications issues de la génodique permettent par l'utilisation de séquences sonores spécifiques de cibler une fonction en influençant la synthèse des protéines par stimulation ou inhibition.

Par exemple, une entreprise Japonaise cultivant des tomates sous serres utilise une méthode génodique qui permet d'augmenter significativement le taux de sucre des tomates. Aux Pays-Bas, un producteur de tomates a pu enrayer par cette méthode une épidémie de potato virus.



Longueur des plants de tomates en centimètre en fonction du nombre de semaines de traitement



Nombre d'internoeuds des plants de tomates en fonction du nombre de semaines de traitement

Autres applications possibles

La génodique nous permet aussi de créer des séquences sonores spécifiques stimulant la floraison (une expérience a permis de doubler le nombre de fleurs par pied de tomate sur deux semaines par un traitement de quelques minutes par jour), la fécondité, la croissance, l'enracinement, les résistances aux maladies, le goût, la tolérance aux conditions de sécheresse. Elle peut permettre de freiner la propagation des maladies, d'inhiber les maladies virales, de prolonger la période de conservation des fruits et légumes (expérience en cour sur des avocats) en inhibant les processus de mûrissement, de ramollissement et de maturation.

Certaines séquences sonores peuvent à elles seules augmenter la croissance des cultures telles que le blé, le riz et le maïs de 5 à 10 % et jusqu'à 20 % selon les cas. On peut atteindre des résultats similaires sur la majorité des cultures avec des séquences sonores adaptées selon la plante. Il existe aussi des séquences stimulants la santé et la vigueur générale des plantes. D'autres séquences plus récemment découvertes permettent d'inhiber la croissance des herbes indésirables dans les cultures.

Certaines expériences montrent que les effets peuvent être transmis de génération en génération, par exemple sur des semences de blé ou de noyer où les générations suivantes poussent plus vite et sans traitement. Certains chercheurs suggèrent que certains sons permettent d'activer le potentiel génétique latent d'une plante.

Précautions d'emploi

La technique de résonance des stomates est totalement inoffensive mais nécessite un savoir-faire évident. Il est important de ne pas utiliser n'importe quel engrais ou autres substances de pulvérisation foliaire lors de la stimulation de l'absorption car cela peut entraîner des déséquilibres. Il existe sur le marché des mélanges spécifiques pour l'utilisation combinée avec les séquences sonores.

En ce qui concerne la génodique, le suivi par un utilisateur averti s'avère nécessaire afin d'éviter de possibles surdosages (temps d'exposition aux séquences sonores trop long) ou d'interaction avec les autres organismes vivants dont l'homme. La prudence est de rigueur.

On retrouve des utilisateurs de ces deux méthodes dans le monde entier : Indonésie, Inde, certains pays africains, Japon, Etats Unis, Angleterre, Belgique, France et Suisse.

Les secteurs d'activité sont multiples : plusieurs applications sont actuellement en cours dans les domaines agricoles, horticoles et arboricoles, sur vignes, houblon, tomate, blé, petits pois, gingembre, noyer, cacao et café.

La mise en œuvre de tests supplémentaires en laboratoire, de concert avec des tests *in situ* menés par les agriculteurs pour différentes productions, serait souhaitable afin de vérifier ces premiers travaux avant de les mettre en application chez les producteurs et pour mettre au point de nouvelles applications. ■

Organisme pour la promotion, le conseil et la diffusion des BIO-technologies sonores et utilisant les ondes dans l'agriculture.
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Résumé

Influence de fréquences sonores variables sur la croissance et le développement des plantes.

Ecole Supérieure de Gand Département Agriculture et Sciences Biotechnologique
Thèse de fin d'études présentée par Yannick Van Doorne

Une première partie explique les notions du son et des fréquences sonores variables sur le plan physique et biophysique.

Une deuxième partie donne un inventaire des recherches menées jusqu'à ce jour dans le domaine de l'influence de fréquences sonores variables sur la croissance et le développement des plantes. L'histoire commence par des études empiriques qui depuis les dernières années ont permis des découvertes plus précises sur les mécanismes en action causés par le son.

Les découvertes les plus récentes et précises sont celles de Dan Carlson (1989), Weinberger (1972) et de Joel Sternheimer (1992). Joël Sternheimer a découvert une technique permettant de stimuler ou d'inhiber la synthèse de protéines cibles par des séquences sonores spécifiques. Un brevet intitulé : "Procédé de Régulation épigénétique de la biosynthèse des protéines par résonance d'échelle" a été déposé. Issu de cette découverte un vaste domaine de recherche est né sous le nom de Genodique.

D'autres techniques ont été découvertes et permettent : l'activation de certains gènes, d'influencer la perméabilité de la membrane cellulaire et la pénétrabilité de la paroi cellulaire, la cavitation, la sonication, l'absorption de certains sons par les plantes, des résonances des organelles cellulaires, des résonances des cavités stomatales. De nombreuses découvertes ont abouti au dépôt de nouveaux brevets d'applications dans le domaine de l'agriculture et de la biotechnologie comme par exemple les techniques Sonic Bloom commercialisées et diffusées par Dan Carlson Scientific Enterprises. Issues de ces recherches plusieurs applications dans le domaine agricole et agroalimentaire se sont développées et ont mené à la commercialisation et l'utilisation par plusieurs entreprises.

La dernière partie de la thèse relate une expérience menée pour vérifier la validité de la technique développée par J. Sternheimer. Une expérimentation a été mise en place sur 4 groupes de plants de tomates. Le traitement consistait à soumettre les plants de tomates à certaines séquences sonores bien spécifiques décodées à partir du code génétique correspondant à certaines protéines cibles. Selon le principe de la génodique le traitement des plants par ces séquences sonores induit la stimulation de la synthèse de certaines protéines cibles correspondant à ces séquences sonores spécifiques.On obtient ainsi des changements pheénotypiques décelables auprès des plants ainsi traités. Les expériences ont confirmé que le traitement a des effets sur la croissance et le développement des plants de tomates et cela statistiquement tres significativement ($p<0.001$).
Le traitement consistait à traiter les plants chaque jour durant 6min par les séquences sonores épigénetiques susceptibles de stimuler la synthèse des protéines connues sous le nom d'extensines, afin de verifier la spécificité de l'action de ces séquences sonores épigénétiques (spécifique pour la stimulation des extensines), la taille des plants fut mesurée régulierement durant leur croissance. Une augmentation de la synthèse d'extensines provoque l'obtention de plants de plus grande taille. Les effets spécifiques de ces séquences ont été observés dans chacune des expériences et confirment ainsi des expériences antérieures et la théorie de résonance d'échelle. Une expérience similaire fut réalisée afin d'augmenter la tolérance à la sécheresse des plants de tomates en les traitant avec les séquences sonores correspondant à une protéine connue pour augmenter la tolerance des plantes à la sécheresse. Les plants de tomates exposés ont poussé et se sont développés en recevant la moitié moins d'eau que ceux du groupe témoin. La conclusion confirme aussi la spécificité de l'action de ces séquences sonores épigénetiques sur la tolérance à la sécheresse.
Ces différentes techniques offrent de multiples possibliltés d'utilisations et de développement d'applications pour l'agriculture, l'horticulture, la microbiologie et l'industrie agroalimentaire.

Recherche

Le pouvoir de la musique sur les plantes

Selon Yannick Van Doorne, s'il y a des séquences sonores stimulantes correspondant chacune à des protéines distinctes, il existe aussi des séquences sonores inhibitrices.

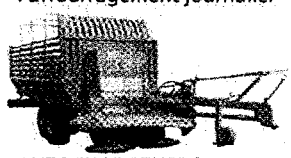
Les fréquences sonores influent sur la croissance et la résistance des plantes. Des expériences ont montré que ce phénomène est bien réel et qu'il est possible de l'appliquer en agriculture. Alors, à quand des sonos dans les champs bio ?

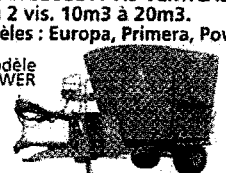
A l'occasion du dernier festival Science frontières, Yannick Van Doorne a présenté l'étonnant travail de sa thèse de fin d'études. À l'École supérieure de Gand, il a récemment fait des recherches sur *« l'influence de fréquences sonores variables sur la croissance et le développement des plantes »*. Ce phénomène n'est d'ailleurs pas nouveau puisque l'histoire est jalonnée d'anecdotes et de croyances anciennes vantant le pouvoir des sons sur la croissance des plantes. Jean Marie Pelt, lui aussi, évoque les chants de la tribu Hopi qui en Arizona sont appliqués aux champs de maïs.
Une expérience récente a montré l'influence positive de la musique classique alors que la musique rock fait régresser les mêmes plantes. En France, Joël Sternheimer a découvert les bienfaits provoqués par certaines ondes avec des applications concrètes en agriculture. Grâce à des séquences musicales décodées, un producteur de tomates hollandais a pu contrer une épidémie virale sur ses plants de tomates. Aux USA, une entreprise développe la technique Sonic Bloom basée sur l'utilisation de fréquences sonores améliorant fortement l'absorption foliaire de produits pulvérisés.

Le pouvoir des séquences sonores

Yannick Van Doorne explique le phénomène. Les ondes acoustiques sont transformées en ondes électromagnétiques qui, à leur tour, sont sources d'ondes d'échelle. Ces dernières atteignent les ribosomes de la cellule végétale où elles influencent la synthèse des protéines par des effets de résonance. S'il y a des séquences sonores stimulantes correspondant chacune à des protéines distinctes, il existe aussi des séquences sonores inhibitrices.
Ainsi, des périodes de croissance raccourcie mais aussi la prévention contre les maladies et les insectes ont été permises par des sons appropriés. Lors de ses travaux, Yannick Van Doorne a vérifié l'influence de séquences sonores sur le développement des pieds de tomates. Pour lui comme pour ceux qui s'intéressent à la question, la faisabilité économique est bien réelle mais de nombreuses recherches seront encore nécessaires pour comprendre les mécanismes intimes de l'influence des sons sur les plantes.

G.L.





Des ondes et des sons au service des plantes : une solution en cas de sécheresse

Entre autres influences, les plantes sont sensibles aux ondes sonores et magnétiques. Ainsi, des chercheurs passionnés par ces questions, agriculteurs, horticulteurs, maraîchers et vignerons commencent à s'intéresser à ces techniques qui permettent notamment aux végétaux de mieux résister à la sécheresse. Les résultats sont là !

Par Michèle Egli-Wachs

Dans la nature, les chants d'oiseaux, le matin au printemps, soutiennent l'éveil des végétaux (germination des semences et rapidité de croissance). Des récits recueillis de tribus indiennes (La légende de Kokopelli chez les Hopi par ex.) et des écrits religieux font mention de l'importance de certains rituels sonores pour soutenir la croissance des plantes et augmenter leur résistance à la sécheresse. Même en biotechnologie la sonication est utilisée pour faciliter certaines manipulations génétiques. De nombreuses recherches ont été effectuées ces 20 dernières années en France, Belgique, Suisse, Etats-Unis etc. qui forment les bases scientifiques des applications décrites ci-dessous développées par Yannick van Doorne au sein d'Ecosonic.

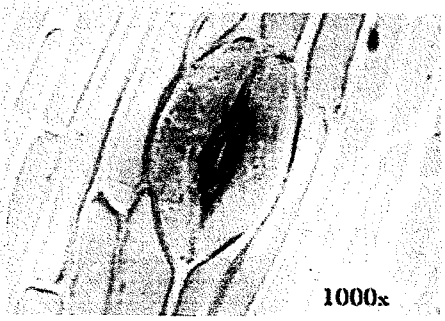
La technologie Sonic permet d'augmenter la capacité des plantes à absorber l'humidité ambiante

La technologie Sonic stimule l'ouverture des stomates[1] et donc l'absorption foliaire par l'utilisation de fréquences sonores précises, émises à une forte intensité durant un traitement foliaire, augmentant ainsi l'absorption des liquides pulvérisés. Les plantes ont naturellement la capacité de réguler l'ouverture de leurs stomates. Situées sur la surface des feuilles, ces cavités sont munies d'un système d'ouverture et de fermeture ingénieux qui permet à la plante de réguler son degré d'ouverture en fonction des conditions climatiques, d'humidité, de température et de différents stress. Certains sons améliorent l'absorption de plus de 30 à 50 %. En cas de traitement phytosanitaire, cette technique implique l'utilisation d'une formulation des engrais foliaires très équilibrée pour ne pas perturber la plante. Bien évidemment, la quantité de produit est très réduite par rapport à celle utilisée dans les traitements classiques.
Cette même technologie (physique des résonances) permet d'interagir avec les organelles cellulaires des plantes par une émission sonore ciblée, créant une résonance avec elles. Certaines fréquences sonores spécifiques peuvent avoir une action de stimulation de l'activité cellulaire, déclenchant une action favorable sur la croissance et le développement des plantes en stimulant, entre autres, la respiration et la photosynthèse. La croissance des cultures telles que le blé, le riz et le maïs augmente de 5 à 20 % et jusqu'à 100 % selon les cas. On peut atteindre des résultats similaires sur la majorité des cultures avec des séquences sonores adaptées selon la plante.

La technique SRP (Séquence de résonance des protéines), issue d'une découverte transversale combinant des recherches en physique quantique et en génie biologique, consiste à émettre des séquences électromagnétiques et bioacoustiques précises qui inhibent ou stimulent la biosynthèse des protéines. Ce système permet de soutenir les processus de défenses naturelles de la plante, et au niveau moléculaire des cellules, de contrer le développement des maladies, de stimuler ou d'inhiber des caractéristiques ciblées de la plante afin d'améliorer sa croissance et son développement dans son environnement spécifique. Ce qui peut aboutir à un traitement préventif et curatif de maladies telles oïdium, mildiou ou botrytis.
D'autres expériences significatives ont eu lieu notamment chez un vigneron du Valais en Suisse; le taux de sucre d'une parcelle mal exposée - systématiquement en déficit de sucre par rapport aux autres mieux ensoleillées - a manifestement augmenté de plus de 5 % après stimulation des éléments moléculaires concernés. Ce même taux de sucre a pu être augmenté sur des tomates au Japon. Ces deux techniques pourraient-elles résoudre les problèmes que rencontrent les plantes lors de restriction d'eau ?
La technologie Sonic peut permettre d'augmenter la capacité des plantes à absorber le plus d'humidité ambiante possible (rosée ou brumisation très fine) jusqu'à 400 l/Ha et la technologie SRP peut simuler la capacité naturelle des plantes à la résistance à la sécheresse.

▼ *A gauche, betteraves ayant bénéficié de la technologie Sonic, à comparer à celles de droite n'ayant pas reçu ce traitement*

▼ *Stomate grossie 1000 fois*

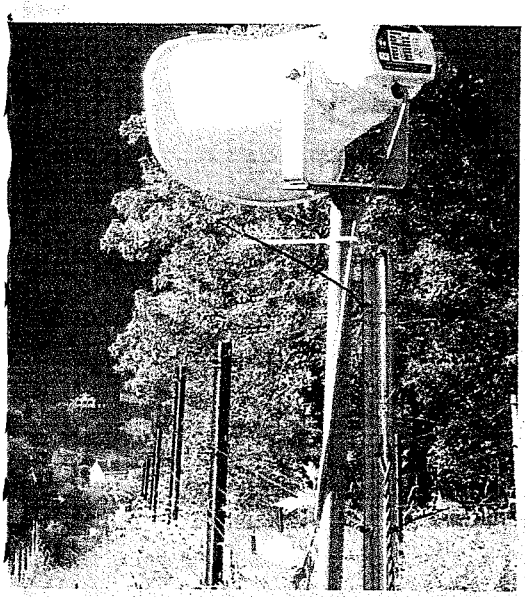


Comment ça marche ?

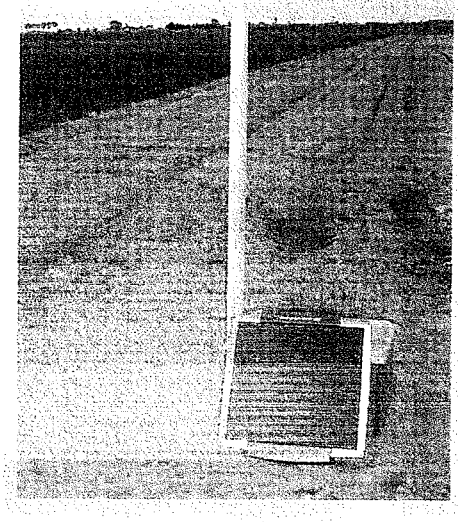
Résonance des stomates (technologie Sonic)
On sait en physique que chaque structure, petite ou grande, possède une fréquence de résonance.

C'est une propriété que l'on retrouve aussi pour les cellules des plantes et leurs microstructures. Des tests ont démontré que sous l'effet de fréquences sonores adéquates, même de faible intensité, ces structures cellulaires peuvent entrer en résonance, ce qui a pour conséquence de modifier le fonctionnement même de la cellule, positivement ou négativement, selon la dose, la fréquence et l'intensité. La physique nous explique aussi que des cavités, munies d'une ouverture de l'ordre de grandeur de quelques micromètres, possèdent une fréquence de résonance dans la gamme audible. De telles cavités se retrouvent aussi sur les plantes comme nous l'avons vu plus haut ; les stomates, lieu des échanges gazeux entre la plante et le milieu extérieur.

▲ *Des expérimentations sont menées avec succès sur des plants de tomates*



▼ *Kit anti-sécheresse*



Ainsi, des expériences ont démontré que l'on peut sensiblement augmenter la capacité d'absorption des plantes de l'humidité de la rosée du matin. Cette augmentation est de l'ordre du double ou du triple par rapport aux plantes sans traitement sonore (une augmentation de 700% a même été enregistrée dans le cadre d'une expérience effectuée en laboratoire). Les fréquences sonores possédant les propriétés de stimuler la capacité d'absorption des plantes se retrouvent dans des gammes audibles similaires aux chants d'oiseaux.

Technique SRP

Les acides aminés, lorsqu'ils s'assemblent pour former une protéine, émettent une onde d'échelle, à une fréquence donnée, qu'il est possible de calculer. La succession de ces ondes dans une chaîne protéique en formation constituerait précisément une mélodie associée à sa synthèse dans l'organisme. La transposition audible de cette suite de fréquences est alors une séquence sonore spécifique comme une mélodie qui est capable d'influencer cette synthèse. Ainsi en exposant un organisme à la mélodie spécifique d'une protéine qu'il possède, cela stimule sa synthèse - ou l'inhibe pour une mélodie complémentaire, en « opposition de phase » avec la précédente.

La «mélodie» de la protéine TAS 14 ressemble fort à des rythmes de tam-tam africains ! Coïncidence ?

En 1996, au Sénégal, près de Dakar, une petite exploitation avait testé les effets de la «musique» de la protéine TAS 14 sur quelques milliers de plants de tomates. Cette protéine devait aider les plants à résister à la sécheresse. Trois minutes par jour, on diffusait à l'aide d'un radiocassette placé à côté des plants, la «mélodie» déduite de la séquence d'acides aminés de la TAS 14. Les résultats furent impressionnants : les plants de tomates exposés tous les jours à cette «musique» de la protéine TAS 14 anti-sécheresse, sont effectivement apparus comme ayant beaucoup moins besoin d'eau et ont eu une production bien supérieure, tout en devenant plus grands que ceux, à l'autre bout du champ, qui ne bénéficiaient pas de musique mais d'un arrosage plus important, conforme à l'usage dans la région. Yannick van Doorne a réitéré l'expérience lors de son mémoire de fin d'études en 2000 à Gand. Il a obtenu des plants de tomates bien verts dans des pots desséchés !!! A noter que la « mélodie » de » la protéine TAS 14 ressemble fort à des rythmes de tam-tam africains ! Coïncidence ?

Ecosonic propose maintenant des « kits anti-sécheresse » alimentés par des panneaux solaires à utiliser dans les champs. Ils permettent de réduire de 50 % les besoins en eau pour une croissance équivalente aux besoins complets. La technique SRP doit être utilisée en milieu professionnel avec des précautions d'usage. Elle est adaptée à chaque cas car elle doit être appliquée en tenant compte de nombreux paramètres ■

Note :

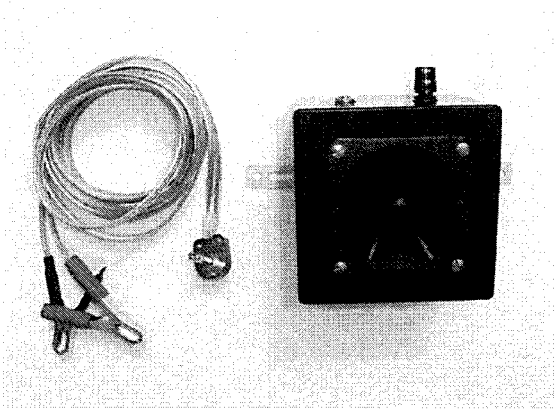
1) stomate : Terme de Botanique. Petit orifice qui sert à la respiration des végétaux.

Pour en savoir plus

- Société Ecosonic SARL,
  (
  Tél. [redacted]
  Site : www.ecosonic.net
  Bibliographie succincte et accessible à tous
- Van Doorne Yannick. 2000. Thèse de fin d'études. L'influence de fréquences sonores variables sur la croissance et le développement des plantes. Hogeschool Gent Belgium. Ecole d'ingénieurs en agriculture en collaboration avec l'université de Gand
- Les langages secrets de la nature, Jean Marie Pelt, Fayard 1996
- La vie secrète des plantes, Peter Tompkins, Christopher Bird, Robert Laffont, 1975
- Joël Sternheimer, diverses publications scientifiques
  http://members.aol.com/jmsternhei/
- John Kimney, Le chant du maïs,
  The Ecologist, mai 2000.
- TerreSacrée.org, Le chant du maïs,
  http://terresacree.org/haricot.htm

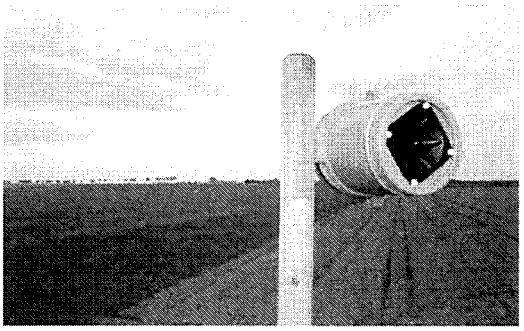
Kit de protection anti-gel
des gelées printanières

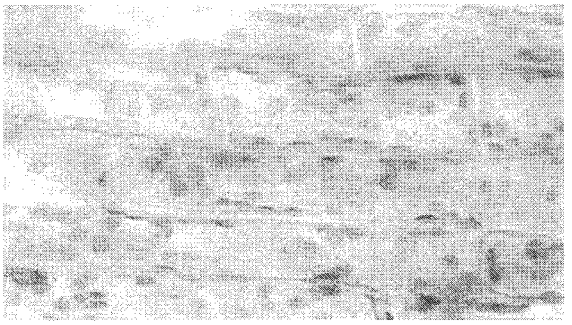
Viticulture - Arboriculture



Principe de fonctionnement

Des fréquences sonores oscillantes stimulent l'activité intracellulaire, ce qui en conséquence stimule les résistances au gel. Plus précisément ces fréquences stimulent la cyclose intracellulaire. Le contenant intracellulaire en mouvement accéléré résiste tout naturellement plus au gel, tel une eau en mouvement gèle moins vite qu'une eau statique.
Les fleurs, fructifications et bourgeons sont ainsi protégés efficacement et tout naturellement.





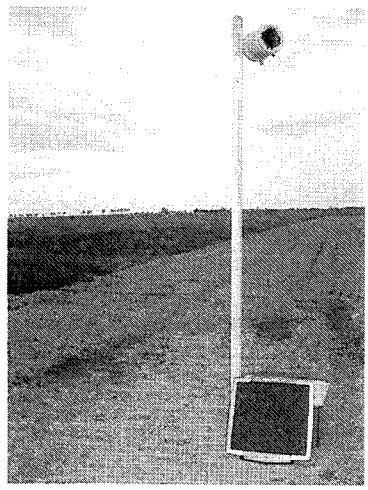
C'est une **action mécanique du son qui augmente le mouvement intracellulaire, ainsi le liquide intracellulaire en mouvement gèle moins rapidement** et seulement à des températures plus basses, ce qui augmente la résistance au gel des végétaux.
L'action de stimulation du métabolisme cellulaire augmente la concentration en substances et molécules biologiques comme les sucres fonctionnant comme antigel naturel augmentant ainsi la résistance au gel des fleurs, bourgeons ou des fruits.
En complément des pulvérisations foliaires à base d'algues simultanément au traitement sonore permettent davantage l'augmentation de la concentration en substances biologiques antigel et renforcent ainsi encore la protection et la résistance au gel. Ces fréquences sonores émises permettent d'augmenter fortement l'absorption des pulvérisations foliaires.
Certains utilisateurs témoignent de protections jusqu'à – 7°C, selon l'inventeur on peut protéger efficacement jusqu'à – 3°C et jusqu'à – 5°C avec l'usage des pulvérisations en complément.

Références scientifiques

- "Analyse de la dépendence de la temperature sur le mouvement du cytoplasme" Analysis of temperature dependence of cytoplasmic streaming using tonoplast-free cells of Characeae T. Shimmen.S. Yoshida. 30 August 1993. Department of Life Science, Faculty of Science, Himeji Institute of Technology, Harima Science Park City, 678-12 Hyogo, Japan. Protoplasma. Springer Wien. Volume 176, Numbers 3-4. September 1993 . Pages: 174 – 177
- Extrait : Lors d'un refroidissement le mouvement du cytoplasme et des organelles intracellulaires ralenti graduellement et s'arrête en fin de compte a une température entre 5°C et –7°C. » Cine-Photomicrography of Low Temperature Effects on Cytoplasmic Streaming, Nucleolar Activity and Mitosis in Single Tobacco Cells in Microculture . T. M. Das, A. C. Hildebrandt, A. J. Riker. *American Journal of Botany*, Vol. 53, No. 3 (Mar., 1966) , pp. 253-259

Kit de protection anti-gel
des gelées printanières

Pour utilisation en arboriculture, culture plein champ et tunnels.



Pour toutes les cultures en pleine terre :

- viticulture
- arboriculture (pépinières, arbres et arbustes, cerises, abricots, pêches, pommes, poires, prunes, ...)
- cultures maraîchères et horticoles en pleine terre

Un kit est composé de :

- un émetteur sonic résistant aux intempéries
- module électronique d'émission des fréquences intégré dans l'émetteur
- câbles d'alimentation

*options ou accessoires :

- *piquet en bois de 2 mètres
- * un programmateur thermostat ou horaire, ou par alerte et démarrage par GSM
- * panneau solaire et régulateur de charge
- *bac de protection et *batterie 12 Volt

Le kit est prêt à l'emploi à poser au milieu du champ de 1 - 5 à 10 ha.

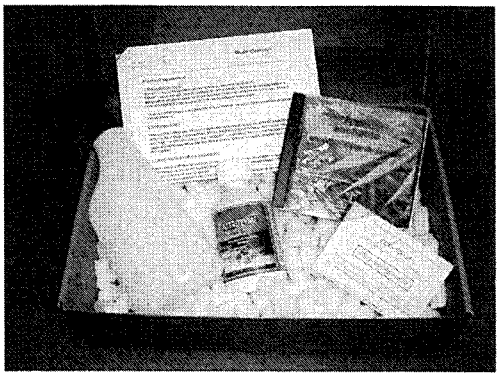
Principe de fonctionnement
Les fréquences sonores oscillantes stimulent l'activité intracellulaire, ce qui en conséquence stimule les résistances au gel. Plus précisément ces fréquences stimulent la cyclose intracellulaire. La cyclose est le mouvement circulaire du cytoplasme, ce qui s'observe par microscope par les mouvements des chloroplastes à l'intérieur des cellules. Le contenant intracellulaire en mouvement accéléré résiste tout naturellement plus au gel, tel une eau en mouvement gèle moins vite qu'une eau statique. Quand l'activité cellulaire des cellules des bourgeons, fleurs et de la fructification augmente, alors tout naturellement leur résistance au gel augmente aussi.
Certains utilisateurs témoignent de protections jusqu'à –7°C, selon l'inventeur de cette technique on peut protéger efficacement jusqu'à –5°C.

Ce kit est doté d'un circuit électronique d'une haute technologie pour mettre en œuvre l'application de fréquences sonores oscillantes de stimulation du métabolisme et activité des cellules et de l'absorption foliaire.
Le kit est discret et facilement transportable d'un point à l'autre. Il peut aussi être installé sur le champ à traiter de manière fixe afin de pouvoir assurer un traitement régulier pour une période de plusieurs semaines à plusieurs mois.
La batterie est automatiquement rechargée par le panneau solaire même en cas de temps nuageux. Un réglage de puissance permet d'ajuster l'intensité de l'émission sonore.
Le programmateur horaire de branchement automatique est réglé en général pour une émission lors des périodes de risques de gel souvent durant la nuit et le matin. Le système est modulaire et permet l'ajout d'émetteurs supplémentaires.
Tableau et photo à titre indicatif

Superficie de terrain à traiter	Pour l'émission des fréquences oscillantes	
	Nombre de kits (avec batterie)	Nombre d'émetteurs
1 ha	2	6
5 ha	5 à 10	30
10 ha	10 à 20	60

Contact : Yannick Van Doorne - Tel port. +33 (0) 6 88 08 68 94 -

Kit du jardin enchanté



Description technique

Votre kit du jardin enchanté comprend :

- Un pulvérisateur de type spray manuel.
- Une CD de musique et fréquences favorables à la croissance des plantes. Plusieurs passages de musique classique enrobés de fréquences sonores spécialement sélectionnées pour les plantes.
- Un mode d'emploi en format papier A4
- Un flacon de 250 ml du produit naturel et organique Nitrozyme spécifiquement formulé et équilibré pour cette application, à base d'algues et d'extraits de plantes. Il y a suffisamment de produit concentré pour faire plus de 50 litres de solution pour la pulvérisation. Une dilution de 1/200 recommandé pour l'application.
- Poids total du kit : 1,40 kg.

Résultats et Avantages

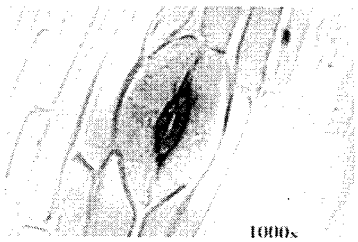
- Forte croissance des plantes
- Meilleures et plus grandes récoltes de fruits et légumes
- Teneurs en certains nutriments et vitamines plus élevées
- Plantes en meilleure santé
- Fleurs éclatantes, un jardinage agréable et musical
- En harmonie avec les chants des oiseaux. Une technologie innovante, naturelle et ancestrale
- Un stimulateur de croissance musical et naturel
- Une formulation nutritive biologique, organique, équilibrée et efficace
- Utilisé pour toutes les plantes sous tous climats, en intérieur ou extérieur, sans distinction. Il y a quelques exceptions, par exemple certaines plantes comme les cactus sont moins influencées.

Témoignage :
Johan Toebat, jardinier près de Bruxelles : Cette année avec la technique d'absorption sonic, nous avons récoltés des oignons d'un calibre impressionnant. Après avoir fait des mesures sur une quarantaine de plants dans mon jardin, j'ai constaté un accroissement de 50% en poids sur les oignons. Mes betteraves rouges sont aussi beaucoup plus gros et ça se voit dans les rangés.

Yannick Van Doorne, ingénieur agronome - Tel. + 33 (0) 6 88 08 68 94
http://musique-pour-soigner-les-plantes.weebly.com

Principe de fonctionnement

La technologie d'absorption Sonic permet, par l'utilisation de fréquences sonores précises émises à une forte intensité durant un traitement foliaire, d'augmenter l'absorption foliaire des liquides pulvérisés. Ces fréquences sonores et certaines compositions musicales stimulent l'ouverture des stomates. *(Les stomates sont des petites pores dispersés sur le feuillage par lequel les plantes respirent et absorbent des nutriments par voie foliaire).* Les plantes ont la capacité de réguler l'ouverture des stomates en fonction des conditions climatiques, de l'humidité, de la température et de différents stress. En pratique, certains sons améliorent l'absorption foliaire de plus de 30 à 50 %. Un test en laboratoire a permis une meilleure absorption de 700 %. Une forte amélioration de l'absorption foliaire implique l'utilisation d'une formulation des engrais foliaires très équilibrée pour ne pas perturber la plante.



Les stomates sont des petits pores du feuillage par lesquels les plantes respirent et absorbent des nutriments. Les plantes ont la capacité de réguler l'ouverture de leurs stomates en fonction de l'humidité, de la température et de différents stress.

Certaines compositions musicales, ensemble avec certaines fréquences sonores spécifiques qui les composent, peuvent avoir une action de stimulation de l'activité cellulaire. Ces compositions musicales, accompagnées des séquences sonores adaptées, peuvent avoir une action favorable sur la croissance et le développement des plantes par la stimulation de l'absorption foliaire, de la respiration et de l'activité biologique.

Dans la nature ces phénomènes sont bien connus, il y a les chants d'oiseaux les matins de printemps accompagnant l'éveil des végétaux par la germination des semences et la rapidité de leur croissance. De nombreuses recherches ont été effectuées de par le monde en France, Belgique, Suisse, Indonésie, Chine, Hongrie, Australie et aux Etats-Unis qui forment les bases scientifiques de cette application.

Références

Références scientifiques

- Van Doorne Yannick. 2000. Thèse de fin d'études. L'influence de fréquences sonores variables sur la croissance et le développement des plantes. Hogeschool Gent Belgium. Ecole d'ingénieurs en agriculture en collaboration avec l'université de Gand
- Site internet : www.ecosonic.net et www.sonicbloom.com
- Matsuhashi Michio et al. (1998). Production of sound waves by bacterial cells and the response of bacterial cells to sound. Journal Gen. Appl. Microbiol., **44**, 49-55.
- Measures, M. and Weinberger, P. (1970). The effect of four audible sound frequencies on the growth of Marquis spring wheat. Can. J. Bot. **48**: 659-662.
- Mirtskhulava, M. B. (1991). The primary mechanism of the biological action of weak magnetic fields of sound frequency. Soobshcheniya Akademi Nauk Gruzii. **144**(2-3): 313-315.

Presse

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- Guiness book of world records. La plus grande plante intérieur. Largest indoor plant in the world. 1974-1990. Dan Carlson using sonic bloom process.
- Bio/Tech News, Bio/Tech publishing, special report. 2002. Supersonic.
- World Watch. May-june 1993. Sonic bloom speeds growth of food crops. Windstar vision. Winstar foundation. POB 6991. Syracuse.New York.
- AgriAlternatives. July/August 1998. Published by media discoveries. Canton Georgia. Stephen Jones

Traitement foliaire sonic sur rose coupé

Lieu d'expérimentation : La Roseraie à Aramon (Gard)

Condition de culture :

Rosier sous serre thermorégulée
Conduite hors sol sur pouzzolane
Ferti-Irrigation identique pour les deux zones.

Variété : Red France
Date de taille : le 01/04/05

Protocole

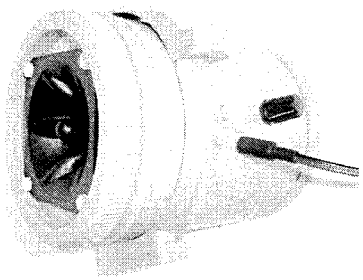
Matériel de traitement : Emetteur sonic
Fonction sonore : stimulation de l'absorption stomatique
Période : toutes les semaines, jusqu'à la coupe
Durée : 2 heures
Période d'essai : Date : Du 18/04/05 au 31/05/05
Fréquence de traitement : Un traitement par semaine, 5 traitements

Mesure de croissance et observation sur 2 x 25 tiges.

Méthode de pulvérisation :

1) Produit concentré de traitement (ex : Solalg) dilué a 1:200 dans le pulvérisateur. Diluer en mélangeant énergiquement.
2) Enclencher l'unité sonore une 30 minutes avant le traitement.
3) Pulvériser sur toute la surface du feuillage, en dessous et au dessus. Bien mouille toute la surface de la plante.
4) Continuer le traitement sonore pendant la pulvérisation. Désenclencher le traitement sonore 1 heure minimum après la fin de la pulvérisation. De préférence continuer le traitement sonore jusque 2 heures après la pulvérisation.
5) Garder le produit a l'abri de la lumière et de températures extrêmes

Image de l'émetteur



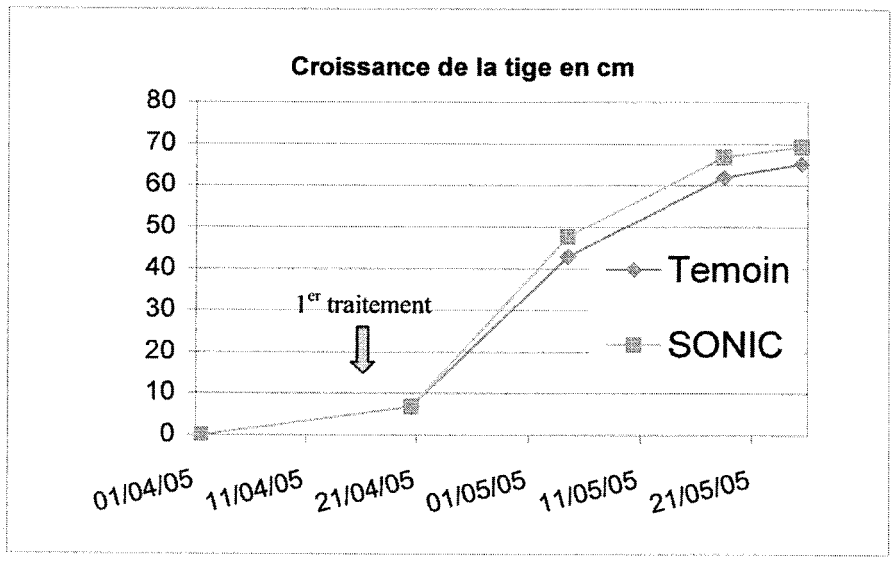
Contact : Yannick Van Doorne – Tel +33 688086894 – Email yannickvd11@yahoo.fr

Résultats :

Un rendement supérieur

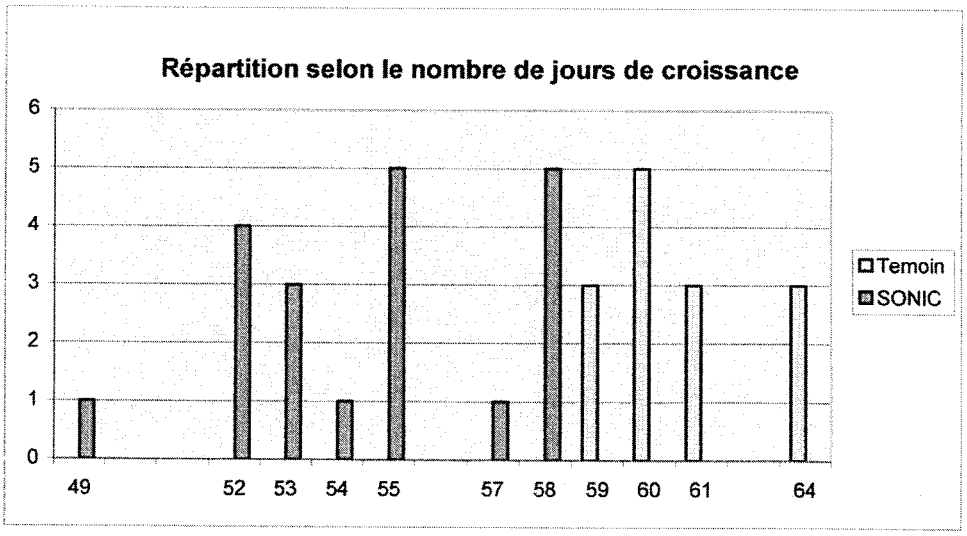
% de plantes dont la croissance n'a pas excédé 65 jours :
Témoin : 64 %
SONIC : 84 %

Une longueur de tige accrue de 6%



Pour une longueur témoin de 65 cm, les roses traités font 70 cm en moyenne.

11,5 % de temps de croissance gagné sur la coupe



Gain de 5 jours de précocité en moyenne

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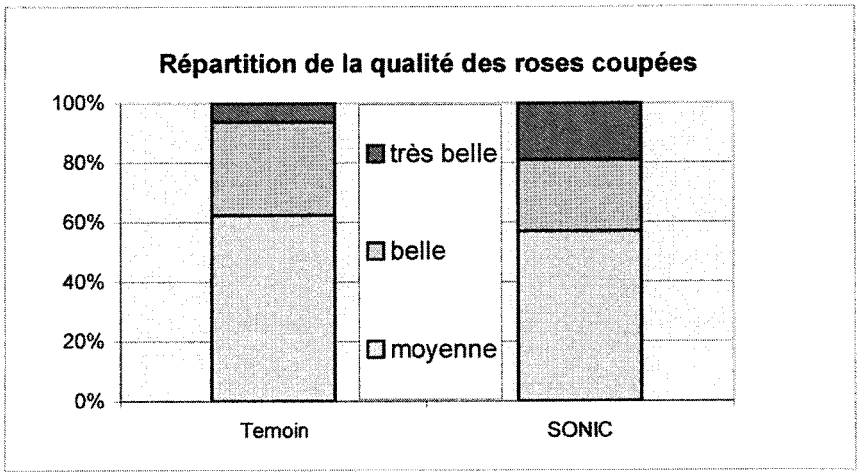
Amélioration significative de la qualité des roses



Le producteur observe une plus grande proportion de rose de belle qualité : + 5 %
Et en même temps l'état sanitaire est amélioré : trace d'oïdium : - 4,6 %

L'Emetteur Sonic pendant la pulvérisation d'engrais foliaire à base d'algues.
VOUS DONNE :

- ✓ L'assurance d'une maturité plus précoce.
- ✓ La garantie de tiges plus grandes surmontées d'un bouton de plus grande qualité.
- ✓ Un état sanitaire de la culture plus satisfaisant grâce à l'équilibre et la richesse nutritionnelle du produit de traitement .
- ✓ Financièrement, ce procédé vous assure au minimum de 10 % de gain de chiffre d'affaire.

Contact : Yannick Van Doorne – Tel +33 688086894 – Email yannickvd11@yahoo.fr

Produit de traitement foliaire préconisé actuellement :

Solalg (Samabiol)

Composition

Engrais NFU 42 001
Engrais entièrement d'origine végétale
Solution N K 1.8-0-3.5

Composition	Poids/Poids	Poids/Volume
Azote total (N)	1,8 %	2 %
dont Azote organique	1,5 %	1,6 %
Oxyde de Potassium (K2O) soluble eau	3,5 %	4 %
Anhydride Sulfurique (SO3)	4,5 %	5 %

Principaux autres composants

Bios : hormones, vitamines, acides aminés, enzymes dont

- **AIA - Acide Indol-Acétique** 60 mg/l
- **ABA - Acide Butyl-Acétique** 20 mg/l
  (2 puissants facteurs de croissance)
- **Adénine** 40 mg/l
- **Acide Ascorbique** (vitamine C) 40 mg/l
- **Les Biotines** 40 mg/l qui stimulent la pénétration des éléments nutritifs dans le végétal.
- **Les Bétaïnes** 80 mg/l qui ont une action sur le renforcement des défenses naturelles des plantes traitées contre les maladies.

Oligo-éléments (33 identifiés)

- Cuivre (Cu) 2 mg/l
- Fer (Fe) 40 mg/l
- Manganèse (Mn) 2 mg/l
- Zinc (Zn) 20 mg/l
- Bore (B) 20 mg/l
- Molybdène (Mo) 1 mg/l
- Cobalt (Co) 2 mg/l

Eléments spécifiques aux algues marines

- Acide alginique
- Laminarine
- Mannitol

Contact : Yannick Van Doorne – Tel +33 688086894 – Email yannickvd11@yahoo.fr

Essai de l'émetteur sonic + extraits d'algues en foliaire sur culture de radis

1. Objectif de l`essai

Les fréquences sonores peuvent avoir une influence sur la croissance et le développement des plantes. L`objectif est de tester l`intérêt de la technique Emetteur Sonic en culture de radis sous abris. Les indicateurs finaux sont le poids, le calibre et la couleur du feuillage. D`autres paramètres comme la vigueur et la sensibilité aux maladies sont aussi observées.

2. Coordonnées

Réalisateur du test :
Nom : Julien Brissier

Lieu d`expérimentation :
Adresse : Eyragues

3. Conditions de culture

Radis sous serre.
Variété : flamboyant
Date de semis : 27 juin
Dispositif : ¼ de m² par traitement :
- Temoin

Son + produit solalgue
produit solalgue seul
Terre de semis : limono-sableux

4. Protocole

Matériel de traitement ;
Emetteur Sonic
Contenu bande sonore : Oscillation de fréquences sonores pour stimuler l'absorption stomatique
Durée : 2 heures
Produit foliaire : Solalgue
Concentration lors du traitement : 5ml/l

Pulvérisateur ;
Caractéristiques : manuel
Volume : 600 ml
Période d`essai : Date : Du 27/06/05 au 01/08/05
Fréquence de traitement : Un traitement par semaine

Méthode

1) Produit concentrée Solalgue dilué à 1 : 200 dans le pulvérisateur. Une à deux cuillères à soupe dans le pulvérisateur et remplir avec l'eau de pluie ou de source. Diluer en mélangeant et secouant énergiquement.
2) Enclencher l'unité sonore 30 minutes avant le traitement.
3) Pulvériser sur toute la surface du feuillage, en dessous et au dessus. Bien mouillé toute la surface de la plante.
4) Continuer le traitement sonore pendant la pulvérisation. Continuer le traitement sonore jusque 2 heures après la pulvérisation.
5) Garder le produit à l'abri de la lumière et de températures extrêmes

5. Tables

Dates de traitement :
Traitement 1 : 04/07/05
Traitement 2 : 11/07/05
Traitement 3 : 18/07/05
Traitement 4 : 25/07/05

Groupes	Poids total (en g)	% différence	Calibre moyen (diamètre radis en mm)	% différence
Témoin - 1	**90 g**	**référence 100%**	**6**	**référence 100%**
(Produit solalgue + son) - 2	**165 g**	**+ 83%**	**9**	**+ 50%**
Produit solalgue seul - 3	**75g**	**- 17%**	**5**	**- 17%**

6. Observations

Développement du feuillage : sur la placette produit + son, la différenciation des feuilles à commencer le 13/07, 4 jours avant les autres placettes. La couleur du feuillage et des radis était égale pour le groupe témoin, le groupe traité avec le solalgue seul et le groupe traité avec le solalgue et avec le son. Il y a des prises de photos hebdomadaire avec la notation de la date et du sujet photographié

Van Doorne Yannick
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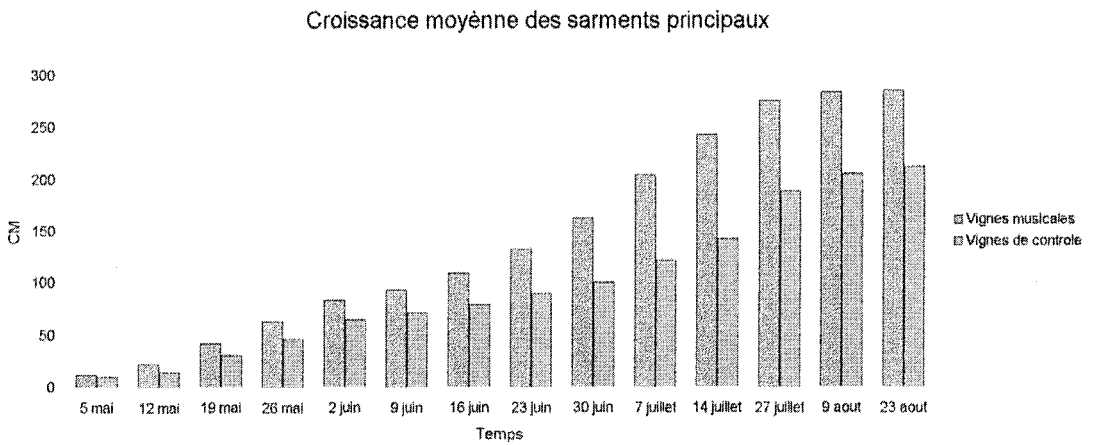
Croissance moyenne du sarment principal de chaque vigne (CM)

L'un des groupes, nommé "musical", était exposé 8h par jour à plusieurs passages de musique classique émis par une caisse audio; l'autre groupe, le control, était distant du premier environ 20 metres de façon qu'il ne resentisse pas les effets des ondes sonores et au meme temps que les conditions microclimatiques puissent être les memes.

Vignes musicales	5 mai	12 mai	19 mai	26 mai	2 juin	9 juin	16 juin	23 juin	30 juin	7 juillet	14 juillet	27 juillet	9 aout	23 aout
M1-A	11	24	45	66	86	91	98	116	144	183	228	282	286	288
M2-B	10	23	47	76	104	118	139	170	209	257	282	300	305	305
M3-B	17	26	41	53	63	68	80	96	122	164	207	262	296	304
M4-C	4	11	27	49	66	72	81	93	103	134	171	211	230	232
M5-A	22	32	49	68	92	104	122	148	182	226	277	318	318	318
M6-A	10	19	41	64	87	101	130	171	211	257	292	292	292	292
M7-B	15	27	46	67	86	96	114	138	174	212	241	252	252	252
M8-C	6	17	38	60	83	93	108	123	156	201	244	286	292	292
Moyanne	11,875	22,375	41,75	62,875	83,375	92,875	109	131,875	162,625	204,25	242,75	275,375	283,875	285,375

Vignes de controle	5 mai	12 mai	19 mai	26 mai	2 juin	9 juin	16 juin	23 juin	30 juin	7 juillet	14 juillet	27 juillet	9 aout	23 aout
C1-A	7	16	36	54	68	70	72	73	81	109	130	166	175	179
C2-B	11	20	39	56	76	84	95	104	113	129	155	212	220	224
C3-B	5	12	34	51	71	78	84	91	93	102	124	168	180	186
C4-A	G	3	8	17	31	37	43	54	76	111	138	196	222	234
C5-B	5	12	33	54	81	92	110	140	159	172	183	220	234	240
C6-A	16	23	34	45	63	67	72	76	80	104	122	168	202	208
Moyanne	10,5	14,3333333	30,6666667	46,1666667	65	71,3333333	79,3333333	89,6666667	100,333333	121,166667	142	188,333333	205,5	211,833333



Ondes sonores et végétaux

Etienne Boucher, Marie-Hélène Jolicoeur, Amélie Boudreau et Olivier Bergeron, étudiants au collège Gérald-Godin.

Théorie

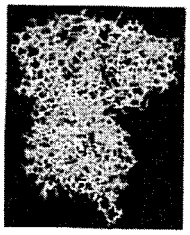
Notre expérience est basée sur les travaux d'un physicien français (Dr. Sternheimer) qui a développé une théorie sur la résonance harmonique mettant en relation les ondes mécaniques (sons) et les ondes de De Broglie associées à l'assemblage des acides aminés lors de la synthèse protéique.

Hypothèse

Exposer des plantes à une «musique» protéique stimule la production de sa protéine correspondante.

Peroxydase p7

Une surproduction de cette enzyme a une influence négative sur le développement des racines et sur la croissance globale.



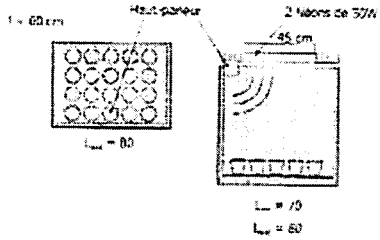
Brassica rapa

Plante à développement rapide, 15 cm en 15 jours.

- Sous règne : Vasculaire
- Embranchement : Spermatophyte
- Sous Embranchement : Angiosperme
- Classe : Dicotyledone
- Ordre : Crucifère
- Genre : *Brassica*
- Espèce : *rapa*

Protocole expérimental

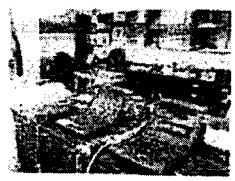
Nous avons recréé deux environnements de culture identiques, comprenant chacun 20 sujets, en exposant seulement le groupe expérimental à la série d'ondes sonores 30 minutes par jour et ce durant 15 jours. Depuis la remise de notre rapport, nous avons répété notre expérience en inversant les montages.



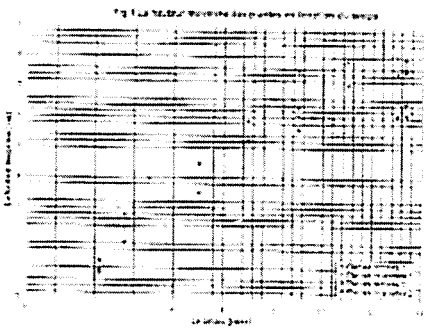
Montage

Deux environnements contrôlés

- Éclairage
- Insonorisation
- Type de sol
- Quantité d'eau



En permanence, prise de données assistée par ordinateur de certains paramètres



Résultats

À partir des résultats obtenus lors des deux expériences, nous avons constaté que la croissance du groupe expérimental a été considérablement inhibée. La surproduction de la protéine Peroxydase P7 pourrait expliquer ces résultats.

Conclusion

Nos résultats confirment notre hypothèse : **il est possible d'influencer la synthèse d'une protéine à partir d'une série d'ondes sonores spécifiques** correspondant à la séquence d'acides aminés de cette protéine.

Articles Scientifiques

Interactions Non-Locales dans l'Expression des Gènes

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Résumé: La prise en compte des interactions non-locales dans le génôme et l'expression des gènes conduit à montrer l'existence et à préconiser l'emploi de méthodes spécifiques de régulation épigénétique -- c'est-à-dire agissant sur cette expression pour la stimuler ou l'inhiber --, généralement bien mieux adaptées à leur objet que l'utilisation d'OGM.

1. Comme l'avait pressenti le physicien Hermann Weyl en 1918 (1), l'invariance des lois physiques par rapport au choix de l'unité de mesure, loin d'être une propriété purement numérique ou géométrique ayant seulement trait à leur représentation, a bel et bien des conséquences physiques mesurables (2) - la mesure d'un objet par un observateur n'étant qu'un cas particulier de l'altérité, nécessairement réciproque, des objets physiques les uns relativement aux autres. L'invariance d'échelle de l'instrument de mesure (avec un rapport donné de chaque unité à la suivante), nécessaire pour pouvoir mettre en évidence cette propriété, s'étend ainsi aux objets en général pour autant et dans les limites où chacun peut effectivement être pris comme instrument de mesure par rapport à un autre.

Les ondes d'échelle

Une conséquence de cette invariance est alors l'existence d'ondes reliant entre elles des échelles différentes, et qui généralisent en ce sens les ondes associées aux particules par la mécanique quantique (2). Ceci entraîne que, dans un objet qui en est le siège, la précision relative d'une mesure est limitée en elle-même par la portée de l'échelle (3). En d'autres termes, si l'on réduit cette portée en décomposant l'objet afin d'en étudier les composants, on perd irréversiblement de l'information : si on "démonte" un objet qui est le siège d'ondes d'échelle, on ne peut plus le remonter. Mais inversement, lorsque cette dernière propriété est vérifiée, l'existence conséquente de ces ondes implique qu'il doit exister des traces à l'échelle de l'objet entier de ce qui se passe à d'autres échelles plus fines ; leur "lecture" permet alors non seulement d'étudier cet objet, mais aussi dans une certaine mesure d'interagir avec lui. Le respect de l'objet d'étude, qui découle de la nécessité de préserver la portée de l'échelle afin d'assurer aux mesures une précision suffisante, est alors, dans ce cas, l'attitude naturelle à adopter sur le plan méthodologique (3 et 4).

2. On aura reconnu dans la propriété d'impossibilité de remonter un objet une fois qu'on l'a démonté, une propriété que possèdent, notamment, les êtres vivants. Cela signifie que dans ce qui caractérise précisément ces êtres vivants, à savoir l'existence d'un génome et l'expression des gènes composant ce dernier lors du processus de synthèse des protéines, on peut s'attendre à ce que des ondes d'échelle se manifestent et soient décelables. Et qu'en conséquence soient présentes dans ce génome des interactions non-locales, impliquant différentes échelles de son organisation, et donc une limitation essentielle à toute entreprise de le modifier localement; mais aussi la possibilité d'agir sur son expression de façon spécifique, grâce aux lois qui y président.

Des ondes dans l'expression des gènes

Considérons en effet ce qui se produit lors de l'expression des gènes (5) . Lorsqu'on absorbe des aliments, le processus de digestion qui s'ensuit consiste à les décomposer en éléments simples, les sucres en oses, les graisses en acides gras et les protéines en acides aminés. Notre programme génétique, contenu dans notre ADN, nous permet ensuite de fabriquer nos propres protéines à partir des acides aminés provenant de l'alimentation ou - pour certains - produits par l'organisme lui-même. De l'ADN va se détacher un ARN messager, qui va lui-même se fixer sur le ribosome, endroit très stable dont la forme d'établi va permettre la fixation des molécules nécessaires à la synthèse des protéines. Puis les ARN de transfert (tARN), qui portent les acides aminés, vont à leur tour se fixer sur l'ARN messager déjà fixé sur le ribosome. Par déplacements successifs, les acides aminés portés par les tARN vont alors s'accrocher les uns aux autres pour former une chaîne protéique : un acide aminé, situé au bout d'un tARN, va s'accrocher à un autre acide aminé, bientôt suivi d'un deuxième, puis d'un troisième, et ainsi de suite.

Si ce qui précède est aujourd'hui bien connu, considérons maintenant plus précisément ce qui se passe (6) au moment où l'acide aminé, porté par son tARN, vient s'accrocher sur le ribosome. Car lorsque l'acide aminé est à l'état libre, son comportement est simplement celui d'une particule soumise à l'agitation thermique : sa longueur d'onde de de Broglie est alors négligeable au regard de sa taille. Mais lorsqu'il s'accroche sur le tARN, ce n'est plus tout à fait le cas: fixé par un seul degré de liberté, il conserve une relative autonomie, tout en étant déjà fortement ralenti vis-à-vis de l'agitation thermique. Sa longueur d'onde, inversement proportionnelle au produit de sa masse par sa vitesse, cesse alors d'être négligeable et ses propriétés quantiques commencent à apparaître. Et lorsque le tARN qui le porte vient se fixer sur le ribosome, la stabilisation vis-à-vis de l'agitation thermique devient considérable, et la longueur d'onde de l'acide aminé dépasse sa taille de plusieurs ordres de grandeur : son comportement est alors celui d'une onde, ce qui signifie que, pendant le bref instant où cela se produit, l'acide aminé émet un signal.

Bien sûr, immédiatement après, le comportement de l'acide aminé redevient celui d'une particule : du point de vue de la mécanique quantique ordinaire (7) , si l'acide aminé est, pour parler simplement, particule puis onde puis particule, cela veut dire que le signal a disparu dès que le comportement corpusculaire réapparaît. En fait, c'est là que la considération selon laquelle, dans ce système intégré à plusieurs échelles, la fonction d'onde quantique doit être généralisée en une fonction d'onde d'échelle permet une prédiction originale. Selon celle-ci en effet, à la particule est associée une onde à valeurs non seulement dans l'espace-temps mais dans l'échelle, dans laquelle elle se propage comme une somme d'ondes de vitesses différentes, passant d'une échelle plus petite - celle de l'acide aminé - à une plus grande - celle de la protéine en formation - en des temps multiples entiers de celui mis par l'onde la plus rapide. De là vont nécessairement résulter des corrélations temporelles entre les fréquences associées aux acides aminés séparés par un multiple entier d'une certaine période. D'où une vérification simple : ces corrélations sont-elles ou non observées ?

Des effets non-locaux vérifiables expérimentalement

3. La réponse est oui, et plus encore. Considérons en effet la suite des fréquences associées à la synthèse d'une protéine donnée quelconque. Si, dès la fixation de chaque acide aminé sur l'ARN de transfert, les propriétés ondulatoires se manifestent déjà, il va en résulter une première prédiction: celle de la synchronisation sur harmoniques des fréquences de cette protéine, au bout d'un temps très court (de l'ordre de l0-12,5 seconde) - de la même façon que les masses des particules élémentaires les plus stables (précisément plus stables que cette

durée) se synchronisent sur une même gamme musicale (8). Le résultat d'une telle synchronisation peut alors se calculer aisément pour une proportion donnée de tARN dans une cellule (cf.(9)). Dans ces conditions, les corrélations temporelles mentionnées ci-dessus vont entraîner à leur tour une prédiction : à savoir que les intervalles de fréquences associées aux acides aminés successifs vont tendre eux aussi, à se synchroniser sur les harmoniques de rang le plus bas possible, autrement dit favoriser les intervalles consonants (au sens de Hellegouarch (10)) par rapport aux dissonants. La figure 1 ci-dessous montre ce qu'il en est pour 278 gènes procaryotes (colibacille et phages) (11) ; montrant très clairement (cf. aussi fig.2) l'existence des interactions non-locales prédites.

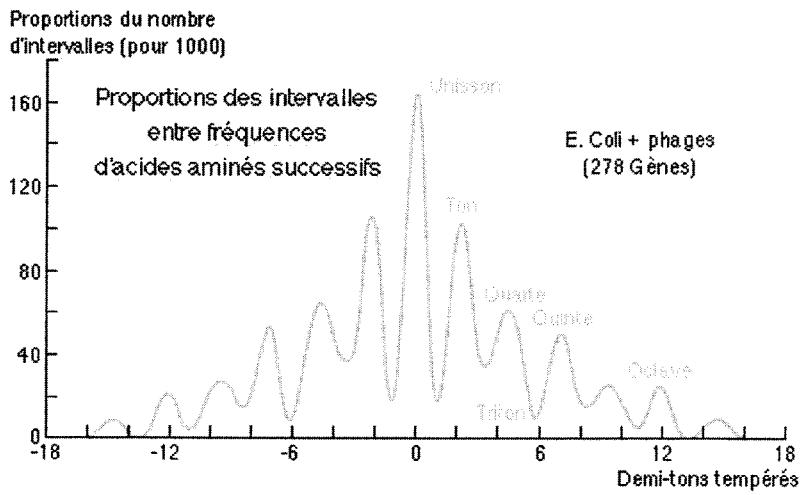

Fig.1: Lissage des proportions pour 1000 du nombre d'intervalles entre fréquences d'acides aminés successifs, pour 278 gènes procaryotes; en abscisse, les intervalles (rapports de fréquences) en demi-tons tempérés (puissances de 2 1/12). La position des maxima et minima, correspondant à des intervalles respectivement consonants et dissonants, révèle la présence (et l'amplitude relative) d'harmoniques dans les ondes associées aux acides aminés individuels, ainsi que leur relative persistence d'un acide aminé à l'autre lors du processus de synthèse.

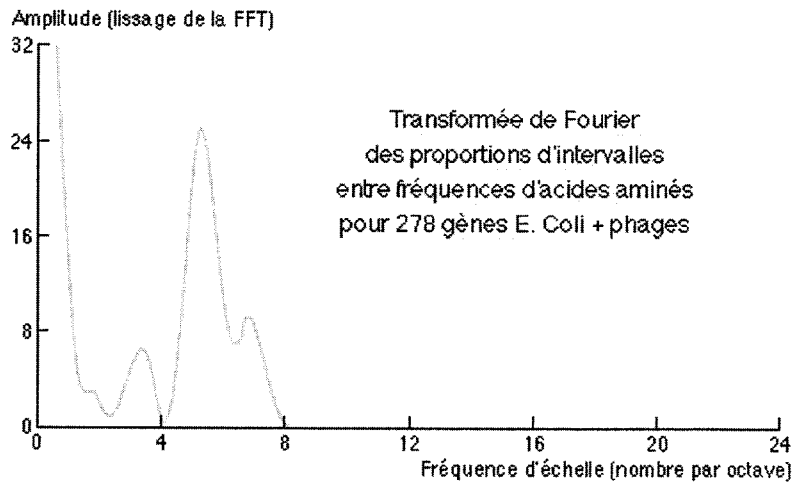

Fig.2: Transformée de Fourier rapide (FFT) du signal de la figure 1. Le pic observé (à la fréquence d'environ 5 par octave) constitue en lui-même une signature de la présence d'interactions non-locales dans l'expression des gènes.

Si l'on prend plus précisement comme indice le rapport unisson (fréquence identique) sur triton (quarte augmentée, particulièrement dissonante) on observe (fig.3) une croissance régulière de cet indice suivant que l'on considère, respectivement : des séquences au hasard, correspondant <1> à des fréquences équiprobables (c'est à dire réparties en proportions égales), <2> à des acides aminés équiprobables, <3> à des codons équiprobables, <4> à des acides aminés selon leurs proportions observées (12) ; puis à des séquences réelles, <5> chez des procaryotes (11) et <6> chez l'homme (séquence de la titine, la plus grosse protéine connue, comprenant 26 926 acides aminés (13)).

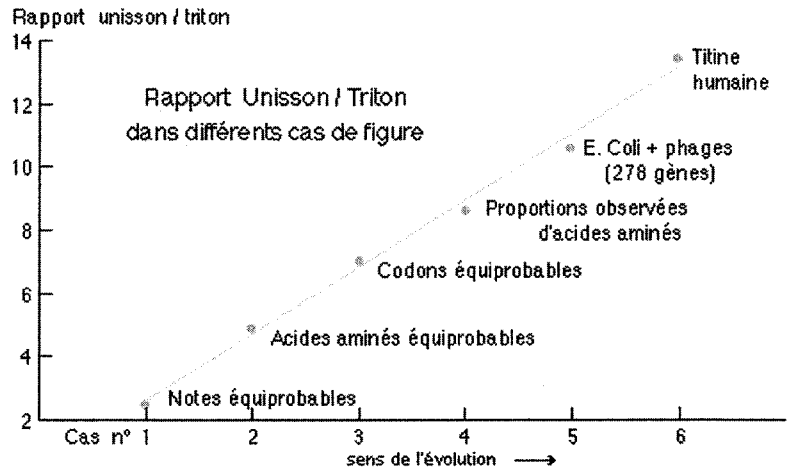

Fig. 3: Variation du rapport des proportions d'intervalles d'unisson (fréquences successives identiques) sur triton (quarte augmentée) pour des séquences au hasard construites à partir de notes équiprobables, d'acides aminés équiprobables, de codons équiprobables, et des proportions observées d'acides aminés ainsi que pour les séquences réelles des 278 gènes procaryotes de la fig. 1, et des 26926 acides aminés de la titine humaine.

En outre les "périodes" prédites sont bien observées, et sont, tout comme les répartitions d'intervalles ci-dessus, caractéristiques d'une protéine donnée (cf.(9)). Mais surtout une propriété essentielle apparaît : les protéines ayant des suites de fréquences homologues sont de façon systématique, métaboliquement agonistes, montrant que ces suites de fréquences ont une activité métabolique de régulation épigénétique réciproque des biosynthèses protéiques. En effet, les amplitudes des "ondes d'échelle" associées à des séquences identiques s'ajoutant, vont correspondre par leur carré à la probabilité que ces séquences soient exprimées dans l'organisme considéré : les fréquences identiques vont ainsi interagir les unes sur les autres par un phénomène de type résonance, et la synthèse d'une protéine va rétroagir positivement sur les autres protéines de l'organisme ayant des suites de fréquences homologues.

Considérons par exemple le cytochrome C, avant-dernière protéine de la chaîne respiratoire. Sa période est de 8 acides aminés, ce qui correspond à un "thème" caractéristique (9) . Dans la dernière protéine de cette chaîne, la cytochrome oxydase, on retrouve effectivement la présence de ce "thème", signifiant que sa synthèse va, en elle-même, "relancer" dans l'organisme concerné la synthèse du cytochrome C, ce dont l'intérêt régulateur pour l'organisme est évidemment manifeste. Il est à noter qu'il s'agit là de suites de fréquences identiques, alors même que les séquences d'acides aminés et donc encore plus de nucléotides correspondants diffèrent : il s'agit donc bien d'une régulation non-locale, distincte d'une interaction chimique ordinaire.

La généralité de ces propriétés peut alors être vérifiée grâce au moyen que nous avons ainsi de prédire les fonctions des protéines à partir de leur séquence d'acides aminés. Et en effet, elle se vérifie de façon systématique (9 et 14). De plus, la transposition à notre échelle de ces suites de fréquences a une action - par résonance d'échelle - sur la synthèse de la protéine correspondante, permettant de réguler épigénétiquement l'expression des gènes, de manière beaucoup plus souple et contrôlable qu'une modification du génome.

Un certain nombre d'expériences ont ainsi été conduites, où en agissant sur l'expression d'un gène donné (soit pour la stimuler comme ci-dessus, soit pour l'inhiber avec des suites de fréquences symétriques (9)), les conséquences à notre échelle en sont systématiquement observées - ce qui, en respectant l'objet d'étude, permet un suivi particulièrement fin et détaillé (15 et 16) .

Nous disposons donc d'un moyen pour stimuler ou inhiber fonctionnellement et réversiblement l'expression d'un gène donné, d'un facteur pouvant aller jusqu'à 20 environ, permettant de répondre avec une bien meilleure finesse et souplesse d'adaptation à beaucoup de problèmes pour lequel le recours aux OGM est aujourd'hui envisagé.

Des actions qui - d'abord - respectent leur objet

4. Considérons en effet les implications de ce qui précède au regard de ce qui constitue l'objet de cet ouvrage, les organismes génétiquement modifiés. Le principe de ces modifications génétiques consiste à insérer un gène extrait d'un génome dans un autre. Il est clair qu'en général ce ne sera tout simplement pas possible, du fait des nombreuses interactions non-locales qui, ainsi que nous l'avons vu, régulent ce génome. Cependant il est des cas où cela sera possible, mais alors avec pour conséquence des modifications du génome résultant, pour le rendre compatible avec les lois qui gouvernent ces interactions : l'organisme résultant va évoluer. Le fait qu'il ne suffit pas que l'insertion ait lieu pour garantir la stabilité et l'innocuité du résultat est attesté, pour ne prendre qu'un exemple, par l'existence de rétrovirus pathogènes. Le maïs transgénique Bt est, de son côté, basé sur un postulat qui découle directement d'une image "mécanique" du vivant : pour qu'un maïs ne soit pas attaqué par les insectes prédateurs, lui insérer un gène insecticide... avec la première conséquence d'un maïs - et son environnement (17) - rendus toxiques à la longue; la deuxième du développement (en à peine quelques années (18)) d'une résistance chez les insectes visés ; la troisième, d'un risque de perturber le cycle de croissance de la plante, du fait d'homologies de suites de fréquences (du type de celles signalées plus haut (14)), entre des passages du transgène Bt et de protéines de division cellulaire du maïs; et enfin... d'être simplement passé à côté de la question. En effet, la prise en compte des lois d'interactions non-locales mentionnées ne fournit pas seulement la possibilité d'un contrôle ou d'une sélection au cas par cas, que peut déjà permettre la considération des homologies que nous venons d'évoquer : elle amène surtout, dans la plupart des cas, à considérer qu'il y a mieux à faire que de modifier génétiquement un organisme pour résoudre un problème. Ainsi de l'expérience réalisée en Afrique (M. Gueye et al.(16)) sur des tomates rendues épigénétiquement résistantes à la sécheresse : elles étaient également épargnées par les insectes prédateurs qui préféraient s'en prendre aux plants témoins moins vigoureux qu'aux plants sur lesquels avait eu lieu l'expérience; simplement (comme certes il conviendrait, en la matière, de ne pas l'oublier) parce que la tendance naturelle de ces prédateurs est quand même d'abord de respecter la nature dans laquelle ils vivent, aussi s'en prennent-ils de préférence aux plants les moins vigoureux, épargnant les autres. Il est évident qu'ils trouvent là un avantage évolutif, puisqu'ils contribuent ainsi à préserver la planète sur laquelle ils vivent.

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Procédé de "Régulation Épigénétique de la Synthèse Protéique": Essai en Panification

Pédro Ferrandiz

Au cours de cet exposé, je vais vous présenter différentes expériences qui utilisent un procédé dont l'application permet d'agir sur la fermentation de la levure de boulangerie, à l'aide de séquences de vibrations sonores.

PLAN: Nous aurons, tout d'abord, une présentation du procédé qui sera suivie de l'exposé des résultats d'expériences.

PRÉSENTATION DU PROCÉDÉ:

L'utilisation de musiques à des fins de production agro-alimentaire n'est pas nouvelle.
Malinovski en 1930 citait des agriculteurs des îles du Pacifique qui imitaient le chant des oiseaux de leur région, afin d'améliorer le rendement de leurs cultures (I).
Ces questions viennent de connaître un regain d'intérêt: C'est ainsi qu'au Japon, la société "Gomei-kaisha Takada" a déposé un brevet sur l'utilisation de certaines musiques, jouées par divers instruments, pour améliorer la fermentation des levures employées dans la fabrication de sauce-soja et de pâte de miso (II).
Toujours au Japon, plusieurs sociétés dont la firme "Pioneer" et la boulangerie industrielle "Shikishima Bread co." financent actuellement des recherches dans ce sens sur différents secteurs, la panification, la production d'alcool et divers produits alimentaires. Leurs travaux visent à obtenir des produits se distinguant par leurs saveurs. Une gamme de produits, dont notamment du pain, a été commercialisée depuis 1990 (III).

Le procédé de "régulation épigénétique de la synthèse protéique", déposé en juin 1992 par M. Joël Sternheimer (IV) propose un moyen de stimuler ou d'inhiber la synthèse d'une protéine spécifique: Cette action a lieu en utilisant une suite de vibrations sonores dont les fréquences et autres caractéristiques physiques sont déduites de la séquence en acides aminés de la protéine considérée.

Je vous rappellerai, par exemple dans le cas de la fermentation panaire, que les étapes qu'utilise la levure de boulangerie pour transformer les sucres fermentescibles en éthanol et en gaz carbonique (CO_2), principaux produits de la fermentation, sont catalysées par des protéines particulières: des enzymes.

Chaque protéine se caractérise par sa séquence propre en acides aminés, qui définit sa forme tridimensionnelle ainsi que son activité métabolique.
De très nombreuses séquences protéiques sont aujourd'hui connues, et disponibles sur différentes banques de données (V).
L'alcool déshydrogénase ou ADH, par exemple, catalyse la réaction biochimique transformant l'acétaldéhyde en éthanol; l'acétaldéhyde provient de la dégradation du sucre, alors que le dégagement de CO_2 contribuera au gonflement du pain.
À partir de sa séquence en acides aminés, par application du procédé, on obtient deux types de séquence sonore, l'une pouvant stimuler, l'autre étant susceptible d'inhiber la synthèse de la protéine.

Ces suites de sons, qui forment ainsi des mélodies dont les structures harmoniques et rythmiques sont remarquables, ont été diffusées au cours des expériences que je vais vous décrire, à proximité des pâtons pendant la fermentation.

PREMIÈRE EXPÉRIENCE:

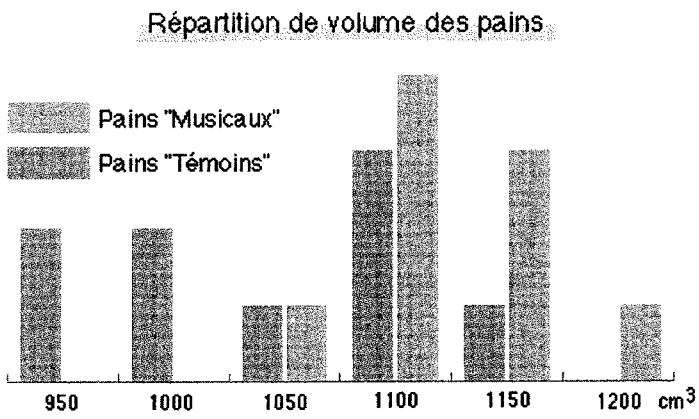
La première expérience fut réalisée sur deux miches de pain dont la pâte provenait d'un même pâton.
Pendant la durée de la fermentation, je diffusais, à l'aide d'un baladeur à défilement continu (Walkman auto-reverse) branché sur hauts-parleurs, les transpositions musicales de l'ADH en stimulation et en inhibition sur chacun des deux pains pris isolément.
Après cuisson et refroidissement, les deux pains se distinguaient principalement par leur différence de goût. Le pain ayant reçu la transposition de l'ADH en inhibition présentait une forte saveur de ranci, qui s'accentua les jours suivants, contrairement à l'autre.
Il sembla donc, qu'outre d'avoir mis en évidence l'effet des musiques sur l'activité des levures de boulangerie, on ait vérifié la spécificité de leur action vis à vis de l'enzyme choisi. On peut en effet corréler cette forte saveur de ranci à une accumulation d'acétaldéhyde résultant de l'inhibition de sa transformation en éthanol.

Ce premier résultat nous incita à poursuivre nos essais, notamment avec le concours de M. Philippe Roussel dans le laboratoire de panification de l'ENSMIC.

DEUXIÈME SÉRIE D'EXPÉRIENCES:

Les deux essais, qui vont suivre, ont donc été réalisés au sein du laboratoire de panification de l'école.
Nous avons utilisé un diagramme de fabrication de pain "type français", en pétrissage intensifié. Par essai, nous utilisons un seul et même pétrin. Les pâtons obtenus, après façonnage, étaient répartis en deux lots homogènes par leur composition et leurs caractéristiques rhéologiques, un lot "témoin" et un lot "musical".
Nous disposions de deux chambres de fermentation réglées aux mêmes conditions de température et d'humidité, l'une d'elle contenant le même appareillage de difusion musicale cité précédemment. Les deux lots étaient placés respectivement dans chacune des deux chambres, le lot musical recevant la transposition musicale de l'ADH en stimulation.
Après cuisson et refroidissement dans les mêmes conditions, le volume de chaque pain a été mesuré à l'aide d'un volumètre à grain.

Le graphique suivant rend compte des résultats obtenus sur le premier essai sur un total de 2 fois 10 pains pour une durée de fermentation de 1H45:

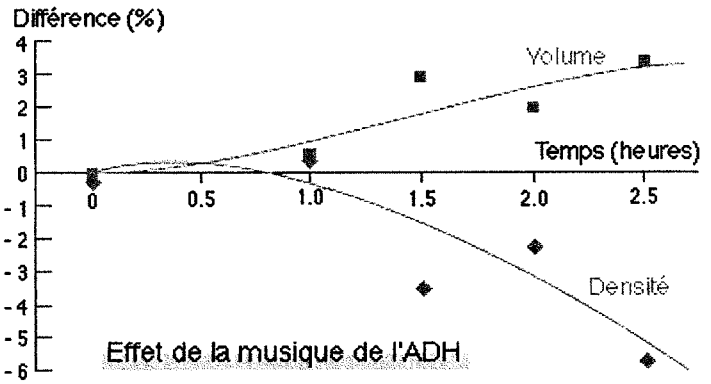


En abcisse, nous avons regroupé par classes les volumes de pain (en cm3), la hauteur des colonnes est proportionnelle aux nombres de pains.
Sur ce graphique il est intéressant de noter, tout d'abord, la différence de répartition entre les deux lots. La dispertion du lot "musical" était plus de deux fois moindre que celle du "témoin", ce qui traduit une plus grande homogénéité du lot musical.

En outre, il a été constaté une différence significative de volume: le volume moyen du lot "musical" apparaissant comme un peu plus important que celui du lot "témoin" d'environ 6%.

Une analyse statistique des données recueillies permet de calculer une signification sur cet essai de 2,7 écarts-types, soit une probabilité, que l'effet observé soit dû au hasard, inférieure à 1%.

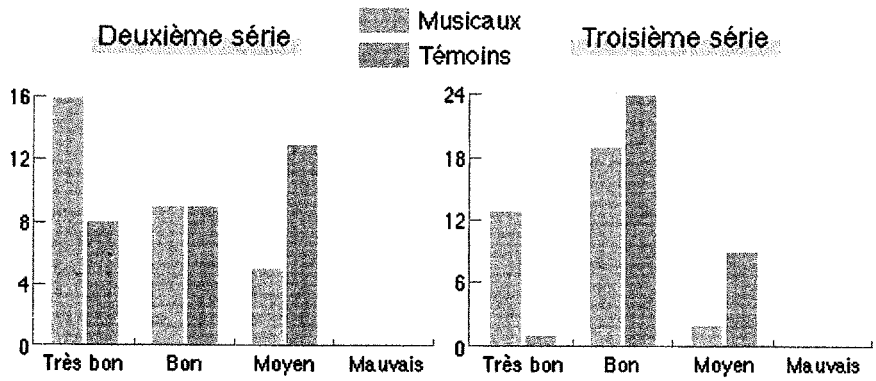
Un second essai a été réalisé sur cette fois ci 2 fois 36 pains, la courbe suivante rendant compte des résultats observés:



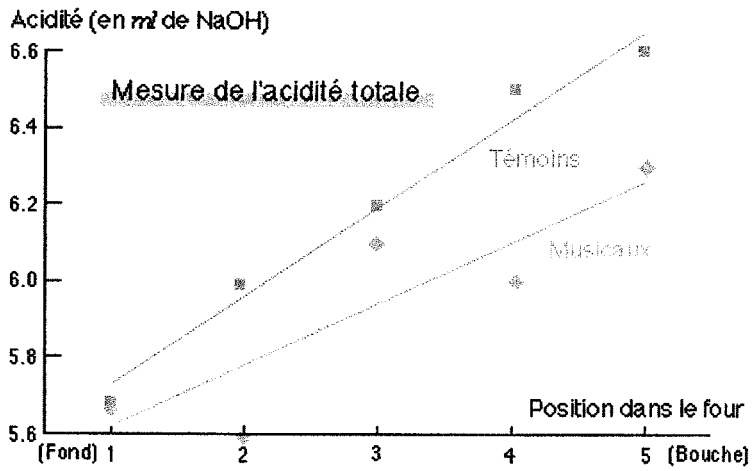
Les pains ont été repartis en huit lots homogènes, quatre avec musique de l'ADH, et quatre sans (servant de témoin). Sur ces deux groupes, nous avons fait des prélèvements pour des temps de fermentation de 1 heure, 1h30, 2h et 2h30 afin d'observer les différences entre les lots musicaux et les témoins au cours du temps.
Sur cette courbe, nous avons reporté les différences de volumes, et de densités (poids / volumes) entre les deux lots. On constate ici encore une différence, qui s'accroît avec le

temps. Les pains "musicaux" apparaissent avec un volume supérieur aux "témoins" qui est confirmé par une densité plus faible.

Afin d'approfondir ce point, nous sommes actuellement en train de réaliser des essais sur une fabrication de "pain au levain", pour les boulangeries "Poilâne". Nous nous basons d'une part sur des panels de goût et d'autre part sur la mesure des variations d'acidité (pH, titration de l'acidité totale) dûes à l'application du procédé. La transposition musicale diffusée est celle de l'ADH complétée par celle de la maltase de la levure de boulangerie.
Les deux graphiques suivants rendent compte de résultats obtenus sur deux "panels de goût":



Sur la trentaine de personnes ayant participé à chaque test (en ordonnée nous avons le nombre de personnes), on voit apparaître une nette préférence de goût pour les "pains musicaux".
La courbe ci-dessous permet de comparer les variations d'acidité entre un lot "musical" et un lot "témoin". Elle se base sur la mesure de l'acidité par neutralisation par la soude:



On voit, sur cette courbe, une augmentation de l'acidité pour les deux lots, entre les séries "1" à "5", correspondant à la différence de temps de fermentation qu'il y a entre les premiers pains façonnés et les derniers. Mais il est surtout intéressant de remarquer une baisse d'acidité systématique entre les pains "musicaux" et les "témoins".

Je vous remercie pour votre attention, et espère vous communiquer aux prochaines Journées Techniques de l'ENSMIC de nouveaux résultats.

Différents documents concernant les expériences menées en panification mais aussi en agriculture sont disponibles.

Références:

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IV) Joël Sternheimer, "Procédé de régulation épigénétique de la synthèse protéique", demande de brevet français n° 92-06765 (juin 1992).

(V) Banque de données NBRF, W. Barker, National Biomedical Research Foundation, Georgetown University, Medical center, 3900 Reservoir road, Washington D.C. 20007, USA.

Exposé présenté aux Journées Techniques de l'ENSMIC, Paris 19 novembre 1993.
Paru dans "Industries des Céréales", n°85, p. 40 (1993).

Title: **Applied Studies of Plant Meridian System I. The Effect of Agri-Wave Technology on Yield and Quality of Tomato**

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Abstract: Agri-wave technology is a new agricultural technology based on the plant meridian system, that focuses on measurement of plant sound characteristics. The basic principle of agri-wave technology is to improve the yield and quality of plants such as vegetables, flowers, and fruit trees by broadcasting sound waves of certain frequencies and spraying a compound microelement fertilizer on the leaves. The application of agri-wave technology on tomatoes remarkably stimulates growth of their seedlings. Fresh weight of the branch, stems, and leaves of the treated tomatoes is significantly (59.53%, $P < 0.0001$) higher than that of the control group. Sampling survey results indicate that agri-wave technology accelerates the ripeness of tomatoes. The fresh weight of ripe tomatoes treated with this technique is 30.73% higher than that of the untreated ($P = 0.0018$), while the fresh weight of the treated unripe tomatoes is 27.29% lower than that of the untreated unripe group ($P = 0.0020$). Yield surveys show that the yield of treated plants is 13.89% ($p < 0.0001$) higher than that of the control group. Moreover, with agri-wave technology treatment the storage period of tomatoes is almost doubled. Analysis of tomato nutrition shows that agri-wave technology has increased their sugar content by 26.19%, vitamin A and niacin (an antifavours vitamin) by 55.39% and 92.31% respectively. There is no difference concerning vitamin B1, B2, and D content between the two groups, and vitamin C and E contents decreased by 2.10% and 12.69%, respectively. Among the analyzed 33 minerals of tomatoes, 26 increased in content, while 7 decreased. In conclusion, agri-wave technology has promoted the growth of the tomato, increased its yield, and improved its quality.

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Applied studies of the plant meridian system: II. Agri-wave technology increases the yield and quality of spinach and lettuce and enhances the disease resistant properties of spinach.

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Agri-wave technology is composed of both a **special frequency sound wave and a microelement fertilizer**. In both components, the effect of sound waves on plants is more than that of fertilizers, but the best function is a combination of the two. Treatment by Agri-wave technology stimulated the growth rate and increased the yield of spinach. In small plot tests, the length and width of the treated spinach leaf was 50.8 cm and 20.3 cm, respectively, whereas the untreated leaves were 29.20 cm and 8.9 cm. The fresh weight of treated spinach was 0.42 kg. This was 5.5 times higher than that of the untreated spinach. In large area testing (17 hectares), the results of two tests show that the yields of the treated spinach were increased 22.7% and 22.2% over those of the control group. Sugar content of the treated spinach was increased by 37.5%, vitamin A, C, and B were increased 35.63%, 41.67% and 40.00%, respectively, above the levels of the control group. Niacin content was decreased by 7.69%. Of 33 elements analysed in the spinach, 29 elements were increased by Agri-wave technology. The spinach was infected with "rot disease" in the control group while there was no disease present in the treated group. In greenhouse testing, the average weight of 3 species of lettuce treated by Agri-wave technology was increased 44.10% over that of the control group ($P < 0.0001$). The average weight of 3 species of lettuce by only sound and only fertilizer treated separately increased 29.92% and 16.19% above that of the control group ($P < 0.0001$). Sampling survey results in the field test were comparable to the above mentioned greenhouse test. The fresh weight of treated lettuce by Agri-wave technology was increased 41.67% over that of the control group ($P < 0.0001$). The fresh weight of treated lettuce by only sound and only fertilizer was increased 30.88% and 19.61%, respectively, over the control group (both $P < 0.0001$).

PMID: 10467447 [PubMed - indexed for MEDLINE]

Induction of bacterial luminescence through exposure of Vibrio fischeri to the proteodies of its luxA and luxB genes

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The Lux A and Lux B luminescence genes of the microorganism Vibrio fischeri were transcribed in the form of two protein melodies ('proteodies'), according to the method described by Joel Sternheimer in his patent 'Method for epigenetic regulation of protein biosynthesis by scale resonance' (1992), filed under n° 92 06765 at the french National Institute for industrial property (INPI). The two proteodies were decoded and connected to each other (Lux A following Lux B) so as to produce the 'Lux AB proteody', which was played in a repeating loop for a given time. The Lux AB proteody was recorded onto a CD-R, using a PC engraver in a Windows 98 environment. The music software used was Cakewalk version 6.0.

Two musical timbres were used: one low-toned harpsichord-like, which produced no effects; and one - a priori much closer to the correct one according to the quoted method - with a 'tiny bell'-like sound, giving positive results. As for note lengths, we simply recorded a series of quarter notes with a value of 90 (Cakewalk), amounting to 90 notes per minute.

A positive reaction to this stimulation could be evidenced and assayed by observing an increase in the quantity of light emitted by Vibrio fischeri. For practical reasons, we first tried exposing Vibrio fischeri to the proteodies in a liquid medium, but the results were not satisfactory.

Experimental protocol

We developed a method that revealed an increase in light emitted by Vibrio fischeri cultivated on agar in an air medium. To do this, we poured agar into glass microtox tubes. The fact that the tubes were made of glass was important. We suspected that tubes made of synthetic materials could modify the results, due to various influences, such as electric-type forces which could be generated (electrostatic, electromagnetic, or other), and possibly disturb the message and/or response of the microorganisms. The tubes were seeded with Vibrio fischeri from a mother culture. Measurements were taken after 24 hours. We verified that the thickness of the agar layer did not exceed 3mm, corresponding to 150µl per tube The agar layer had to be sufficiently thin, since the luminometer used in the study read from the bottom up.
Thus, the values presented here were read from below; through a layer of glass (the microtox tubes) and a layer of agar, before reaching the microorganisms themselves.

Experiment n°1

Two series of tubes were exposed to the proteody. One set was seeded with 15µl of the mother solution and another with 10µl.

For each series:

- The luminosity of 4 tubes was measured at time zero.
- 4 other tubes were exposed for 9 minutes.
- 4 other tubes were exposed for 18 minutes.
- 4 other tubes were exposed for 27 minutes.

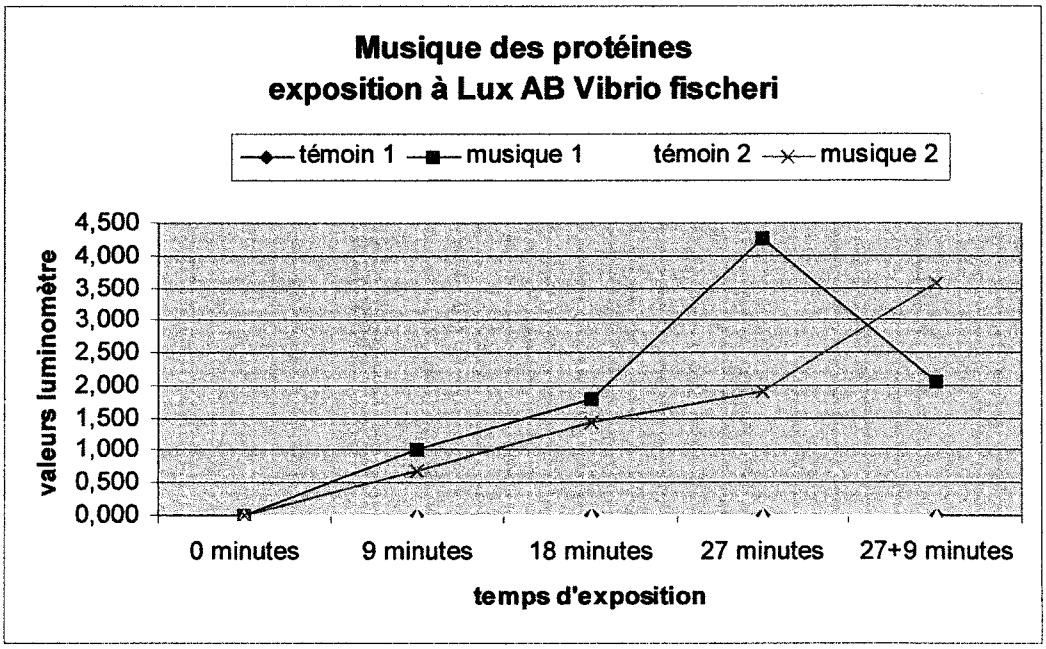
The measurements were always carried out immediately after exposure. The luminosity of four unexposed control tubes was also measured each time.

The last 4 tubes were exposed for an additional 9 minutes, and their luminosity measured again.

Exposure was carried out as follows: The tubes were opened at the last moment and inclined at a 45° angle. The proteodies were played on a portable laser-disc player (Clip Sonic, model n° 1119) whose speakers were aimed directly at the open tubes at a distance of 90cm. The disc player was not positioned nearer to the tubes because of magnetic fields it emitted, especially by its loudspeakers. The sound volume (gain) was adjusted to one-third maximum. The microtox tubes and the laser disc player were raised 3cm above the table surface, so as to avoid being too low with respect to the loudspeakers.

Results of experiment n° 1

Vibrio fischeri exposed to LuxAB proteody
Luminometer values vs. exposure time for control and music tubes 1 and 2



Luminometer readings (individual and mean) as a function of time for control and music tubes

		0 minutes	9 minutes	18 minutes	27 minutes	27+9 minutes
Série 1		Valeurs lues sur le luminomètre				
15µl solution	témoin 1	0,000	0,000	0,000	0,000	0,000
	témoin 2	0,000	0,017	0,000	0,000	0,000
	témoin 3	0,000	0,000	0,000	0,000	0,000
	témoin 4	0,000	0,000	0,000	0,000	0,000
	moyenne	0,000	0,004	0,000	0,000	0,000
15µl solution	musique 1	0,000	1,131	2,236	6,603	3,329
	musique 2	0,000	1,148	1,6	5,997	3,218
	musique 3	0,000	0,794	2,039	0,077	0,059
	musique 4	0,000	0,975	1,26	4,383	1,641
	moyenne	0,000	1,012	1,784	4,265	2,062
Série 2						
10µl solution	témoin 1	0,015	0,000	0,015	0,000	0,017
	témoin 2	0,000	0,000	0,012	0,000	0,000
	témoin 3	0,000	0,000	0,000	0,000	0,000
	témoin 4	0,000	0,000	0,000	0,000	0,034
	moyenne	0,004	0,000	0,007	0,000	0,013
10µl solution	musique 1	0,018	0,723	1,381	2,484	3,698
	musique 2	0,012	0,868	1,577	1,063	4,215
	musique 3	0	0,01	1,54	1,829	2,995
	musique 4	0	1,164	1,195	2,211	3,355
	moyenne	0,008	0,691	1,423	1,897	3,566

Interpretation

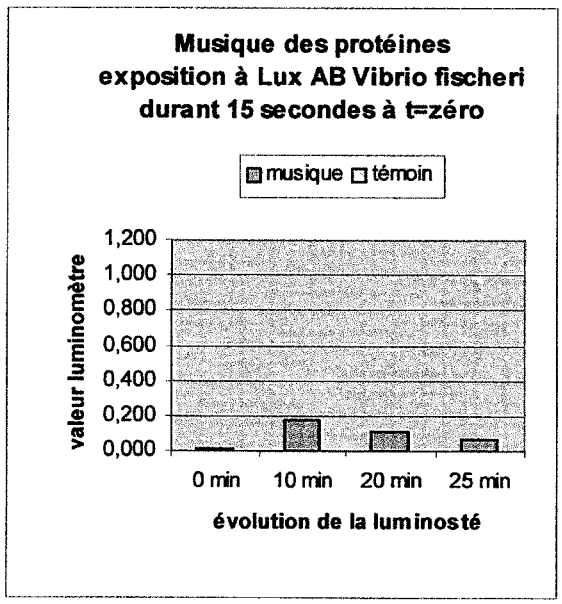
It was possible to observe that the proteodies triggered a luminous reaction in direct proportion to the time of exposure. The relation 'stimulation by proteody/luminous activity' was very strongly significant. Nevertheless, at 27 + 9 minutes, a decrease in luminosity was observed for the 15 µl solution, which must be studied by means of additional trials. A priori this was either an artefact or a saturation-type reaction due to the higher number of microorganisms in the second series of tubes.

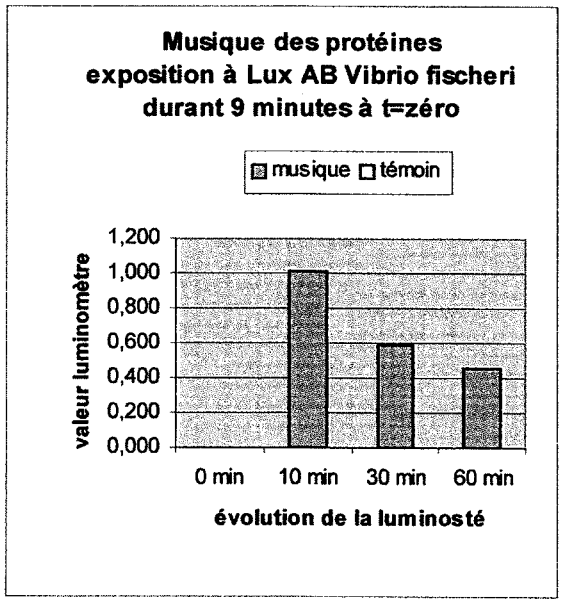
Experiment n°2

Various tubes were exposed to the Lux AB proteody for 15 seconds or 9 minutes. A measurement was taken first at t=0, then at various other times, in order to observe the evolution in luminosity.

Results of experiment n°2

Vibrio fischeri exposed to LuxAB proteody for 15 seconds at t=0 {9 minutes}
Evolution of luminosity for 15 seconds of stimulation (music 1) and 9 minutes





Stimulation 15 secondes (musique 1) Lux AB *Vibrio fischeri*				
	0 min	10 min	20 min	25 min
témoin 1	0,000	0,000	0,000	0,000
témoin 2	0,000	0,000	0,000	0,000
témoin 3	0,000	0,000	0,000	0,000
témoin 4	0,000	0,000	0,000	0,000
Moyenne	0,000	0,000	0,000	0,000
musique 1	0,015	0,167	0,095	0,050
musique 2	0,000	0,179	0,141	0,082
musique 3	0,000	0,195	0,130	0,059
musique 4	0,012	0,170	0,093	0,062
Moyenne	0,007	0,178	0,115	0,063

Stimulation 9 minutes (musique 1) Lux AB *Vibrio fischeri*				
	0 min	10 min	30 min	60 min
témoin 1	0,000	0,000	0,000	0,000
témoin 2	0,000	0,010	0,000	0,000
témoin 3	0,000	0,000	0,000	0,000
témoin 4	0,000	0,000	0,000	0,000
moyenne	0,000	0,003	0,000	0,000
musique 1	0,000	1,131	0,567	0,484
musique 2	0,000	1,148	0,777	0,349
musique 3	0,000	0,794	0,45	0,641
musique 4	0,000	0,975	0,544	0,357
moyenne	0,000	1,012	0,585	0,458

Interpretation

We clearly observed:

- A general correlation between time elapsing and progressive reduction in V. fischeri luminous activity;
- A correlation between the duration of stimulation (i.e. of exposure to LuxAB proteody) and the intensity of V. fischeri luminous activity.

Once again, the relation 'stimulation by proteody / luminous activity' was very strongly significant.

Conclusion

In the work described here, the luminous activity of Vibrio fischeri was stimulated by stimulation of the Lux A and Lux B genes of that same organism, via a series of audible frequencies (LuxAB proteody).

The results obtained show that it is possible to stimulate a protein synthesis in a highly significant way by using proteodies.

Numerous parameters have not been perfectly mastered, such as (among others):

- melody
- timbre
- rhythm
- the exact frequency assigned to each amino-acid
- sound volume
- frequency preferences of the organism studied (low frequencies, ultrasound, light)
- appropriateness in the selection of selected genes
- interactions between/among the various genes
- etc...

Considering the fact that the results obtained were very highly significant under non-optimal experimental conditions, it is possible to deduce that living organisms seem to react in an extremely rapid and strong manner to the stimulation of gene expression delivered via proteodies.

It would appear that we have observed a key mechanism involved in the functioning of living organisms.

(Metz, September 2002).

The effect of variable-frequency sounds on plant growth

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Received July 10, 1972[2]

WEINBERGER, P., and U. GRAEFE. 1973. The effect of variable-frequency sounds on plant growth. Can. J. Bot. 51: 1851–1856.

Four tunes and two random noise selections were used to determine whether variable sound frequencies may affect the growth and development of cucumber, corn, and oats. The selections were subjected to a power spectral density analysis. Some growth changes were observed and an indication given that a growth – audio action spectrum may be a widespread general phenomenon.

WEINBERGER, P., et U. GRAEFE. 1973. The effect of variable-frequency sounds on plant growth. Can. J. Bot. 51: 1851–1856.

Quatre mélodies et deux sélections au hasard de bruits ont été utilisées pour voir si des fréquences sonores variables peuvent affecter la croissance du concombre, du maïs et de l'avoine. Les sélections ont été soumises à une analyse de densité spectrale. Quelques changements ont été observés dans la croissance; des données indiquent qu'un spectre d'action audio sur la croissance pourrait être un phénomène général répandu.
[Traduit par le journal]

Introduction

Previous studies have shown that some audible and low ultrasound frequencies affect plant growth and development (Weinberger and Measures 1968; Measures and Weinberger 1970; Weinberger and Das 1971).

Folklore has frequently associated specific sounds of the musical or incantation type with the growth habit of plants exposed to these cadences during germination and subsequent growth (Gimbutas 1903; Malinowsky 1930). In the ethnographic folklore associated with Byelorussia these sounds are thought to have originated as the vocalization of the names of certain pagan gods. In some Pacific cultures, melodic cries, mimicking the calls of birds indigenous to the region are always used when plants are tended in the field (Malinowsky 1930). More recently, Hicks (1963) and Singh (1965) reported that some musical sounds affected the growth of plants. In the Valley Tonga, a chikorckore (a four loose note xylophone) was played at the time of sowing. Two tunes from the Valley Tonga were used in the present study. The village where the music was rerecorded is now 300 ft below the waters of the Kariba Dam.

[1]Partially supported by the National Museum of Man Canadian Centre for Folklore Studies, Ottawa, Canada.
[2]Revised manuscript received May 30, 1973.

The present study was undertaken to provide confirmation or rejection of the suggestion that some sequential audio frequencies may affect plant growth. Four of the tunes were subjected to a rigorous analysis to determine whether some particular sequential set of frequencies did indeed have any growth-promoting effects.

Materials and Methods

Audible Sound Frequencies

The eight tune-like sequential sound frequencies used in this study were provided by the Canadian Centre for Folklore Studies, Museum of Man, Ottawa, through the courtesy of Drs. Carmen Roy and R. Klymatz.

Apart from the two Valley Tonga selections (Ulumbundubundu and Nyoro) the other ethnic agrarian tunes (I–VI) are catalogued by Dr. R. Klymatz under the following headings.

TUNE No.	TYPE	AGRARIAN CONNECTION	MUSEUM CODE AND No.
I	Male choir	Cucumber	Klymatz collection
II	Female solo	Oats	Roy 20-A-5732
III	Vocal	Haying	Pea 368-2553
IV	Vocal	Flax	Pea 414-2843
V	Saduccai pipes	Vegetables	Pea 421-2869
VI	Flute Sopilka	Vegetables	Klymatz collection
VII	Flute Sopilka randomized		Courtesy NRCC Anal. Div.
VIII	White noise		Random noise source

All selections were used for the germination studies, but only II, VI, VII, and VIII for the growth studies as

well as the two Valley Tonga recordings. The tunes were recorded on high-fidelity tape.

The tapes were replayed on a tape recorder (Uher Universal 5000) at $1\frac{7}{8}$ in./min. The sound was delivered into controlled environment growth cabinets. Each speaker was matched to a Dynaco amplifier located outside the cabinets. The tape recorders were modified to take a tape loop so that the sound was continuous during the periods of exposure.

A full spectral power density analysis of tunes I, II, V, and VI was carried out by Dr. U. Graefe. The Flute Sopilka (tune 7) was a special tape on which the amplitude distribution pattern of the original recording was completely randomized, while the distribution of power at various frequencies remained the same. The white noise (tune 8) was obtained through an 8-in. speaker attached to a random noise source (Allison Model 650). A flat shaping of the sound spectrum was obtained, i.e. the energy gain was never greater than 3 dB per octave with increasing frequency.

In all cases the sound levels were monitored in the growth cabinets with a precision sound pressure level meter (Bruel Kjaer, Type 2203/1613). The sound pressure level varied between 78 dB and 92 dB over the range 63 Hz and 8 kHz, dropping to 72 dB at 16 kHz only in the case of the random white noise (tune 8) and 56 dB at 31.5 kHz.

Power Spectral Density Analysis

The actual computation of the power spectral densities of the four musical signals was done on an EAI 640 digital computer and associated peripheral equipment in the Analysis Laboratory of the National Research Council of Canada, using a modification of an existing program '*A Digital Program for On-line Correlation and Power Spectral Density Analysis*' (Funke *et al.* 1968).

The musical signals were transferred from the direct-recorded magnetic tapes used for the plant-growing experiments to a frequency modulation (FM) recorded tape using a PI400 tape recorder. This was necessary to obtain a slowdown in time by a factor of 64 as required by the program to perform on-line calculations for spectra with upper frequencies near 2000 Hz and resolutions of 5 Hz. The EAI 640 digital computer under control of a clock was used to sample the analog signal through an analog-to-digital converter and to compute the auto-correlation function during the intersample time (Blackman and Tukey 1958). To prevent aliasing, the sample interval was set such that the sample frequency was at least twice the highest signal frequency present. (Aliasing is a misidentification of frequencies that are larger than one-half the sample frequency.)

After sampling was completed, the computer program provided for the computation of the autocovariance function, Fourier transformation, and 'hamming' (convolving the raw spectrum with the Hamming spectral window). Through the use of digital-to-analog converters the power spectrum was then displayed on an x–y plotter.

Results of Spectral Analysis on Musical Records

The four musical signals I, II, V, and VI were selected for analysis on the basis of their growth-promoting effect.

In each case a preliminary analysis was performed with a rather coarse resolution (wide spectral window) covering the frequency range from 0 to 5000 Hz. These analyses showed that there was no power at frequencies above 2000 Hz for signals 1 and 2 and 1000 Hz for signals 3 and 4. Consequently, a more detailed analysis, using a finer resolution, and covering only the frequency ranges of interest was obtained.

Germination Studies

The seeds of eight plant species were allowed to germinate at 25 ± 1°C in dark cabinets (Sherer Gillet Model CEL 255-6), and were, except for the control group, exposed to a sound treatment. For each experiment four petri dishes (8.5 cm diam) were used containing 25 morphologically comparable seeds per dish. The experiments were carried out in triplicate, and therefore for each plant species a minimum total of 300 seeds was used for each tune as well as for the control (no sound). Water was not a limiting factor.

The eight plant species used were as follows (amount of water per 8.5-cm petri dish is given in parentheses): alfalfa, Saranac (10 ml); bean, Pencil Pod (20 ml); corn, Golden Bantam (20 ml); cucumber, Straight Eight (10 ml); flax (10 ml); lettuce, Grand Rapids (7 ml); oats, Russell (10 ml); and pea, Cremette (15 ml).

Different batches of each species were allowed to germinate for 48 h and were exposed for 8-h periods (0–8, 16–24, 32–40 h) to tunes I–VIII. A further batch of each species was continuously exposed to tunes I, VI, VII, and VIII during the whole germination period. The control series of each was only exposed to background machinery noise (35 dB). Music and control cabinets were rotated with each repetition of the experiment to eliminate any cabinet effect.

Each hour, the percentage germination of the sound-treated and control seeds was noted. Germination was assessed to have taken place when the root pierced the seed coat.

Observations were made using a binocular dissecting microscope at a magnification of 100 ×.

Growth Studies

Seeds (25 per dish) of cucumber, corn, and oats were germinated as described above. During the germination, and the subsequent growth period, each species was exposed for 8 h per day (9 a.m.–5 p.m.) to the same tune. Tunes I, VI, VII, and VIII were used in parallel experiments. When over 80% of the seedling roots in any group reached 3 cm in length the whole set of 100 seedlings were planted in peat pots (2 in. × $2\frac{1}{2}$ in.) filled with sterilized loam soil. The soil for all the experiments was obtained from one source and bagged at the same time.

Pots were watered as required to keep the soil-moisture content to field capacity. A regime of 16-h day and 8-h night was maintained in all cabinets. The total light intensity during the daytime period was 1500–1750 ft-c, and was provided by four 25-W incandescent and eight fluorescent lights (Sylvania F.8-T12 cw HO). A constant temperature of 24 ± 1°C was maintained.

Fresh and dry weight of "tops," number of leaves, height of plants, and number of emergent buds and flowers were assessed at the end of each 8-week growth period. Dry weights were obtained after the plant material was heated to 95 ± 1°C for 24 h and then equilibrated with atmospheric humidity.

Statistical Analysis

The germination and growth data were subjected to statistical analysis using Scheffé's test at the 5% level (Scheffé 1959; Guenther 1968).

Results

Germination Studies

In no case was a clearly significant stimulation of germination obtained. Only bean and corn showed an indication that some tunes might affect the rate of germination and these results are shown in Table 1. The tunes which most consistently stimulated germination even though the effect was not clearly significant at the 95% level were the two vocal pieces, I and II, and the instrumental tune, VI. None of the songs with plant-growing connotations, that is, the cucumber song I, and the haying song III, the flax song IV, nor the Valley Tonga selections had any effect upon the germination capacity of the seeds named in the song title.

Tunes II and VI were used in the growth studies. together with tunes VII and VIII and the Valley Tonga selections.

TABLE 1

Percentage of germination of control and sound-exposed seeds at 18 h and 24 h

	Bean, time, h		Corn, time, h	
Tunes*	18	24	18	24
C	11 a	44 a	26 ab	41 a
I	12 a	57 a	23 b	36 b
I a‡	9 a	27 b	19 b	35 b
II	21 a	53 a	36 a	52 a
III	12 a	32 b	21 b	33 b
IV	10 a	43 a	19 b	29 b
V	10 a	29 b	28 a	40 ab
VI	18 a	44 a	35 a	44 a

*Notation referred to in text.
†Scheffé's test of significance. Parameter comparable means in any one column not followed by the same letter differ significantly at the 5% level.
‡Continuously exposed to tune I.

TABLE 2

Cucumber var. Straight Eight after 8 weeks growth

Tunes*	Height, cm	Wet wt. tops, g	Dry wt. tops, g	No. buds	No. leaves
C	25.4 b†	6.9 b	0.6 b	20.2 b	10.8 b
II	26.1 b	5.8 b	0.5 b	31.7 b	11.2 b
VI	51.0 a	12.7 a	1.0 a	61.3 a	18.7 a

*Notation referred to in text.
†Scheffé's test of significance. Parameter comparable means in any one column not followed by the same letter differ significantly at the 5% level.

Growth Studies

Table 2 shows the five growth parameter values for variously treated cucumber plants.

It can be seen that the flute melody VI evoked a twofold increase in the overall height and weight (wet and dry) of the "tops" of the cucumber plants. Three times the number of buds were present when the plants were exposed to this tune and a significant increase in the number of leaves was also observed. Plants exposed to song II did not differ in growth parameters from the control except in the number of buds, which increased by 50%.

Exposed to tune VI, the wet weight of the "tops" of corn and oats was significantly increased; while the overall height of the oat plants was enhanced by exposure to both II and VI (Tables 3 and 4). No other growth parameters changed with sound exposure. The growth of the plant species used in this study was unaffected by exposure to the Valley Tonga tunes, randomized Sopilka tape, and white noise.

Power Spectral Density Analysis of Non-stationary Signals

The spectral density plots are linear plots with frequency in Hertz as abscissa and power density in $(volts)^2$/Hertz as ordinate. This refers to the signal voltage at the radio/phono output of the Uher Universal 5000 tape recorder used in the

TABLE 3

Corn var. Golden Bantam after 8 weeks growth

Tunes*	Height, cm	Wet wt. tops, g	Dry wt. tops, g	No. leaves
C	78.9 a†	13.9 b	1.5 a	7.8 a
II	78.6 a	15.1 ab	1.4 a	7.5 a
VI	82.9 a	17.2 a	1.7 a	8.4 a

*Notation referred to in text.
†Scheffé's test of significance. Parameter comparable means in any one column not followed by the same letter differ significantly at the 5% level.

TABLE 4

Oats var. Russell after 8 weeks growth

Tunes*	Height, cm	Wet wt. tops, g	Dry wt. tops, g	No. leaves	No. tillers
C	66.5 a†	36.4 b	0.4 a	9.6 a	2.4 a
II	70.3 b	37.3 b	0.5 a	9.2 a	2.0 a
VI	76.0 c	43.9 a	0.5 a	9.2 a	2.0 a

*Notation referred to in text.
†Scheffé's test of significance. Parameter comparable means in any one column not followed by the same letter differ significantly at the 5% level.

plant-growing experiment. The tape recorder amplifiers and speakers would, of course, have some effect on the shape of the spectrum of the speaker output; however, this frequency weighting was the same for all four signals. The area under any peak of the spectrum represents the average (volt)^2 associated with the frequencies near this peak, as seen at the radio/phono output of the Uher tape recorder.

The number of degrees of freedom given with each spectral estimate is a convenient description of the stability of this estimate. This number is equal to twice the square of the average divided by the variance of the spectrum. Figures 1 to 8 represent eight spectra of the four musical signals. The effect of time variation of the spectrum may be seen by comparing Figs. 1 and 2; 3 and 4; 5 and 6; and 7 and 8, which show the spectra of the same signal but over various lengths of time.

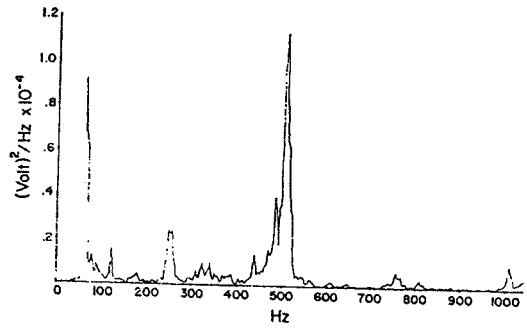

FIG. 1. Tune I, first 13.88 s. Record length, 1.88 s. Number of samples, 3910. Sample interval, 0.486 ms. Degrees of freedom, 18. Filter bandwidth, 5.0 Hz. Signal RMS value, 0.0750 V.

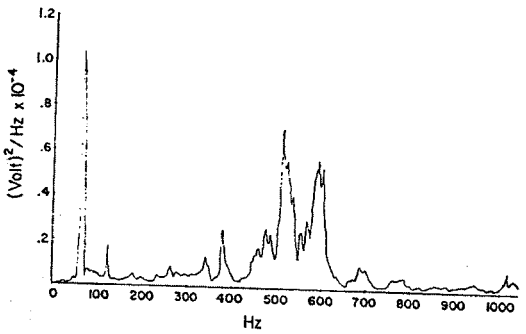

FIG. 2. Tune I, entire record. Record length, 104.56 s. Number of samples, 216 697. Sample interval, 0.486 ms. Degrees of freedom, 1046. Filter bandwidth, 5.0 Hz. Signal RMS value, 0.09845 V.

Some records contain a 60-Hz hum and a 120-Hz harmonic, which were present on the original magnetic tape and as such were present in the plant-growing experiment.

Discussion

The data reinforce the fact that some audible frequencies have a growth-promoting effect on some species (Weinberger and Measures 1968; Measures and Weinberger 1970; Weinberger and Das 1972). Sequential audio frequencies of the type analyzed here vary with respect to their effect on plant growth. Not all sequential frequencies promote growth nor do all tunes with an agrarian growth-promoting connotation. However, in all the experiments, the flute appears to elicit a response above the 5% level at 450 Hz.

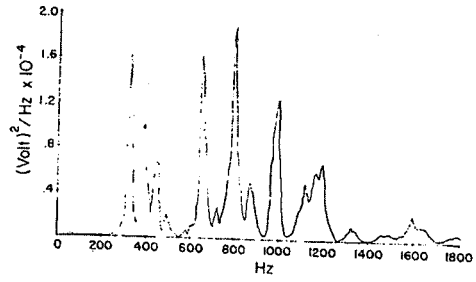

FIG. 3. Tune II, female soloist, first 26 s. Record length, 26.20 s. Number of samples, 94339. Sample interval, 0.278 ms. Degrees of freedom, 789. Filter bandwidth, 15.0 Hz. Signal RMS value, 0.2080 V.

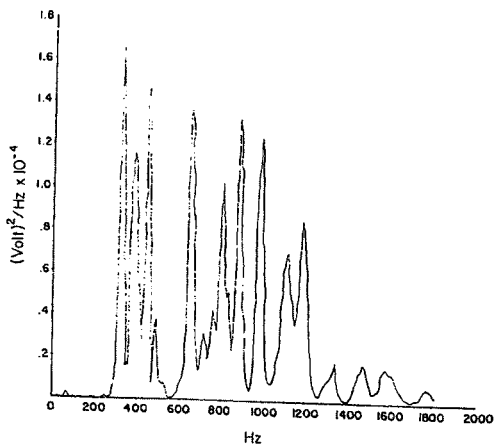

FIG. 4. Tune II, female soloist, entire record. Record length, 78.15 s. Number of samples, 281 306. Sample interval, 0.278 ms. Degrees of freedom, 2354. Filter bandwidth, 15.00 Hz. Signal RMS value, 0.2242 V.

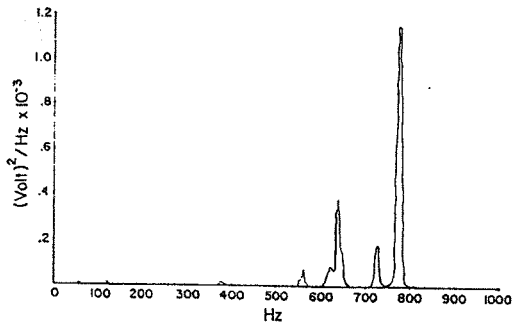

FIG. 5. Tune V, Saduccai pipes, first 5.67 s. Record length, 5.67 s. Number of samples, 11 684. Sample interval, 0.486 ms. Degrees of freedom, 56. Filter bandwidth, 5.0 Hz. Signal RMS value, 0.1543 V.

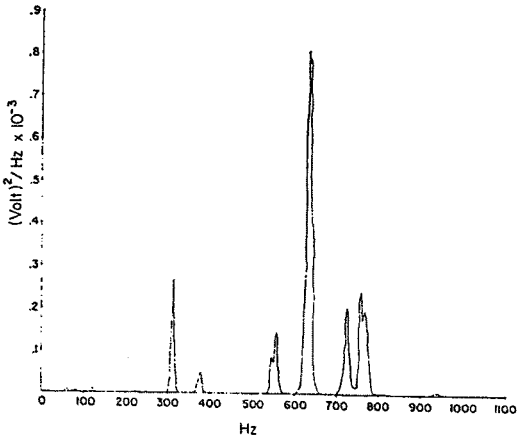

FIG. 6. Tune V, Saduccai pipes, entire record. Record, 12.23 s. Number of samples, 25 356. Sample interval, 0.486 ms. Degrees of freedom, 122. Bandwidth, 5.0 Hz. Signal RMS value, 0.1582 V.

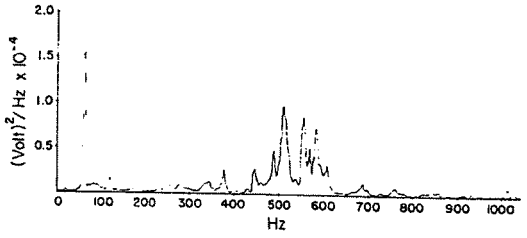

FIG. 7. Tune VI. Record length, 13.88 s. Number of samples, 28 770. Sample interval, 0.486 ms. Degrees of freedom, 138. Filter bandwidth, 5.0 Hz. Signal RMS value, 0.1026 V.

This orchestral instrument probably produces the purest tone and contains the least amount of overtones for each note played. This would not show up in the power spectral density analyses in

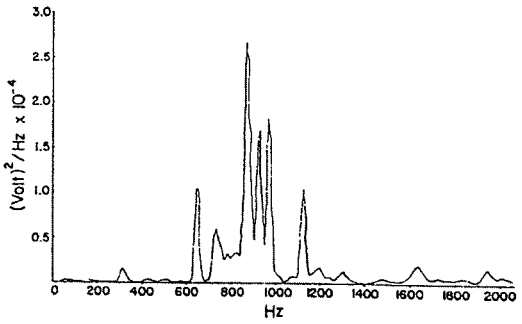

FIG. 8. Tune VI, Sopilka, entire record. Record length, 45.98 s. Number of samples, 187 656. Sample interval, 0.244 ms. Degrees of freedom, 1804. Filter bandwidth, 20.0 Hz. Signal RMS value, 0.1969 V.

Figs. 7 and 8 because these were made by integrating overall frequencies of musical selections. An obvious conclusion from this work and previous studies (Measures and Weinberger 1970) is that plants may well have an audio action spectrum, but this could only be detected by observing the responses to successive narrow-band frequencies scanned over the entire audio spectrum. This was not possible in the present study, which did, however, underscore the probability of such action spectra in plants other than that observed previously for Marquis wheat (Measures and Weinberger 1970).

Acknowledgments

I am most grateful to Drs. C. Roy and R. Klymatz of the Canadian Centre for Folk Culture Studies, National Museum of Man for their enthusiastic interest in this project and for supplying the ethnic tunes used in this study. Dr. C. Roy was particularly helpful in interesting the Museum of Man to partially support this study. Her avant-garde approach and interest were responsible for this study being initiated.

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Effects of the intensity of audible sound on the growth and development of Rideau winter wheat[1]

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WEINBERGER, P., and M. MEASURES. 1979. Effects of the intensity of audible sound on the growth and development of Rideau winter wheat. Can. J. Bot. 57: 1036–1039.

Rideau wheat seeds and (or) seedlings exposed to 0.30, 1.25, 5.0, and 12.0 kHz sound frequencies and one display of random white noise at an intensity level of 92 dB grew normally, whereas some of those exposed to the same frequencies at 105–120 dB showed abnormalities and reduced weights of root and shoot tissue. Only sonication at 5 kHz and 92 dB led to stimulated tiller growth coupled with an increase in plant dry weight and number of roots. None of the sound treatments affected floral initiation and development.

WEINBERGER, P., et M. MEASURES. 1979. Effects of of the intensity of audible sound on the growth and development of Rideau winter wheat. Can. J. Bot. 57: 1036–1039.

Des graines et (ou) des plantules de blé Rideau exposées à des fréquences sonores de 0.30, 1.25, 5.0 et 12.0 kHz et à un "white noise" présenté au hasard sous une intensité de 92 dB ont poussé normalement, tandis que certaines graines ou plantules soumises aux mêmes fréquences sonores mais à 105–120 dB ont présenté des anormalités et ont réduit le poids du tissu des racines et des rejetons. Seule la "sonication" à 5 kHz et 92 dB a stimulé la croissance des pousses secondaires, produisant une augmentation du poids sec de la plante et du nombre de racines. Aucun des traitements sonores n'a affecté l'ébauche et le développement des fleurs.

[Traduit par le journal]

Introduction

Previous studies have shown that axillary bud dormancy in Rideau winter and Marquis spring wheats may be broken by exposure to single frequency audible sound (Measures and Weinberger 1970). The changes noted in vegetative growth of the wheats were closely correlated with specific sound frequencies, namely, 5 kHz (Rideau) and 12.0 and 0.3 kHz (Marquis). The present study was undertaken to determine if 1.25 kHz, one of the resonant frequencies of this series, or white noise affected the growth of these wheats and whether the intensity of the sounds was related to developmental change.

Materials and Methods

Imbibition, Vernalization, and Growth Procedures

Rideau wheat was the experimental material used in all experiments. Grains were placed in 8.5-cm, blackened plastic petri dishes lined with two pieces of Whatman No. 1 filter paper. Excess distilled water, 10 mL per 5–9 grains (approximately 150), was added to each petri dish.

The grains were imbibed for 6 h at 25 ± 2°C and placed in refrigerators maintained at 2 ± 2°C for 4 weeks until vernalization was complete (Weinberger and Ku 1966). Chloramphenicol (20 μg/mL) was added to the water to inhibit bacterial and fungal growth (Jones and Varner 1967). At this concentration it did not affect the growth of Rideau wheat (Measures 1971).

The petri dishes were then transferred to growth chambers where a 16-h day at 25 ± 2°C and 10.1 klx and an 8-h night at 18 ± 2°C were maintained. Unless stated otherwise seedlings were transferred to blackened polyethylene bottles containing one-quarter strength Hoagland solution (Hoagland and Arnon 1950) when their roots reached 3 cm in length. The culture solution in each bottle was changed at least twice weekly. The bottles were rotated within the chamber when the solution was changed (Measures and Weinberger 1973).

Plant height, numbers of roots, tillers, and emergent leaves, and dry weights of both the root and shoot systems were measured after 8 weeks' growth. The experiments were repeated three times at different times to provide three replicates of at least 10 plants each, to a minimal total of 30 for each treatment. Grains and seedlings exposed only to background machinery noise constituted the control series.

Exposure of Grains and Plants to Audible Sound

Five audible sound frequencies, 0.30, 1.25, 5.00, and 12.00 kHz, and one array of white noise were used in the experiments.

Hewlett-Packard model 200 CD audiooscillators were used to generate each single sound frequency. The 0.30- and 1.25-kHz frequencies were obtained through 23-cm and 24 × 33 cm woofer speakers, respectively, attached to the audiooscillators. The 5.00- and 12.00-kHz frequencies were obtained through 10-cm tweeter speakers. The sound pressure level, monitored with a precision sound pressure level meter (Bruel Kjaer type 2203/1613), was 93 dB (re 0.0002 dyn cm^{-2}) at 0.30 kHz, 89 dB at 1.25 kHz, 92 dB at 5.00 kHz, and 95 dB at 12.00 kHz (Measures and Weinberger 1970). The 10-cm speakers were substituted by a horn (University model H-600) and driver (University model T-30) attached to an amplifier ‡Dynakit Stereo 70) to obtain 105 and 120 dB levels of sound.

[1]Partially supported by NRCC grant A1737.

[2]Present address: Department of National Health and Welfare, Radiation Protection Bureau, Ottawa, Ont., Canada.

[3]Supported by an NRCC studentship.

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TABLE 1. The effects of frequency and intensity of sonication during and after 4-weeks chilling and 8-weeks growth of Rideau wheat

	Frequency						
		5.00 kHz		Mean for 12.00, 5.00, 1.25, and 0.30 kHz and white noise			
Intensity, dB							
During chilling	0*	92	92	105	105	120	120
During growth	0*	0	92	0	105	0	120
Plant length, cm	51.5a†	57.2a	60.3a	59.9a	52.9a	53.4a	57.8a
No. of roots	46b	67a	71a	56ab	34c	45bc	41bc
Root dry weight, g	0.24c	0.64b	0.77a	0.38c	0.26c	0.31c	0.27c
Shoot dry weight, g	2.4b	3.73a	4.50a	3.63ab	1.40b	2.0b	1.9b

*Sound levels above background to which seeds were exposed before and after vernalization respectively.
†Numbers on any one line followed by the same letter are not significantly different at the 0.05 level (Scheffé (1957) test).

TABLE 2. Morphogenetic studies

Treatment	Days to reach stage 14*	No. of tillers ± SD	No. of emerged leaves ± SD
0 db during chilling, 0 dB during growth	29	2.6±0.2	10.5±0.5
5 kHz(92/92)	29	4.0±0.4	13.5±1.5
S†	29	2.7±0.2	10.0±1.0

*As defined by Friend *et al.* (1963).
†Mean from sound treatments 0.30, 1.25, 5.00, and 12.00 kHz, or random white noise, 105–120 dB.

White sound was obtained through a 20-cm speaker attached to a random noise source (Allison model 650). The sound specimen was flat and the energy gain was never greater than 3 dB per octave with increasing frequency. The sound pressure level varied between 78 and 92 dB over the range of 63 Hz to 8 kHz, dropping to 72 dB at 16 kHz and 56 dB at 31.5 kHz.

In each experiment, only the speaker or horn and driver was placed inside the germination or growth chamber. General background noise (from machinery) was 35 ± 3 dB in the refrigerators and 45 ± 3 dB in the growth chambers.

Vegetative Growth Study

Frequency Response

Twenty-two lots of grains were imbibed and subsequently chilled. During chilling two series were not exposed to sound, a further five were exposed to 0.30, 1.25, 5.00, or 12.00 kHz or random white noise, respectively, at a level approximating 92 dB. After vernalization, the sound-treated series were transferred to control chambers and not exposed to sound above background level.

Intensity Response

The last 15 lots of Rideau wheat grains and plants were exposed to each of the sonication regimes at intensities of 105 to 120 dB, as a follow-up to the 92-dB treatment (Weinberger and Measures 1968). In one series, the grains were sound treated both during the 4-week vernalization period and the subsequent 8-week growth period. In a second, parallel experiment grains were exposed to sound only during the vernalization period and in a third series germinated and partially germinated grains were exposed to sound only during the growth period following vernalization.

Morphological Response

The experimental and control series were examined during both the vernalization and growth periods.

Rideau wheat seedlings from each of the treatments were later planted in peat pots and placed in growth chambers as previously described. Daily, some of these seedlings were randomly selected, dissected, and examined under a stereomicroscope. Stage 14, where the double ridges are well established and beginning to swell (Friend *et al.* 1963) was used as the criterion for floral initiation. The time required for floral initiation was noted. The general growth habit of the other plants was also assessed on a daily basis.

Results

Frequency vs. Intensity Response

Significant differences in vegetative growth were mainly observed only in the 5-kHz, 92-dB series as reported previously (Weinberger and Measures 1968). The responses of Rideau wheat to the other sonication treatments showed the differences to be insignificant when tested by analysis of variance one-way classification (Guenther 1964). They were treated as a single group and compared with non-sonicated controls. Plant height was unaffected by

FIG. 1. Rideau wheat: morphological change effected by exposure to 5.0 kHz at intensity levels of 105–120 dB.

exposure to the high intensities. Increasing the sound intensity from 82–92 to 105 dB or more at 5 kHz, generally significantly reduced the dry weight of root and shoot tissue (Table 1). Apart from the 5-kHz series exposed to sonication both during vernalization and subsequent growth, sonication did not affect the timing of floral initiation nor the number of tillers and emergent leaves. Continuous exposure to 5 kHz led to an increase in tillering and leaf emergence (Table 2).

Morphological Response

Approximately 3% of the seedlings exposed to one or another of the sonication treatments at 105–120 dB developed a recognisable change in the form of the second or third emergent leaf (Fig. 1). Subsequent or earlier leaves were not affected by any of the treatments nor was the initiation of floral induction, as evidenced by stage 14.

Discussion

The vegetative growth response of Rideau winter wheat to audible sound is both frequency and intensity dependent. The frequency response differs with wheat variety, in that growth of the variety Rideau was not accelerated by exposure to the 0.30 Hz frequency although this was noted in previous studies with Marquis spring wheat (Measures and Weinberger 1970). Also, the response is negated when the grains and plants are exposed to additional frequencies as in the random white noise experiment.

Increased sound intensity from 92 to 105–120 dB eliminated the accelerated growth response to 5.0 kHz. A comparable intensity effect has been reported in germination studies during ultrasonic frequencies. Jonas (1955) found that the germination rate of onion seeds was accelerated by exposure to ultrasound when the power input was 10–15 W/cm^2 but was no longer affected when the power input was increased to 20 W/cm^2. In wheat, higher intensity levels did not otherwise effect a general change in growth or development to floral initiation. A significant reduction of the number of roots was observed.

The unusual change in leaf form of some of the plants exposed to one or another of the sonication frequencies at 105–120 dB was unexpected under the conditions of these experiments, although a comparable type of injury is known to occur following heat or cold stress during leaf development. Leaf cells at this stage of growth seem to be particularly susceptible to adverse environmental conditions. Evidently, high intensity sound may be

regarded as an adverse environmental factor in early leaf growth.

Acknowledgments

The authors wish to express their sincere appreciation to Dr. U. Graefe for the use of his random white noise generator and to Dr. J. Fisher of Agriculture Canada for his patience and help in showing us how to dissect meristems to determine floral induction.

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The effect of four audible sound frequencies on the growth of Marquis spring wheat

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MEASURES, M., and P. WEINBERGER. 1970. The effect of four audible sound frequencies on the growth of Marquis spring wheat. Can. J. Bot. **48**: 659–662.

The effect of 300 Hz, 1250 Hz, 5 kHz, and 12 kHz sound frequencies on the growth of Marquis spring wheat was investigated. Sound was added only during an extended (4-week) chilling period.

The height, number of roots, number of tillers, and fresh and dry weights of the root and shoot systems were significantly larger in plants pretreated with 5 kHz sound, when compared with controls. The height, dry weight of roots, and fresh and dry weights of tops were also significantly larger in plants pretreated with 300 Hz sound. Plants pretreated with either 1250 Hz or 12 kHz frequencies did not differ significantly from controls.

Introduction

Increase in the height and tillering of paddy grown in fields exposed to daily half-hour periods of music have been reported by Singh (2, 3). Field trial experiments in Illinois, U.S.A., have led to unconfirmed reports that the germination, growth, and development of corn is enhanced by exposure to music (1).

Continuous exposure to 5 kHz sound induced a twofold increase in the number of roots and in the fresh and dry weights of the root and shoot systems of fully vernalized (4 week chilled) Rideau winter wheat grown under controlled conditions (4). The number of roots and fresh and dry weights of the root system were also stimulated by exposure to 12 kHz sound. However, fully vernalized (1 week chilled) Marquis spring wheat did not show an accelerated growth response when exposed to either frequency.

In the present study, the chilling period to which Marquis grains were subjected was extended to 4 weeks, that is, beyond the vernalization requirement. Two other frequencies, 300 Hz and 1250 Hz, were also tested to assess differences, if any, in frequency response.

Materials and Methods

Two batches of 10 medium-sized Marquis grains per treatment were imbibed with excess water in petri dishes for 6 h at 25 °C and then chilled in refrigerators at 2 °C for 4 weeks. Four sound-exposed series (300 Hz, 1250 Hz, 5 kHz, and 12 kHz), and one control series were chilled simultaneously. The 300 Hz and 1250 Hz frequencies were obtained through 9-in. and 9.5 × 13 in. woofer speakers, respectively, and the 5 kHz and 12 kHz were obtained through 4-in. tweeter speakers attached to audiooscillators (4). The seeds were continuously exposed to the respective sound frequency throughout the chilling period. The sound pressure level, monitored with a precision sound pressure level meter (Bruel Kjaer Type 2203/1613), was 95 d*b* re 0.002 dyne/cm^2 at 12 kHz, 92 d*b* at 5 kHz, 89 d*b* at 1250 Hz, 93 d*b* at 300 Hz.

After completion of the chilling period, the petri dishes were transferred to growth chambers where a 16-h day at 25 °C ± 1 and 1500 ft-c and an 8-h night at 18 °C ± 1 were maintained. Seedlings were transferred

TABLE I

Marquis wheat after 4 weeks chilling and 8 weeks growth (Scheffe's test at the 5% level)

Height, cm				
5K,C	300,C	1250,C	12K,C	C,C
57.0	55.5	50.9	49.5	49.2
Number of roots				
5K,C	300,C	1250,C	12K,C	C,C
43.8	33.8	32.1	26.3	22.8
Number of tillers				
5K,C	300,C	1250,C	12K,C	C,C
10.1	7.6	7.5	6.5	5.5
Fresh wt. roots, g				
5K,C	300,C	1250,C	12K,C	C,C
4.8	3.4	2.7	2.4	2.1
Dry wt. roots, g				
5K,C	300,C	1250,C	12K,C	C,C
0.44	0.36	0.30	0.25	0.16
Fresh wt. tops, g				
5K,C	300,C	1250,C	12K,C	C,C
11.9	9.2	7.8	6.0	4.9
Dry wt. tops, g				
5K,C	300,C	1250,C	12K,C	C,C
1.94	1.53	1.27	0.94	0.84

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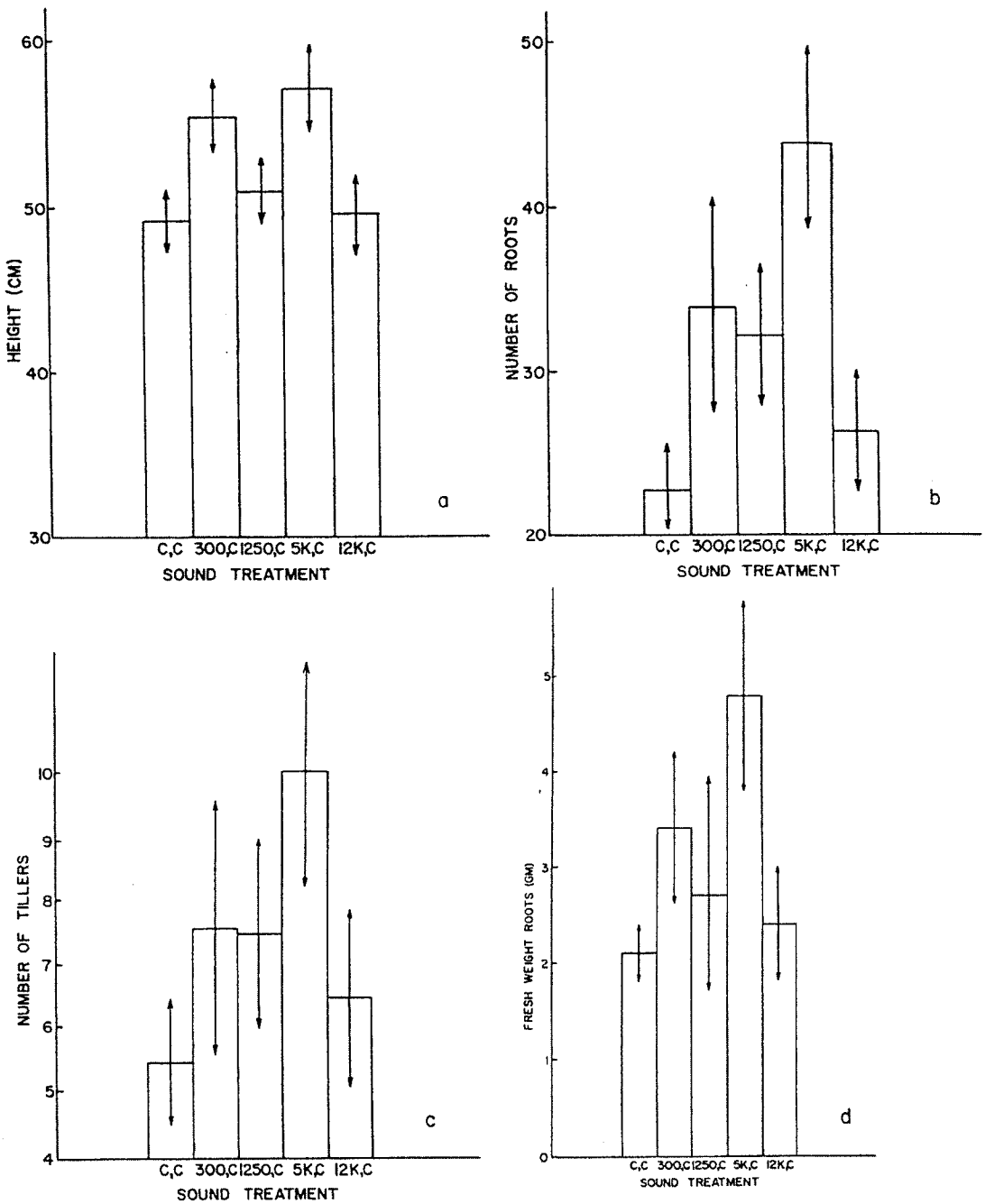
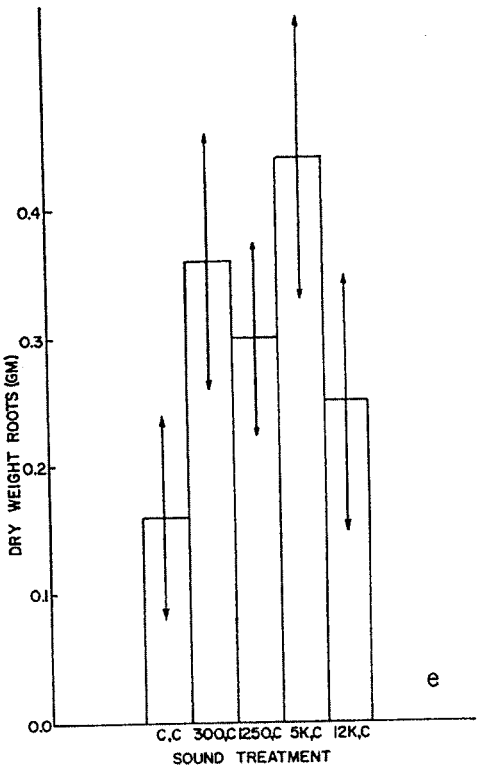


FIG. 1, *a–g*. Parameter values together with their standard deviations for the five treatments. (*a*) Height, cm. (*b*) Number of roots. (*c*) Number of tillers. (*d*) Fresh weight of roots, g. (*e*) Dry weight of roots, g. (*f*) Fresh weight of tops, g. (*g*) Dry weight of tops, g.


DRY WEIGHT ROOTS (GM)
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C,C 300,C 1250,C 5K,C 12K,C
SOUND TREATMENT
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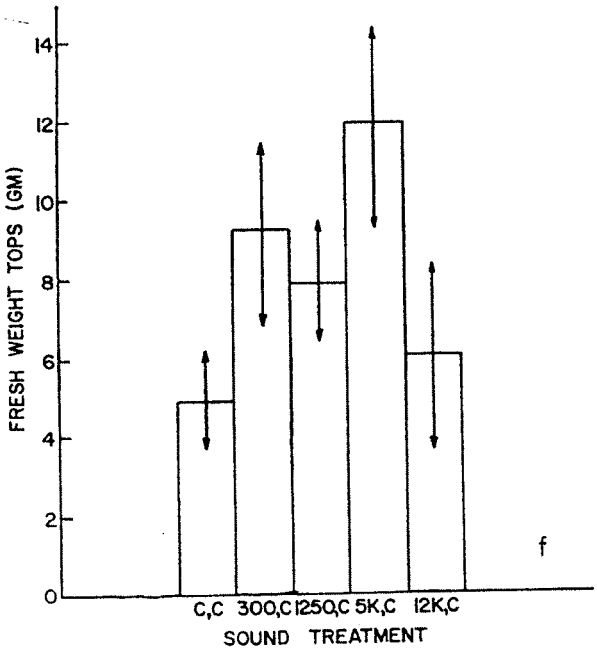
FRESH WEIGHT TOPS (GM)
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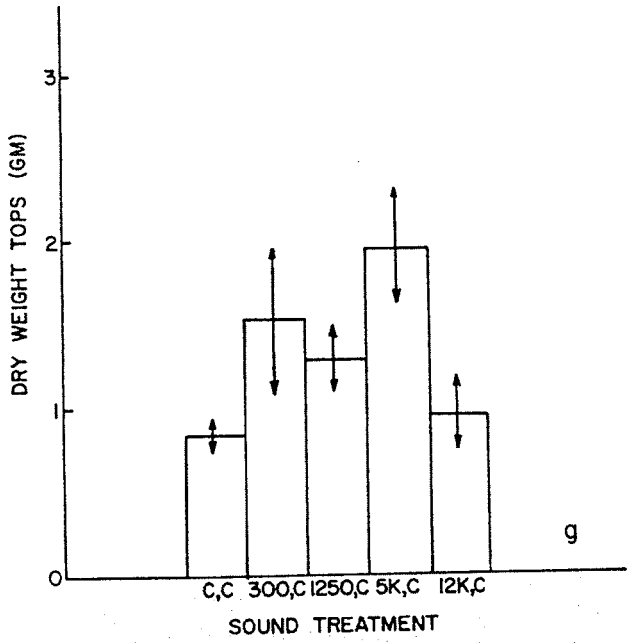
2
4
6
8
10
12
14
C,C 300,C 1250,C 5K,C 12K,C
SOUND TREATMENT
f


DRY WEIGHT TOPS (GM)
0
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C,C 300,C 1250,C 5K,C 12K,C
SOUND TREATMENT
g

to blackened polyethylene bottles containing one-fourth strength Hoagland solution when their roots reached 3 cm in length.

Plant height, number of tillers, number of roots, and the fresh and dry weights of both the root and shoot systems were measured after 8 weeks growth. Ten plants of each treatment were sampled. The experiment was repeated once, using growth cabinets other than those used in the initial experiment.

The data were subjected to statistical analysis using Scheffé's test at the 5% level.

Results

Table I shows the growth parameters for Marquis wheat after 8 weeks growth. Plants treated with 5 kHz sound during the vernalization period (5K, C) were significantly larger than control plants (C, C), for all parameters examined. The height, dry weight of the roots, and fresh and dry weights of the tops of plants pretreated with 300 Hz sound were also larger than controls. Plant growth was not significantly stimulated by treatment with either 1250 Hz or 12 kHz sound frequencies.

The parameter values, together with their variability, are also shown in Fig. 1, *a–g*, for the different sound frequencies. For all parameters studied, the 5 kHz treatment produced the largest growth stimulation when compared with controls. Although no statistically significant differences were observed between the 5 kHz and 300 Hz treatments, grains treated with 5 kHz sound consistently gave an indication of a more stimulated growth response.

Discussion

The frequency–response curve of Marquis wheat appears to have at least two peaks, one at 300 Hz and one at 5 kHz. The harmonic frequencies used here do not necessarily react in the same manner. The plant growth parameters examined were not significantly affected by treatment with 1250 Hz sound, although all were enhanced by treatment with 5 kHz, the fourth harmonic of 1250 Hz.

The duration of the exposure period at specific developmental stages may also be important (4). In our previous experiments, Marquis plants treated with 5 kHz sound for a total of 9 weeks, 1 week of vernalization and 8 weeks of subsequent growth, did not differ significantly from the control plants. In the present study, however, there was a 100% or greater increase in the fresh and dry weights of Marquis plants treated with 5 kHz sound during the prolonged 4-week imbibition in the cold.

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EFFECTS OF AN AUDIBLE SOUND FREQUENCY ON TOTAL AMINO ACIDS AND MAJOR FREE ALCOHOL-SOLUBLE AMINO ACIDS OF RIDEAU WHEAT GRAINS

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The alcohol-soluble amino acids of imbibed Rideau wheat (*Triticum aestivum*) grains exposed to 2 C was modified by sonication at 5 kHz for 4 wk. Although the free amino acid content of this fraction was unchanged, the percentage of glycine and aspartic acid was higher in the endosperm of nonsonicated controls. By contrast, the sonicated series always had comparatively more alanine in the embryo and less in the endosperm than comparable control grains. The amount of glycine and alanine was always substantially higher whereas asparagine content was lower in sonicated endosperm tissue as compared with untreated controls. Generally, the amino acid content of both the embryo and endosperm was higher in the control series.

Les acides aminés solubles dans l'alcool de grains de blé (*Triticum aestivum*) Rideau imbibés et exposés à une température de 2 C ont été modifiés par un traitement à des sons de 5 kHz pendant 4 semaines. Bien que la teneur en amino-acides libres de cette fraction n'ait pas été modifiée, le pourcentage de glycine et d'acide aspartique était plus élevé dans l'endosperme des grains témoins non soumis à des sons. Par contre, les grains soumis à des sons contenaient toujours relativement plus d'alanine dans l'embryon et moins d'alanine dans l'endosperme que les grains témoins comparables. Les teneurs en glycine et en alanine étaient toujours considérablement plus élevées, et la teneur en asparagine plus faible dans l'endosperme des grains soumis à des sons que dans les grains témoins. En général, la teneur en acides aminés de l'embryon et de l'endosperme était plus élevée dans les grains témoins.

INTRODUCTION

Concurrent exposure of Rideau winter wheat (*Triticum aestivum*) grains and Marquis spring wheat to a 4-wk chilling period and sonication at 5 kHz has been shown to act as a preconditioning treatment for breaking the dormancy of previously dormant tillers (Weinberger and Measures 1968; Measures and Weinberger 1970). Knowing that the protein-synthesizing ability of young embryos may develop as early as 30 min after the start of imbibition (Marcus et al. 1966) we wondered whether exposure to audible sound during prolonged imbibition in the cold might affect the normal course of protein synthesis over and above that caused by the cold exposure. With seeds grown at 25 C, Jones and Pearce (1967) generally found that the loss of many amino acids from the endosperm was identical with the gain in the embryo. Changes in the ratio of amino acids (Aronoff 1962; Wang 1968) and proteins (Daussant and Abbott 1969) vary with species and stage of germination. Oaks (1965) suggested that degradation of storage protein in the endosperm of *Zea mays* may be regulated by amino acid requirements in the embryo. It was of interest then to determine whether sonication led to changes in grain metabolites. In the present investigation changing patterns of the content of the major free (alcohol-soluble) grain amino acids and amides was determined.

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MATERIALS AND METHODS

Preparation of Grains

Imbibed grains of Rideau wheat were exposed to 5 kHz single frequency sound at an intensity level of 92 dB or to control conditions (background 35 ± 3 dB) during a 4-wk vernalization period (Weinberger and Measures 1968). The grains were then removed from the cold and their pericarps removed. Embryos were carefully dissected out and separated from the endosperm.

Free (Alcohol-Soluble) Amino Acids

Free amino acids were extracted in 70% ethanol; 0.5 ml ethanol was used for each sample of 15 embryos and 2.0 ml for each sample of 15 endosperms. The tissue was homogenized, let stand for 30 min at 60 ± 2 C and then centrifuged for 15 min at 500 *g*. The debris was further extracted three times, the final extraction lasting overnight. The combined supernatants were dried in a warm-air current and redissolved in 1.0 ml of 12.5% sucrose solution. Determinations of amino acids were made on a Technicon amino acid analyzer. The determination of asparagine and glutamine was obtained from samples hydrolyzed for 3 h in 1 N HCl in sealed tubes at 110 C (Boulter 1966).

Total Amino Acids

Samples of 15 embryos and 15 endosperms were hydrolyzed for 18 h in 6 N HCl in sealed tubes at 110 C (Boulter 1966). The HCl was then evaporated over a hot plate and the residue redissolved in 12.5% sucrose solution and analyzed for amino acids on a Technicon amino acid analyzer.

All experiments were repeated twice at different times and the replicates did not differ by more than 6%.

RESULTS

Free Amino Acids

The concentration of alcohol-extractable amino acids and amides of the embryo and endosperm of 4 wk chilled control and 5-kHz exposed grains are presented in Table 1.

The amino acids were, on the average, 18 times more concentrated in the embryo than in the endosperm. The most abundant amino acids in the embryo were serine, proline, and alanine. The concentrations of serine and proline were 38% and 26%, respectively, higher in the control series than in the sound-exposed series. Alanine, however, was 62% more concentrated in the 5-kHz exposed series.

Differences in the concentrations of aspartic acid and glutamic acid between the control and sound-exposed embryos were insignificant. The concentration of leucine in the control series was about double that of

Table 1. Free alcohol-soluble amino acid and amide composition (μmol/10 g dry wt) of vernalized control and sound-exposed Rideau wheat grains

	Embryo		Endosperm	
	C	5-kHz	C	5-kHz
Aspartic acid	42	43	5	7
Serine	84	61	4	4
Glutamic acid	59	55	6	5
Proline	244	193	4	4
Glycine	46	36	1	4
Alanine	121	196	5	2
Valine	35	27	2	2
Methionine	†	†	†	†
Isoleucine	17	14	2	1
Leucine	19	9	1	1
Tyrosine	–	–	1	1
Phenylalanine	11	13	2	2
Lysine	†	†	†	1
Histidine	14	14	†	1
Arginine	22	14	1	1
Asparagine	304	254	16	10
Glutamine	598	528	13	11

†Less than 1 μmol/g dry wt.

Table 2. Relative proportions of free amino acids and amides (%) of vernalized control and sound-exposed Rideau wheat grains

	Embryo		Endosperm	
	C	5-kHz	C	5-kHz
Aspartic acid	2.6	3.0	7.9	12.7
Serine	5.2	4.2	6.3	7.3
Glutamic acid	3.7	3.8	9.5	9.1
Proline	15.1	13.2	6.3	7.3
Glycine	2.8	2.5	1.6	7.3
Alanine	7.5	13.5	7.9	3.6
Valine	2.2	1.9	3.1	3.6
Methionine	†	†	†	†
Isoleucine	1.1	1.0	3.1	1.8
Leucine	1.2	0.6	1.6	1.8
Tyrosine	†	†	1.6	1.8
Phenylalanine	0.7	0.9	3.1	3.6
Lysine	†	†	†	†
Histidine	0.9	1.0	†	†
Arginine	1.4	1.0	1.6	1.8
Asparagine	18.8	17.4	25.4	18.1
Glutamine	37.0	36.2	20.6	20.1

†Less than 1%.

the sonicated series. There was 20% more asparagine and 13% more glutamine in the control embryos than in the sound-exposed embryos. Asparagine was 60% more concentrated in the endosperm of the control than in that of the sonicated series.

Although the free amino acids and amides were more concentrated in the embryos of the control series than in those of the 5-kHz group (except for alanine), the relative proportions of most amino acids were the same for the two series (Table 2). The amino acid showing the greatest difference was alanine, which was almost twice as abundant in the embryo and half as abundant in the endosperm of the 5-kHz series when compared with its concentration in the respective grain parts of the control group. A fourfold increase of glycine and a 1.5 times increase in the content of aspartic acid was noted in the endosperm of the 5-kHz series when compared with comparable grain parts of the control group. Asparagine content was comparatively low in the sonicated endosperm. The major difference was in the amides. Compared with untreated controls embryos of sonicated grains contained 13% less of these compounds (Table 3).

Total Amino Acids

The total amino acid compositions of the embryo and endosperm of 4-wk chilled control and 5-kHz exposed grains are shown in Table 4. Concentrations in the embryo were on the average higher than in the endosperm.

In all instances except methionine, the amino acid concentrations were higher in

Table 3. Percent change in free alcohol-soluble amino acids and amides in the embryo of vernalized control and sound-exposed Rideau wheat grains (μmol/10 g dry wt)

	C	5-kHz	% difference
Amino acids	714	675	5.5
Amides	902	782	13.3
Overall	1616	1457	9.8

Table 4. Amino acid composition (μmol/g dry wt) of vernalized control and sound-exposed Rideau wheat grains‡

	Embryo		Endosperm	
	C	5-kHz	C	5-kHz
Aspartic acid	155	114	62	33
Threonine	77	52	114	37
Serine	120	101	79	59
Glutamic acid	207	147	328	231
Proline	68	41	109	70
Glycine	163	93	96	57
Alanine	132	90	62	43
Valine	42	35	22	33
Methionine	†	†	†	†
Isoleucine	23	20	13	27
Leucine	97	63	52	47
Tyrosine	17	13	37	27
Phenylalanine	43	37	36	27
Lysine	52	37	†	12
Histidine	38	28	17	18
Arginine	63	47	12	14

†Less than 1 μmol/g dry wt.
‡Total = free and protein and amide (total amino acid residues).

embryos from the control series than those from the sound-exposed group. The greatest differences appeared in proline (65%) and glycine (75%). Methionine was present in only trace amounts in both series.

Asparagine and glutamine concentrations were included with aspartic acid and glutamic acid concentrations since the amides were converted to their respective amino acids by acid hydrolysis during the preparation of the sample (Boulter 1966). Thirty-six percent more aspartic acid and 41% more glutamic acid was present in the embryos from the control grains than those from the sound-exposed grains.

Amino acids were also more concentrated in the endosperm from the control grains than in the endosperm from the sound-exposed series, apart from valine, isoleucine, and lysine, which were more concentrated in the sound-exposed series, and methionine, histidine, and arginine, which were about the same level in both series. The most abundant amino acids were aspartic and glutamic acid, serine, proline, glycine, and alanine. These were more abundant in the control series than in the 5-kHz exposed series.

Percentage composition was almost the same for the amino acids in both the embryo and the endosperm of the two series (Table 5).

DISCUSSION

Evidence of protein breakdown in the endosperm, transfer of amino acids to the embryo, and protein synthesis in the embryo are suggested by the larger concentration of free amino acids in the embryo than in the endosperm (Tables 1 and 3). The changes in the proportion of amino acids in the embryo, compared with proportion in the endosperm, suggest the interconversion of many amino acids during these processes. The higher amino acid content in both the embryo and endosperm of the control series, when compared with the sound-exposed group, suggests that more protein may have entered the respiratory cycle or have been converted to some other nitrogenous compounds in the sound-exposed series. Steward et al. (1956) using cultured carrot cells showed that although the total amount of protein produced in the cultures depended upon the rate of growth of the cells, the relative proportions of amino acids were almost unaffected. The same relationship can be seen in the present study when amino acid content is expressed on a percentage

Table 5. Relative proportions of total amino acids (%) of vernalized control and sound-exposed Rideau wheat grains

	Embryo		Endosperm	
	C	5-kHz	C	5-kHz
Aspartic acid	11.9	12.4	6.6	4.5
Threonine	5.9	5.6	1.2	5.0
Serine	9.2	11.0	8.4	8.0
Glutamic acid	15.9	16.0	35.0	31.4
Proline	5.2	4.5	11.6	9.5
Glycine	12.5	10.1	10.3	7.8
Alanine	10.1	9.8	6.6	5.9
Valine	3.5	3.8	2.4	4.5
Methionine	†	†	†	†
Isoleucine	1.8	2.2	1.4	3.7
Leucine	7.5	6.9	5.6	6.4
Tyrosine	1.3	1.4	4.0	3.7
Phenylalanine	3.3	4.0	3.8	3.7
Lysine	4.0	4.0	†	1.6
Histidine	2.9	3.1	1.8	2.4
Arginine	4.8	5.1	1.3	1.9

†Less than 1%.

basis (Tables 2 and 4). Differences in total amino acid concentration between control and sound-exposed grains are minute. This could be interpreted to show that sound-exposed grains, in contrast to control grains, lose (or more rapidly utilize) their nitrogenous compounds.

The percentage of free alanine in the embryo of the sound-exposed grains is almost double that found in the control series. In the endosperm, however, the reverse is true. Steward and Durzan (1965) found that alanine was present in large quantities in the soluble-nitrogen component of rapidly growing cells. Hence, the larger proportion of alanine in the embryo of sound-exposed grains might indicate a more rapid rate of development. Alanine may also affect morphological development since Virtanen and Linkola (1946) found that pea plants fed with this amino acid showed an abnormally high degree of branching. Hence, the presence of large amounts of this amino acid in the embryos of the sound-exposed series may be related to the large number of tillers produced by these plants. It is quite possible that the breakdown of storage protein in the endosperm is controlled by the demands of the embryo (Oaks 1965), and that amino acid interconversions occur in the endosperm as they do in the cotyledons of castor bean (Steward and Beevers 1967). The presence of smaller amounts of asparagine in the sound-exposed series compared with the amounts of asparagine in the control group suggests that ammonia released during deamination is entering some alternate pathway in the sonicated series.

As glycine and ammonia are used as precursors to RNA (Webster 1959; McKee 1962), and Webster (1959) found evidence to suggest that nucleic acid synthesis is necessary for and coupled with protein synthesis, there is a tantalizing suggestion borne out by some of our preliminary investigations that seems to indicate that audible sound may indeed affect nucleic acid metabolism.

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The effect of two audible sound frequencies on the germination and growth of a spring and winter wheat[1]

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The effect of sound of 5 kc/s and 12 kc/s on the germination and growth of grains and seedlings of vernalized spring (Marquis) and winter (Rideau) wheats was investigated. Untreated controls were simultaneously followed, and all experimental series were replicated at least three times. Growth cabinets were systematically interchanged with the replications to eliminate other variables. Sound at both frequencies significantly stimulated the germination of Marquis grains maintained at 2° and 10 °C. At 25 °C the rate of germination was unchanged. An indication of a slightly elevated germination rate was observed in Rideau grains held at 2° and exposed to 5 kc/s. Neither frequency significantly affected germination at 10° or 25 °C.

Growth of plants derived from fully vernalized grains was followed by measuring total plant height, wet and dry weight of "tops", number of roots, and their fresh and dry weights. Rideau wheat grew more vigorously at both sound frequencies. Continuous exposure to 5 kc/s both during vernalization and subsequent growth resulted in a 200% or greater increase in all parameters followed. The growth response of Marquis wheat was dependent upon treatment. Some conditions of sound exposure accelerated growth, whereas in others growth was depressed.

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Introduction

Stimulation of germination and growth of barley, sunflower, pine, spruce, and Siberian pea tree seedlings by treatment with ultrasonic frequencies has been found to occur by Johnson (1), Obolensky (1, 2), Kozubov (3), Timonin (4), and Lisenkov (5). In all cases, stimulated growth was accompanied by increased activity of the enzymes γ-amylase and peroxidase both in the seed and seedlings. An increase in the respiration rate was also observed. Obolensky and Timonin independently found some species to be inhibited by the same frequency and length of exposure time that stimulated other species. Both found a critical intensity level, below which germination and growth were enhanced, but above which they were inhibited (1, 2, 4). The frequency and amount of energy required to produce these effects appear to vary widely between species.

Very few studies concerning the effects of audible sound have appeared in the literature. Several descriptive papers reporting stimulation of plant growth by exposure to daily periods of music have been noted (6, 7, 8). However, the effect of single-frequency audible sound on plant growth has not, so far, been critically assessed. No information is presently available on the effect of audible sound on the rate of germination of any seeds or grain. The present study on the effect of sound frequencies in the audio range on wheat grain seedlings was therefore initiated.

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Materials and Method

Marquis (spring) and Rideau (winter) wheats, *Triticum aestivum* L., were used throughout the study in parallel experiments. Grain was obtained from the Department of Agriculture, Division of Cereal Crops, Ottawa.

1. *Germination Studies*

This series consisted of a control group, C, not sound treated, and two groups 5K and 12K, exposed to sound of frequency 5 kc/s and 12 kc/s respectively. Each group was held at three temperatures, 25°, 10° and 2 °C, requiring a total of nine cabinets (Sherer-Gillett, model CEL 255-6). In each cabinet were placed five blackened petri dishes, filter paper lined, each containing 10 medium-sized, morphologically comparable grains, to which excess water was added (7.5 ml per 8.5-cm diam petri dish).

In the 5K and 12K groups the sound was transmitted to the cabinets by a 4-in. loud-speaker mounted inside, and in the middle of the rear wall. Each speaker was driven via an impedance matching transformer by the full output of an audio-oscillator (Hewlett-Packard model 200CD) located outside the cabinet.

The sound pressure level was monitored at various places in the cabinet by a meter (Bruel Kjaer).

The sound pressure level at the petri dishes was 95 db re 0.002 dyne/cm^2 at 12 kc/s, and 92 db re 0.002 dyne/cm^2 at 5 kc/s, and varied by less than ± 1 db over the various positions of the petri dishes. General background noise (from machinery) was 45 db in all cabinets, but contributions from noise at 5 and 12 kc/s were negligible.

The number of grains germinated was observed at hourly intervals for grains held at 25°, every 4 hours at 10° and every 12 hours on the grains at 2 °C. Germination

was assessed to be complete when the radicle just pierced the grain coat.

Replication of the Germination Studies

The set of nine growth conditions described above was repeated at three different times during a 15-month period. In each such repetition cabinets were systematically interchanged, so that control cabinets became 5 kc/s or 12 kc/s cabinets and vice versa. The cabinets assigned to different temperatures were also interchanged during one replication.

2. *Growth Studies*

In this series the grains (10 per blackened petri dish) were first allowed to imbibe at 24 ± 1 °C for 6 hours, and were then divided into three groups which were chilled at 2 °C (9) until vernalization was completed (1 week for Marquis, 4 weeks for Rideau wheat). During chilling one group was not exposed to sound, the other two were exposed to 5 kc/s and 12 kc/s respectively. After vernalization, the sound-treated groups were each divided into two sets. With one of the sets the same treatment was continued during the subsequent growth period, whilst the other was transferred to control cabinets and not exposed to sound. Using a two symbol notation to describe the conditions during vernalization and growth respectively, the four resultant sets are represented by 5K,5K; 5K,C; 12K,12K; and 12K,C. The vernalized, but sound-unexposed group was split into three sets, two of which were sound treated during the growth period, giving the sets represented by C,C; C,5K; and C,12K. Each of the final sets consisted of 5 petri dishes with 10 young seedlings per dish.

When the seedling roots reached a length of 3 cm, two seedlings were randomly selected from each petri dish and singly transferred to blackened polyethylene bottles containing a culture medium (Hoagland solution, ¼ strength). The original sample of 50 grains per growth condition, now reduced to 10 seedlings per treatment, was analyzed after the selected growth period with respect to the following parameters: plant height, number of roots, fresh and dry weights of total root system, fresh and dry weight of "tops".

Growth periods chosen were 1, 2, 4, 6, and 8 weeks. For each growth period a complete set of the combinations of vernalization and growth conditions was required.

To reduce the number of cabinets, various samples undergoing the same treatment at a particular time were often housed together.

The culture medium was changed twice weekly initially, and subsequently three or four times weekly as warranted by plant growth. A regime of a 16-hour day and 8-hour night was maintained in all cabinets. The total light intensity during the daytime period was 1500–1750 ft-c provided by four 25-watt incandescent, and eight fluorescent lights (Sylvania F48 T12-cw-Ho).

Dry weights were obtained after the plant material was heated at 95 ± 1 °C for 24 hours and then equilibrated with atmospheric humidity.

Replication of Growth Series

Each of the above experiments C,C; C,5K; C,12K; 5K,C; 5K,5K; 12K,C; 12K,12K was repeated three times for Rideau wheat and five times for Marquis wheat, at all the growth periods stated. In addition, systematic cabinet interchanges were made between replications, as described for the germination studies.

Statistical Analysis

The data were subjected to statistical analysis using Scheffé's test at the 5% level.

Results

Germination Studies

The percentage germination was plotted against time. At each temperature the time was deduced at which the divergence between the curves for the sound-treated and control groups was largest. The results are shown in Table I for Marquis and Rideau wheat. Both wheat varieties appear to show the greatest divergence between sound-treated and control samples at the same times, although for Rideau wheat the divergences are not statistically significant.

TABLE I

Percentage germination of Marquis and Rideau wheat as affected by sound and germination temperature (Scheffé's test at 5% level)

Temp., °C	Time	% germination		
	Marquis wheat			
2	6 days	5K	12K	C
		84	82	24
10	3 days	12K	5K	C
		98	64	50
25	14 hours	5K	12K	C
		64	49	45
	Rideau wheat			
2	6 days	5K	C	12K
		94	72	50
10	3 days	12K	C	5K
		100	98	96
25	14 hours	5K	C	12K
		90	90	84

With Marquis wheat, the effect of sound was temperature dependent. At 2° a larger percentage of Marquis seeds had germinated after 6 days, when exposed to either 5 kc/s or 12 kc/s sound, than when left under control conditions. At 10° only seeds kept under 12 kc/s germinated faster than controls, whereas at 25 °C there were no significant differences between treatments.

Rideau grain, on the other hand, did not show statistically significant differences in germination between treatments at any of the temperatures.

In all cases, 99.8% of the grains germinated when left for longer periods at each of the three temperatures.

TABLE II

Marquis wheat after 4 weeks growth (Scheffé's test at the 5% level)

Height cm						
12K,12K*	C,5K	5K,C	5K,5K	12K,C	C,C	C,12K
48.8	46.9	46.0	45.2	42.1	41.8	41.6
Number of roots						
5K,5K	12K,12K	C,5K	5K,C	C,C	12K,C	C,12K
27.5	27.4	24.8	24.3	22.9	20.1	16.0
Fresh wt. of roots, g						
12K,12K	C,5K	5K,5K	5K,C	C,C	12K,C	C,12K
2.88	2.85	2.70	2.62	2.45	2.28	1.24
Dry wt. of roots, g						
12K,12K	5K,5K	C,5K	C,C	12K,C	5K,C	C,12K
0.21	0.18	0.18	0.17	0.15	0.15	0.08
Fresh wt. tops, g						
12K,12K	5K,5K	C,5K	5K,C	12K,C	C,C	C,12K
6.49	5.61	5.60	4.96	4.43	3.90	3.48
Dry wt. tops, g						
12K,12K	5K,5K	C,5K	5K,C	12K,C	C,C	C,12K
0.76	0.68	0.65	0.59	0.54	0.49	0.41

*Treatment.

TABLE III

Rideau wheat after 4 weeks growth (Scheffé's test at the 5% level)

Height, cm					
5K,5K*	5K,C	12K,12K	C,5K	12K,C	C,C
42.2	4.00	39.7	34.6	33.1	30.2
Number of roots					
5K,5K	5K,C	12K,C	12K,12K	C,5K	C,C
15.9	15.4	15.4	12.8	11.8	10.7
Fresh wt. roots, g					
5K,C	5K,5K	12K,C	12K,12K	C,5K	C,C
1.40	1.27	1.05	0.88	0.69	0.44
Dry wt. roots, g					
5K,C	5K,5K	12K,12K	12K,C	C,5K	C,C
0.10	0.08	0.07	0.07	0.04	0.03
Fresh wt. tops, g					
5K,5K	5K,C	12K,12K	12K,C	C,5K	C.C
3.17	2.80	1.67	1.62	1.38	0.90
Dry wt. tops, g					
5K,5K	5K,C	12K,12K	12K,C	C,5K	C,C
0.41	0.36	0.22	0.22	0.16	0.13

*Treatment.
NOTE: C,12K data not included because of wide spread of values for all parameters.

Growth Studies

Compared with the controls (C,C) the different responses of Marquis and Rideau wheats exposed to sound did not become evident till after 4 weeks of growth, and the data taken at earlier times are therefore not given. Table II shows the parameters for Marquis wheat, grown for 4 weeks. The C,12K treatment evoked a depressed growth response which was clearly significant in the decreased number of roots and depressed levels of fresh and dry weights. Other treatments were barely significant, except 12K,12K where there was a slight stimulation of the fresh and dry weights of tops.

TABLE IV

Marquis wheat after 6 weeks growth (Scheffé's test at the 5% level)

Height, cm						
5K,5K*	C,5K	5K,C	C,C	12K,12K	12K,C	C,12K
60.1	56.8	55.3	51.6	50.3	47.0	46.1
Number of roots						
5K,5K	C,C	C,5K	5K,C	C,12K	12K,12K	12K,C
63.3	50.4	49.4	47.9	47.7	46.6	45.4
Fresh wt. roots, g						
5K,5K	C,C	5K,C	C,5K	C,12K	12K,12K	12K,C
5.20	4.83	4.53	3.91	3.89	3.72	3.62
Dry wt. roots, g						
5K,5K	C,C	5K,C	C,5K	C,12K	12K,C	12K,12K
0.48	0.42	0.34	0.33	0.32	0.29	0.27
Fresh wt. tops, g						
5K,5K	C,C	5K,C	C,5K	C,12K	12K,12K	12K,C
15.75	13.31	13.17	10.05	8.42	8.42	7.75
Dry wt. tops, g						
5K,5K	C,C	5K,C	C,5K	12K,12K	C,12K	12K,C
2.35	1.79	1.56	1.50	1.25	1.22	1.08

*Treatment.

TABLE V

Rideau wheat after 6 weeks growth (Scheffé's test at the 5% level)

Height, cm					
5K,5K*	5K,C	C,5K	C,C	12K,12K	C,12K
54.3	51.5	51.5	47.4	44.5	42.4
Number of roots					
5K,5K	5K,C	12K,12K	C,5K	C,12K	C,C
35.2	32.3	30.4	30.0	22.2	20.6
Fresh wt. roots, g					
5K,5K	5K,C	C,5K	5K,C	C,12K	C,C
3.90	3.32	2.94	2.54	1.69	1.44
Dry wt. roots, g					
5K,5K	5K,C	C,5K	12K,12K	C,12K	C,C
0.28	0.24	0.20	0.20	0.13	0.09
Fresh wt. tops, g					
5K,5K	5K,C	C,5K	12K,12K	C,C	C,12K
12.43	10.71	9.12	7.28	4.90	4.01
Dry wt. tops, g					
5K,5K	5K,C	C,5K	12K,12K	C,C	C,12K
1.51	1.32	1.07	0.92	0.64	0.60

*Treatment.

In contrast, the results with Rideau wheat, shown in Table III, indicate that it was significantly stimulated by all sound treatments.

At the 6-week growth period many treatments adversely affected the growth of Marquis wheat (Table IV). A slight stimulation, significant only in the height of the plants and dry weight of the tops, was noted for the 5K,5K group. All Rideau wheat plants (Table V) grew more vigorously after continuous exposure to 5 kc/s. The weight of both roots and tops were increased by 250–300% over control in this treatment.

After 8 weeks growth, Tables VI and VII, there was an indication that the three series 5K,5K;

TABLE VI

Marquis wheat after 8 weeks growth (Scheffé's test at the 5% level)

Height, cm						
5K,5K*	C,12K	5K,C	C,5K	C,C	12K,12K	12K,C
72.8	70.8	67.7	67.1	62.7	62.0	61.3
Number of roots						
5K,C	12K,C	5K,5K	C,C	12K,12K	C,12K	C,5K
105.6	101.4	98.9	89.8	89.2	85.4	84.7
Fresh wt. roots, g						
12K,C	5K,C	5K,5K	C,C	C,5K	12K,12K	C,12K
14.43	12.67	10.21	8.60	8.04	7.79	7.50
Dry wt. roots, g						
5K,C	12K,C	5K,5K	C,C	C,5K	12K,12K	C,12K
1.27	1.21	1.07	0.98	0.84	0.76	0.57
Fresh wt. tops, g						
5K,5K	5K,C	12K,C	C,5K	C,C	C,12K	12K,12K
31.55	30.08	29.36	25.73	25.18	23.13	18.68
Dry wt. tops, g						
5K,5K	5K,C	12K,C	C,12K	C,5K	C,C	12K,12K
5.90	5.30	4.90	4.37	4.13	4.03	3.45

*Treatment.

TABLE VII

Rideau wheat after 8 weeks growth (Scheffé's test at the 5% level)

Height, cm						
C,5K*	5K,5K	5K,C	C,C	C,12K	12K,12K	12K,C
61.0	60.3	57.2	57.1	55.4	55.1	55.0
Number of roots						
5K,5K	12K,12K	5K,C	C,5K	C,12K	12K,C	C,C
71.0	67.8	66.8	55.1	54.1	53.2	36.0
Fresh wt. roots, g						
C,12K	5K,5K	C,5K	12K,12K	5K,C	12K,C	C,C
9.64	8.31	7.26	6.76	6.60	6.26	4.79
Dry wt. roots, g						
C,12K	5K,5K	12K,12K	5K,C	C,5K	12K,C	C,C
0.96	0.77	0.69	0.64	0.59	0.50	0.35
Fresh wt. tops, g						
5K,5K	C,5K	5K,C	12K,12K	C,12K	12K,C	C,C
29.24	23.79	23.72	21.11	21.04	18.68	15.27
Dry wt. tops, g						
5K,5K	5K,C	12K,12K	C,12K	C,5K	12K,C	C,C
4.50	3.73	3.31	3.14	3.03	2.60	1.85

*Treatment.

12K,C; and 5K,C may have slightly stimulated the growth of Marquis plants. Continuing stimulation was seen in all treated Rideau plants after 8 weeks growth. Highly significant increments in the fresh and dry weights of roots and tops were obtained.

The parameter values together with their variability are also shown in Fig. 1, *a–f*, for the 7 different combinations of vernalization and growth conditions. With respect to most of the parameters, the 5K,5K treatment produced the largest growth stimulation compared to the controls. The photographs in Fig. 2, *a–g*, show the 8-week-old Rideau wheat plants and the stimulating effect of sound is readily visible.

Discussion

Sound appears to have a greater effect on the

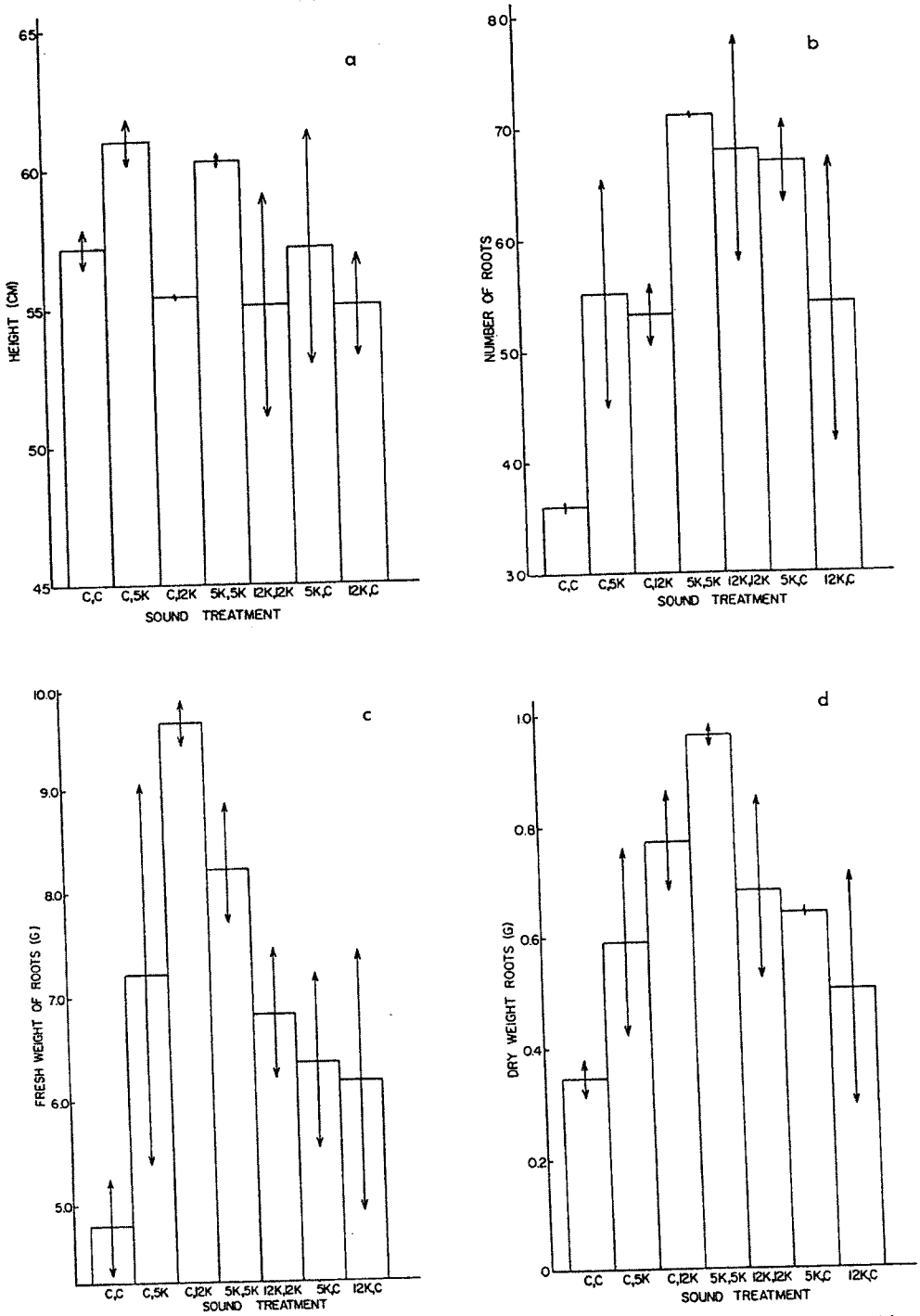

FIG. 1, *a–f*. Parameter values together with their variability for each of the seven different combinations of vernalization and growth conditions. (*a*) Height, cm. (*b*) Number of roots. (*c*) Fresh weight of roots, g. (*d*) Dry weight of roots, g. (*e*) Fresh weight of tops, g. (*f*) Dry weight of tops, g.

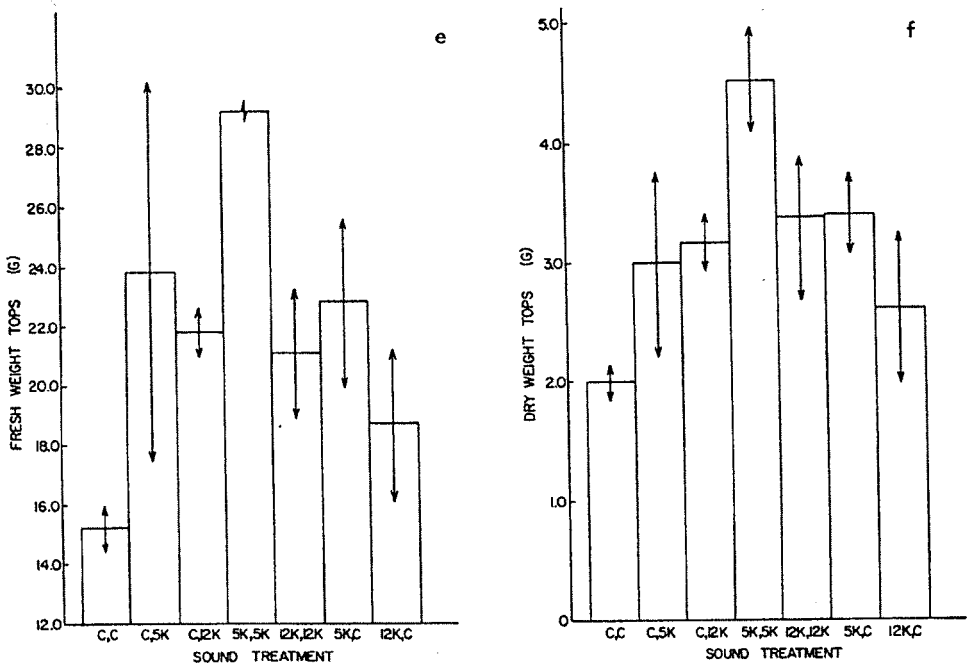

FIG. 1. (*Concluded*)

growth of Rideau wheat plants than on that of Marquis wheat plants, but a greater effect on the germination of the Marquis wheat. This suggests that at least two systems must be affected by these sound frequencies.

Neither the germination response to audible sound nor the different growth responses of the winter and spring wheats to the same sound levels can be explained at this point. It appears, however, that the effect of exposure to sound is transmitted to subsequent cell generations.

The amount of energy added by the sound frequencies in this experiment is very minute, being only one-billionth that required to break a chemical bond and is too low to cause cavitation of water. However, the amount of energy is sufficient to produce a resonance effect in any cellular organelle which has a natural period of vibration corresponding to that of the added sound. In such a case, the effects of individual successive vibrations of the sound waves would be cumulative and might induce larger vibrations of the organelle. This might, in some manner, affect cellular biochemical or biophysical processes which are connected with germination and growth. This then could account for the different responses between the two sound frequencies and between the two wheat varieties.

Another hypothesis involves the effects of sound on water. Since there is no thermal expansion of water at 4 °C, a phase shift of the sound wave may occur at lower temperatures. If the rate of germination is not linear with regards to temperature and pressure, grains may germinate faster in one part of the sound wave than in another. If this is true, then temperature and pressure may re-enforce one another at 2 °C, but not at 25 °C. This then could account for increased germination rates of grains subjected to sound at 2 °C but not at 25 °C. It has also been suggested that the production of ethylene may be involved. It remains to be seen whether the growth-stimulating effect of 5 kc/s and 12 kc/s will be similarly expressed under different environmental conditions.

Obviously, much work remains to be done to elucidate the mechanism involved in reshaping the normal germination and growth processes.

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PLATE I

FIG. 2, *a–g*. Effect of sound treatments on the relative size of Rideau plants after 8 weeks growth. (*a*) C,C). (*b*) C,5K. (*c*) C,12K. (*d*) 5K,C. (*e*) 5K,5K (*f*) 12K,C. (*g*) 12K,12K.

FIG. 2. (*Continued*)

FIG. 2. (*Continued*)

PLATE IV

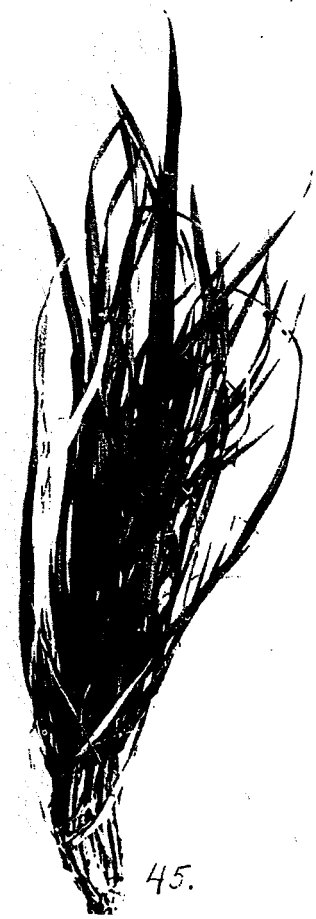

FIG. 2. (*Concluded*)

The effect of an audible and low ultrasound frequency on the growth of synchronized cultures of *Scenedesmus obtusiusculus*

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WEINBERGER, P., and G. DAS. 1972. The effect of an audible and low ultrasound frequency on the growth of synchronized cultures of *Scenedesmus obtusiusculus*. Can. J. Bot. 50: 361–365.

The effects of sonication of synchronized cultures of *Scenedesmus obtusiusculus* Chod. were examined. Two frequencies, 4 kHz and 19 kHz were applied during various phases of the diurnal mitotic cycles. As a result of 4-kHz sonication the average cell division decreased. During exposure to 19-kHz sonication the average rate of cell division initially increased slightly, but mitotic division was subsequently inhibited when the cells were exposed to prolonged sonication. A "relaxation" period of two generations was required before the cells regained their normal rate of productivity (cell number increase). The cells were more sensitive to sonic shock during the first quarter of their 24-h life cycle and apparently insensitive during the last quarter. No chromosomal effect was observed. It is suggested that sonication alters specifically timed events that occur at the earlier stages of the life cycle.

WEINBERGER, P., et G. DAS. 1972. The effect of an audible and low ultrasound frequency on the growth of synchronized cultures of *Scenedesmus obtusiusculus*. Can. J. Bot. 50: 361–365.

Les auteurs ont étudié les effets de la "sonication" sur des cultures synchronisées de *Scenedesmus obtusiusculus* Chod. Deux fréquences, 4 kHz et 19 kHz, ont été appliquées au cours de diverses phases des cycles mitotiques quotidiens. La "sonication" à 4 kHz a produit une diminution du taux moyen de division cellulaire. Durant l'exposition à 19 kHz le taux moyen de division cellulaire augmenta d'abord légèrement, mais la division mitotique fut ensuite inhibée par l'exposition des cellules a une "sonication" prolongée. Une période de "relâche" de deux générations fut nécessaire pour que les cellules retrouvent leur taux normal de productivité (augmentation du nombre de cellules). Les cellules étaient plus sensibles au choc "sonique" durant le premier quart de leur cycle vital de 24 h, et apparemment insensibles durant le dernier quart. Aucun effet chromosomique ne fut observé. Les auteurs proposent que la "sonication" modifie spécifiquement des événements qui ont lieu au cours des premières étapes du cycle vital de la cellule.

Introduction

Exposure of some plant seeds to ultrasound has been shown to change their subsequent growth. Accelerated growth following sonication has been noted for the seeds of woody species spruce, jackpine (10), and Siberian larch (8) and also herbaceous plants such as wild rice (5), sweet corn (4), and barley (6). Prolonged exposure to ultrasound led to decreased germination and lowered growth potential. High audible sound $\sim$ 12 kHz has also been shown to affect seed and plant growth (11). Midrange audible sound, namely, 5 kHz, consistently stimulated vegetative growth of a spring and winter wheat (9, 11). The present study describes the effects of a low ultrasound frequency (19 kHz) and an audible sound frequency (4 kHz) on the life cycle and growth of an alga, *Scenedesmus obtusiusculus* Chod. Evidence is also provided for the existence of a sensitive period when sonication at 4 kHz adversely affects subsequent mitosis of the algal population.

[1]Supported by NRCC Grant A-1737.
[2]Present address: Department of Biological Sciences, Simon Fraser University, Burnaby, B.C.
[3]EDTA = ethylenediaminetetraacetic acid.

Materials and Methods

Algae

The present experiments were carried out with *Scenedesmus obtusiusculus* Chod. (3) obtained from Dr. A. Kylin, University of Stockholm, Sweden and originating from the collection of Dr. E. C. Wassink of the Agricultural University of Waghingen, The Netherlands.

Culture Medium

The final concentration of the nutrient medium had the following composition (millimoles per liter): KNO_3, 25; $MgSO_4 \cdot 7H_2O$, 2.13; KH_2PO_4, 1; $FeSO_4 \cdot 7H_2O$, 0.07; Na-citrate, 0.112; Na-EDTA,[3] 0.107; $Ca(NO_3)_2 \cdot 4H_2O$, 0.1; and (micromoles per liter) H_3BO_3, 46; $MgCl_2 \cdot 4H_2O$, 0.79; $CuSO_4 \cdot 5H_2O$, 0.313; $(NH_4)6Mo_7O_{24} \cdot 4H_2O$, 0.0153; NH_4VO_3, 0.0187; $KCr(SO_4)_2 \cdot 12H_2O$, 0.0194; $NiSO_4 \cdot 6H_2O$, 0.0171; $Co(NO_3)_2 \cdot 6H_2O$, 0.0168; $TiCl_3$, 0.0214; $Na_2Wo_4 \cdot 2H_2O$, 0.0055 (2, 7). Analytical grade reagents and deionized glass-distilled water were used. The trace

elements were dissolved initially in 0.1 *N* H_2SO_4. Final pH of the nutrient solution was 4.9 ± 0.1 and the final concentration of H_2SO_4 was 10^{-5} *N*. All glassware and solutions were sterilized and aseptic techniques were used.

Culture Conditions

The culture was kept in 60 ml nutrient solution in 250-ml Erlenmeyer flasks which were gently shaken at a rate of 80 oscillations per minute. The shakers were housed in controlled environment growth chambers.

Light was provided by an overhead panel of incandescent (six 100-W G.E. lamps) and fluorescent (four 20-W cool white) lamps. These provided a total illumination at the surface level of the culture medium of 600 ± ft-c. The temperature was kept constant at 26 ± 1°C. The air (enriched with 3% CO_2) supplied to the cultures was passed through filters of cotton wool and activated charcoal in series.

Synchronization

Stock cultures were kept on nutrient agar slants in a continuous, low level (600 ft-c) of light, at a temperature of 26 ± 1°C. A preculture was inoculated from such an agar slant and grown under diurnal light (600 ft-c) and dark conditions (15:9 h) in the liquid nutrient medium for 48 h at a temperature of 26 ± 1°C. At this time the cell density reached 5 million per milliliter. The culture was then poured into a glass cylinder (covered with aluminum foil to keep out the light) and the whole put into a dark sterile chamber kept at 3 ± 1°C while the algae sedimented. After several days, 3 ml was pipetted from the bottom of the cylinder and used to inoculate the nutrient medium. Erlenmeyer flasks containing medium plus inoculate were then placed on the shaker in the thermoregulated chambers. After 48 h the sedimentation procedure was repeated. This procedure produced cultures that were fully synchronized and completed their life cycle within 24 h when exposed to a 14 h : 9 h day:night photoperiod. However, of the total cell population only 70–75% actually produced autospores (4) at each cycle.

Sensitive Stage of Scenedesmus Life Cycle

Algal cells were exposed for 4 and (or) 8 h to 4 kHz sonication at predetermined times of their life cycle.

Cell Counting

Cells were counted in a hemacytometer cell (Levy chamber, American Optical Co., Buffalo, N.Y., U.S.A.). At each time period, on different aliquot samples, the counting was performed at least three times, and from the arithmetic mean was computed the total number of cells. The difference between counts of the same medium was never more than 3%.

Cell Dry Weight

The dry weight was determined on a 4-ml aliquot after drying at 80°C. Calibrated, 10-ml centrifuge tubes (No. C 3900, Scientific Glass Apparatus Co. Inc., New Jersey) were used to measure the total cell volume after centrifuging at 6700 rpm for 25 min.

Nuclear (Chromosome) Staining

Sample aliquots were filtered by mild vacuum suction on a small piece of glass fiber filter paper which was withdrawn when visibly well covered with algal cell deposit. This paper was then put into a fixative medium, composed of glacial acetic acid, ethanol, and chloroform 1:6:3 (v/v/v) for 30 min. After this, the filter paper containing the cells was transferred to 1 *N* HCl for 15 min at 60°C. The cells, still on the original paper, were rinsed with distilled water and the nuclei stained blue with 0.2% brilliant cresyl blue (1). The stained algal cells were mounted on a slide in glycerine. The stained nuclei were counted under a light microscope with total magnification of 937.5 ×.

Frequency of Sonication

The frequencies 4 kHz and 19 kHz were generated by a standard audio-oscillator and matched to one of two barium titanate crystals housed under a small stainless steel tank used as the sonicating chamber. Both frequencies were amplified to obtain a gradient energy level of 1.3–2.0 W per square centimeter on the base plate of the chamber. During sonication, the cultures in the Erlenmeyer flasks were subject to gradient energy levels of 1.0 to 1.8 W per square centimeter.

Growth Conditions

The flasks containing the *Scenedesmus* cultures in culture medium were centrally positioned in the sonica-

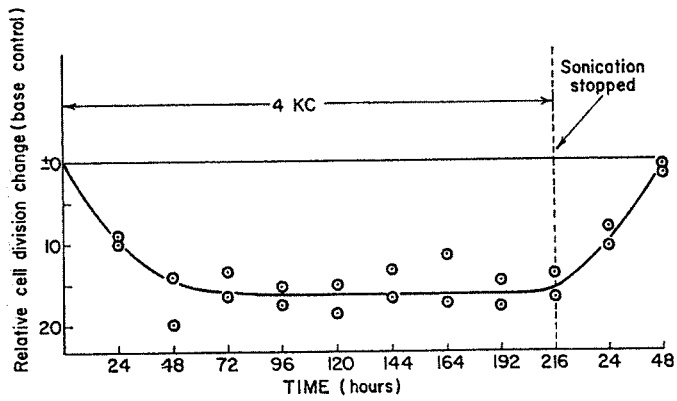

FIG. 1. Synchronous cultures of *Scenedesmus* sonicated at 4 kHz: relative change in percentage cell division following 216 h of continuous sonication followed by "relaxation time."

tion tank. Water was put into the sonication tank till it reached a height 3 cm above the surface level of the culture medium in the flasks. The sonication tank was placed on the shaker in the growth chamber; the other environmental conditions for growth of the culture were the same as stated above. The water temperature of the tank was constantly monitored and remained at 26 ± 1°C. Four-kilohertz and 19-kHz frequencies could be applied while the tank was continuously rocked during the growth of the culture. Control flasks were always kept under similar conditions in duplicate tanks but without sonication.

TABLE 1

Effect of sonication at 4 kHz on the growth of synchronous cultures of *Scenedesmus*

Sonication period, h	Initial no. of cells $\times 10^{-4}$/ml	Final no. of cells $\times 10^{-6}$/ml	Final cell concentration / Initial cell concentration	Average cell dry weight, mg $\times 10^{-7}$	Dry matter, mg/100 µl cells
Control	3.25±0.05	5.52±0.0	7170	1.74	29.3
0–72 sonicated	3.25±0.05	4.62±0.05	142	1.78	30.0
Control	3.60±0.04	5.94±0.09	165	1.70	29.0
144–216 sonicated	3.60±0.06	5.02±0.08	139	1.75	29.6

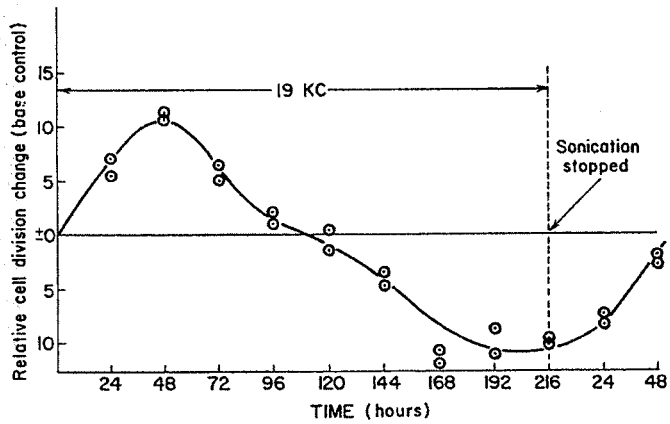

FIG. 2. Synchronous cultures of *Scenedesmus* sonicated at 19 kHz: relative change in percentage cell division following 216 h of continuous sonication followed by "relaxation time."

TABLE 2

Effect of sonication at 19 kHz on the growth of synchronous cultures of *Scenedesmus*

Sonication period, h	Initial no. of cells $\times 10^{-4}$/ml	Final no. of cells $\times 10^{-6}$/ml, after 48 h	Final cell concentration / Initial cell concentration	Average cell dry wt., mg $\times 10^{-7}$	Dry wt., mg/100 µl cells
Control	5.16±0.06*	2.14±0.02	41.5	1.49	28.6±0.2
0–48 sonicated	5.15±0.05	2.36±0.04	46.0	1.46	29.0±0.5
Control	5.16±0.06	6.04±0.07	117.0	1.45	29.0±0.4
48–72 sonicated	5.15±0.05	6.37±0.08	123.0	1.43	29.4±0.8
Control	5.00±0.07	6.25±0.04	125.0	1.56	29.5±0.4
72–144 sonicated	5.26±0.08	6.25±0.01	119.0	1.58	30.4±0.2
Control	5.32±0.04	6.55±0.03	123.0	1.70	29.1±0.3
144–216 sonicated	5.33±0.02	5.86±0.06	110.0	1.74	29.6±0.2

*± S.D.

Results

Continuous sonication at 4 kHz resulted in a progressive decrease in the rate of cell division of *Scenedesmus* cells. A decline of 15% was obtained at 48 h; further sonication merely maintained this lowered level of productivity (Fig. 1). After 216 h, sonication was stopped, and within 48 h (representing two life cycles) a normal rate of cell division was obtained. Although sonication led to a decrease in the percentage cell division, the average cell dry weight was unaffected (Table 1).

By contrast, continuous exposure to 19 kHz led to an initial 10% increase in the percentage cell division of the algal cells (Fig. 2). However, exposure for a further 48 to 192 h progressively inhibited cell division. No further change was noted in the 192- to 216-h period (Table 2). Sonication was stopped at 216 h, and once again there was a "relaxation time" of two life cycles before normal rates of cell division were obtained. This "normal" level was maintained through at least 10 observed life cycles in the absence of sonic exposure.

Throughout the 216-h sonication period algal cells exposed to 4 kHz had more single-nucleate cells and fewer multinucleate cells than the control cells (Fig. 3). Fewer sonicated cells were preparing for division. A similar though slightly less pronounced reduction in the number of nuclei per cell was observed in the cells sonicated at 19 kHz.

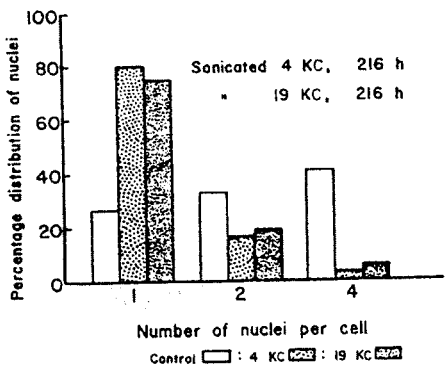

FIG. 3. The effect of prolonged (216 h) sonication at 4 kHz and 19 kHz upon the mitotic activity of synchronous *Scenedesmus* cultures. Cells were assessed at the 13-h period of their life cycle.

Details of the mitotic clock in *Scenedesmus* grown under the conditions described here are shown in Fig. 4. Autospore formation is observed 4½ h after the commencement of the dark period at 11.30 a.m., while separation of the aggregated cells is only apparent at 2 p.m.

The algal cells are most sensitive to 4-kHz sonication during the early portion of their life cycle (Table 3). Four hours continuous sonication immediately after autospore separation (0–4 h) was most effective in depressing subsequent cell divisions. Rating effectiveness as energy input per unit time, then 4-h exposure at the 4- to 8-h period of the 24-h clock proved more effective than a continuous 8 h of sonication spanning 0–8 h. Between 19 and 24 h the rate of subsequent cell divisions of the algal cells was totally unaffected by sonic exposure.

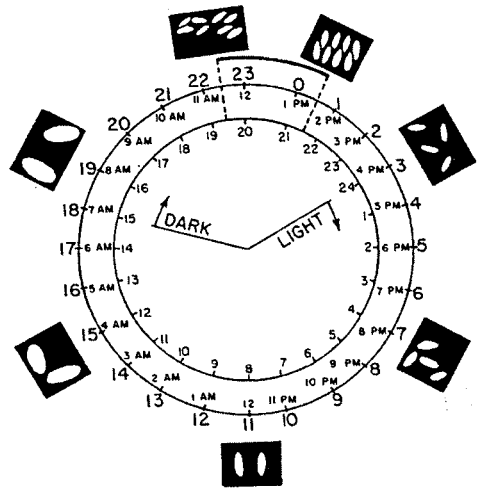

FIG. 4. The life cycle of synchronized cells of *Scenedesmus obtusiusculus* Chod. as related to the 24-h cycle. Outer circle: life cycle; middle circle: time clock; inner circle: diurnal cycle.

TABLE 3

Determination of the sensitive phase of synchronized cultures of *Scenedesmus* to periods of 4 kHz sonication

Sonicated stage in life cycle, h	% decrease in cell division, in following 24-h cycle
0–8	16.6
0–4	19.4
4–8	13.0
3–11	9.6
11–19	6.0
19–24	0

Discussion

From the results of the present investigation it appears evident that although the mitotic clock of *Scenedesmus* was not affected by sonication at 4 kHz the rate of cell division was altered. Gradation of the energy output level within the observed limits during the course of replicate experiments did not appear to alter this effect. Evidently, however, neither the initial stimulation evidenced after 24-h exposure to 19 kHz, nor the subsequent depressant effect following further exposure to this frequency or 4 kHz, resulted in any kind of hereditable response at the intensity of sonication used in these experiments. When the sound was stopped, a relaxation time of two life cycles was required before the cells regained their normal rate of division. This was true for both 4-kHz- and 19-kHz-sonicated cells. This short period (two generations), preceding a normal rate of growth, precludes a dauermodification effect.

Scenedesmus cells were most sensitive to sonic shock in the early part of their life cycle. Evidently, under the present experimental conditions, the metabolic events taking place following division (rather than preceding it) are important in determining subsequent divisions. As the effect of prior sonication is carried over to the F_1 and F_2 generations, but not F_3, it might reasonably be supposed that metabolic events, rather than profound ultrastructural changes of organelles, influence the observed changes.

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Influence of Sound Wave Stimulation on the Growth of Strawberry in Sunlight Greenhouse

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Abstract. In this paper, we adopt the QGWA-03 plant audio apparatus to investigate the sound effects on strawberry in the leaf area, the photosynthetic characteristics and other physiological indexes. It was found that when there were no significant differences between the circumstances of the two sunlight greenhouses, the strawberry after the sound wave stimulation grew stronger than in the control and its leaf were deeper green, and shifted to an earlier time about one week to blossom and bear fruit. It was also found that the resistance of strawberry against disease and insect pest were enhanced. The experiment results show that sound wave stimulation can certainly promote the growth of plants.

Keywords: environmental factors, sound wave stimulation, sunlight greenhouse, strawberry.

1 Introduction

Plants are stimulated inevitably by a variety of external environmental factors in the growth process and these stimulations have different extent influence to plants' growth, and then influence the crops' output and quality. As a flexible mechanical wave, the sound wave is a form of alternative stress and also a universal source of external stimulation to plants. Studies have shown that a certain frequency or sound intensity of the sound wave stimulation can promote the growth of plants. Scholars have done a lot of research on the role and mechanism of sound waves on plants. The approaches are used mainly in the form of music sound and pure tone (single frequency sine wave).

In music sound processing, music sound (natural sounds) had significantly improved the number of seeds sprouted compared to the untreated control, and there were no significant differences between harsh noise group and the untreated control (Creath et at., 2004). Under both light and dark conditions, sound up-regulated expression of the rbcS and ald by using classical music and single-frequency vibration signal (Jeong et at., 2008).

In pure tone processing, the hypocotyls' elongation and gene expression of Arabidopsis thaliana seeds were both improved by sound stimulus of about 50Hz and 90dB (Johnson et at., 1998). Chinese Academy of Sciences, Department of Applied

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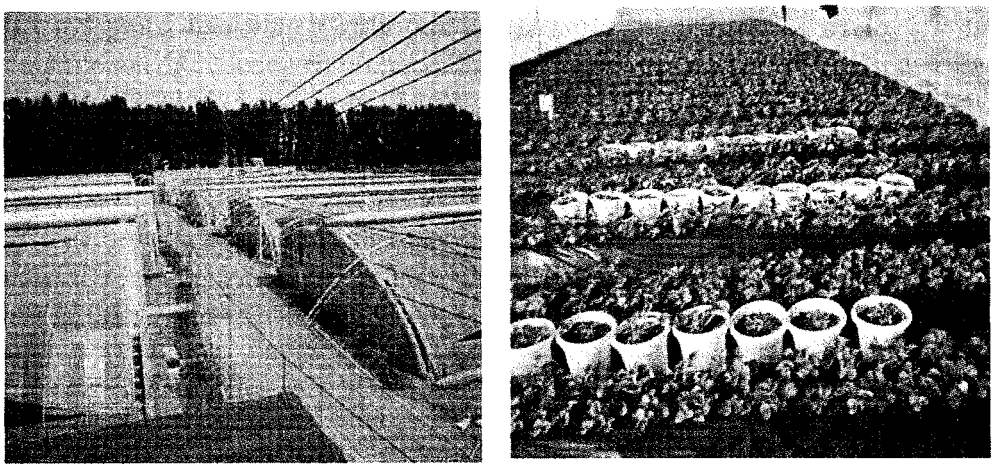
Chemistry of China Agriculture University and Department of Engineering Mechanics of Tsinghua University jointly find that a range of sound waves can stimulate tobacco's synchronization of cell division and promote DNA synthesis in the S-stage of cell division, and then improves plants growth and development (Li Tao et at., 2001). Sound wave stimulation can significantly enhance or inhibit the ATP content of Actinidia chinensis callus. Moderate sound stimulation can increase the activity of ATP synthase and is conducive to the level of energy metabolism of plants (Yang Xiaocheng et at., 2003; Yang Xiaocheng et at., 2007). By using QGWA-03 plant audio apparatus (frequency range: 100-2000Hz), tomato's yield increased by 13.2%, and its disease of grey mold decreased by 9.0% (Hou Tianzhen et at., 2009).

At present, the sound wave stimulation studies on the impact of plants are increasing, but the sound effect and mechanism are still controversial. To this end, QGWA-03 plant audio apparatus (PAA) was used to stimulate the strawberry growing in the sunlight greenhouse, and the sound effects to leaf area, photosynthetic characteristics rate and other physiological indexes were researched. This paper is our preliminary study of sound stimulation mechanism.

2 Materials and Methods

2.1 Test Materials and Design

The test was started in the sunlight greenhouse from November 2008 to January 2009 in Beijing Xiaotangshan National Agricultural Demonstration Zone. We selected 60 healthy strawberry seedlings (U.S. "Sweet Charlie") which grew in the same condition and transplanted them into white plastic flowerpots with medium loam. Then put the flowerpots into two sunlight greenhouses respectively (30 pots each) which were 80m apart. In the two sunlight greenhouses, conditions of structure, environment, irrigation control, and the relative position of flowerpots were basically the same between each other. We carried out the sound stimulation experiment (the PAA was put in the middle of the pots) in one building, and the other one used as control. Test arrangement is shown in Fig.1.



(a) the sunlight greenhouses (b) strawberry seedlings in the flowerpots

Fig. 1. Layout of sound wave stimulation experiment on strawberry in sunlight greenhouse

The sound wave treatment was begun when the strawberry seedlings were transplanted into the greenhouses, and once every two days to play, and 9:00 to start dealing with each 3h. The frequency and volume were determined by the temperature and humidity of greenhouse. We measured the leaf area and photosynthetic indicators of strawberry at the beginning of growing season, squaring period, flowering period and fruiting stage. The production and disease resistance of strawberry were also determined in the fruiting stage.

2.2 Determinations

We used LI-3000 portable leaf area meter (LI-COR Inc. USA) and LI-6400 (LI-COR Inc. USA) portable photosynthesis meter to measure the leaf area and photosynthetic characteristics. Results are expressed as means ± SDs. Data were analyzed using Non-parametric test of two independent samples included in the SPSS version 13.0 software (SPSS Inc, Chicago, Ill). Statistical significance was set at $P<0.05$.

3 Results

3.1 Sound Effect to the Leaf Area of Strawberry

Fig.2 shows that in the beginning of growing season, squaring period and fruiting stage, the leaf area in the treatment are significantly greater than control ($P<0.01$); but there is no significant difference in the flowering period.

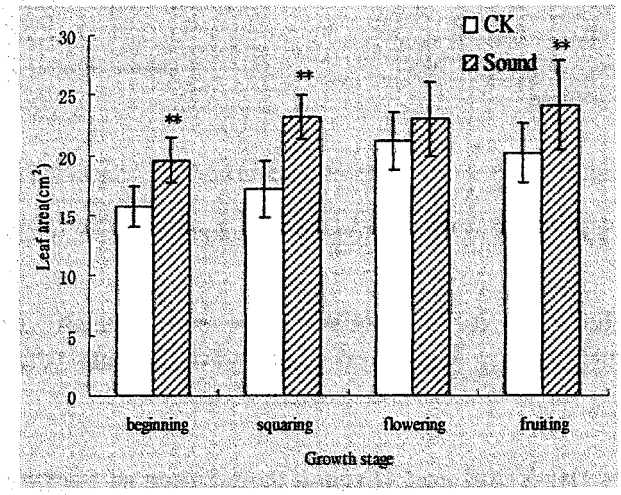
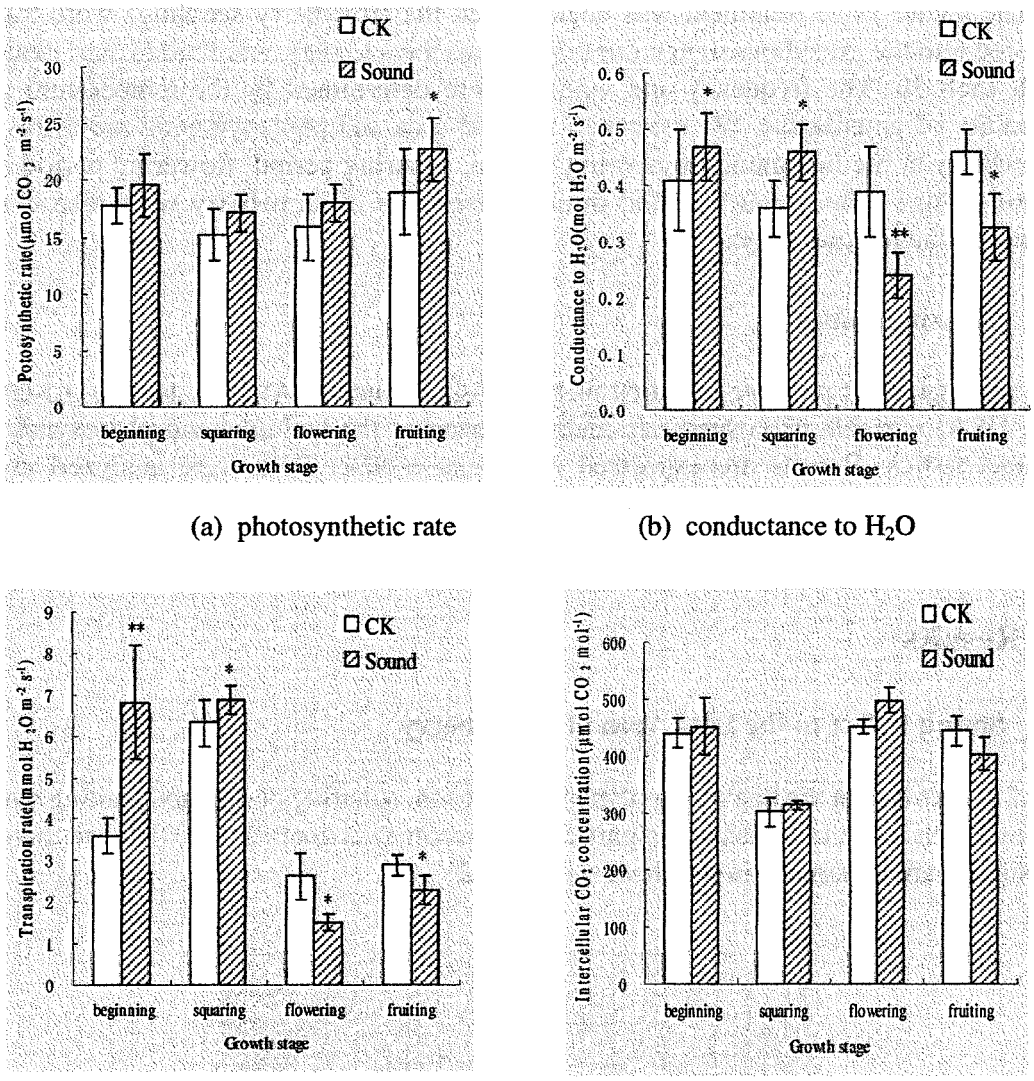


Fig. 2. Sound effect to the leaf area of strawberry

3.2 Sound Effect to the Photosynthetic Characteristics of Strawberry

Fig.3 shows that during the four stages, there is no significant difference of the intercellular CO_2 concentration (Ci) between the two groups, but the transpiration rate



(a) photosynthetic rate (b) conductance to H_2O

(c) transpiration rate (d) intercellular CO_2 concentration

Fig. 3. Sound effect to the photosynthetic characteristics of strawberry

(Trmmol) and conductance to H_2O (Cond) are significantly greater than control ($P<0.05$). Only in the fruiting stage, the photosynthetic rate (Photo) has significant difference ($P<0.05$).

3.3 Sound Effect to the Yield and Disease Resistance of Strawberry

We surveyed the yield and disease situation in January 18, 2008. Table1. shows that the disease rate in the treatment is significantly less than control; but there is little effect on the yield.

Table 1. Sound effect to the yield and disease resistance of strawberry

	Yield (kg)	Yield per plant (kg)	Disease rate (%)
Sound stimulation	1.53	0.051	16.67
CK	1.63	0.054	50.00

3.4 Discussion

It is found that sound stimulation has great effect on the physiology of strawberry, and it has different impact in the different physiological stages.

Viewing in the entire growth period, sound waves do promote the leaf area of strawberry, but the effects on the Photo and Ci are not obvious. The trend of sound influence on Cond and Trmmol are both firstly increasing and then decreasing. It indicates that the Trmmol of strawberry leaf is mainly affected by stomata factors. Trmmol decreases in the latter growth stage. It shows that sound has little effect on the growth of strawberry after the flowering period and also explains the reason of production without significant changes. In addition, the experiment was not started in the breeding period, so it may be another reason for the un-improving production. During the initial growth period, the improvement of Trmmol promotes the transportation of water and mineral elements, so it increases the disease resistance (Wu Weihua, 2003).

4 Conclusion

In this paper, experimental results show that sound waves not only can promote the growth of strawberry, but can also increase the disease resistance. About the mechanism of sound waves improving the growth of plants, there are three possible reasons: environmental stress (including the sound waves stimulation) changes the fluidity and permeability of membrane; the signaling molecule of Ca2+ deliveries the stress signaling to other signaling molecules; the spread of stress signal causes related gene expression (Liu yiyao, et at., 2000). But we believe that there is phenomenon of spontaneous sound in plants. When the frequency between external vibration and plants spontaneous sound are consistent, the resonance will occur, thus promoting plants growth. We did the pre-test by using the He-Ne laser Doppler vibrometer to measure the sound frequency of Alocasia, and found that in normal growth conditions, plants' spontaneous sound frequency was in low-frequency range of 40-2000Hz (Luan Jiyuan, et at., 1995; Hou Tianzhen, et at., 1994). At the same time, we used low-frequency sound waves to stimulate more than 50 kinds of crops, and achieved remarkable effects (Hou Tianzhen, et at., 2009).

To sum up, we believe that the mechanism of sound effect to plants can be explained in two ways. From the biological point of view, sound may affect the characteristics and function of plant cell membrane, and gene expression. But from the physics point of view, the frequencies of sound vibration and plants spontaneous sound are in line, and then the resonance occurs. This experiment is only the initial discussion on the

mechanism of sound stimulation to plants, and it is the foundation for exploring the mechanism from the perspective of plants' vibration characteristics.

Acknowledgements

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Research article / Article de recherche

THE EFFECT OF SOUND ON THE GROWTH OF PLANTS

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ABSTRACT

This project is intended to show how the rate of growth of two different plant species was affected by sounds of varying frequencies. Two plant species, beans and impatiens, were selected because of their relatively fast growing rates. Ambient conditions were regulated by environmental chambers in which the plants were housed. One chamber was used as a control for the plants, and the plants in the other chambers were subjected to sounds of different frequencies at roughly the same sound intensity. Sounds of pure tones and random [wide band] noise were used. The changes in the growth of the plants were monitored every two days for twenty-eight days. Upon completion of the tests, it was observed that optimum plant growth occurred when the plant was exposed to pure tones in which the wavelength coincided with the average of major leaf dimensions. It is suggested that this was due to the "scrubbing" action of the traversing wave, causing air particle motion on the surface of the leaf; this movement removed the stagnant air layer adjacent to the leaf, thus increasing the transpiration of the plant. It was also noted that the plant growth was less when exposed to random noise.

SOMMAIRE

Ce project avait pour but de montrer comment le taux de croissance des deux espèces de plantes être influé par une varieté d'ondes sonores. Les deux espèces, des haricots et des impatiens, ont été choisis à cause de leur croissance rapide. Les plantes furent placées dans des sailles donc les conditions ambiantes étaient réglées selon les critères environnmentales. Une salle servit de contrôle pour les plantes. Dans les autres salles, les plantes furent exposées à divers ondes sonores d'environnment à la même intensité. Des ondes sonores claires et croissant au hazard furent difusées. Les taux de croissance furent servi des près. C'est à dire, à tout les deux jours jusqu'au visit-huitième jour. A la fin de ces tests, nous avons observé été la croissance optimum a eu lieu dans les plantes exposèes aux ondies sonores claires, et que la longeur des ces ondes coincidait avec la dimension moyenne des feuilles. On suggère que ceci s'est produit quand les ondes sonores ont "balayé" les particules dans l'air sur la surface de la feuille. Ce dèplacement d'air stagnnat attenant la feille permet ensuite à celle-ci d'augmenter la transpiration végétale. Aussi, nous avons observé une baisse de croissance dans les plantes exposées aux ondes sonores choisies au hazard.

1. INTRODUCTION

Very little research has been conducted on the specific effect of the growth of plants subjected to sounds of varying intensity and frequency. Any environmental factor that places a biological system under stress can affect its performance and/or behaviour. The effect of sound on physiology and behaviour of animals and man has been studied by various researchers [1, 2, 3, 11, 13, 14]. However, only a limited amount of detailed information is available on the effect of sound on plant systems [4, 8, 9, 10, 12].

An article entitled "The Effect of Noise on Plant Growth" [4], stimulated an interest in further research in this field. The author, A.E. Lord, performed random noise experiments on coleus plants in which one group was subjected to random noise and a second group was used as a control. Lord came to the conclusion that botanists had not carried out sufficient experiments to show causes behind the effects that he observed, and he put forward the idea that the rate of water transpired out of the leaves is affected by the sound. Transpiration, in turn, affects growth. Typical leaf structures and the topic of transpiration can be found in textbooks on botany [e.g. reference 15, 18, 19, 20].

It has been reported [5, 6, 7] that music will increase plant growth, but it is not known what preferred frequencies (if any) in the music have the most pronounced effect on plant growth. Many of the papers (see above) had very little detail about the conditions under which the plants were grown,

how conditions were controlled [or if they even were controlled], and exactly how the growth rates were monitored.

Singh and Ponniah [5, 6] were two of the pioneers in this work. They played obscure violin pieces intermittently to plants at certain times of the day, and they occasionally made use of tuning forks as the sound source. Very seldom, if ever, were the experimental methods or type of analysis revealed. Generally, a table of results was presented and it was left to the reader's imagination to determine how these results were obtained. Singh's work was referred to extensively in the original article by Lord. Very little constructive information was obtained from this source.

One of the more amusing accounts of sound tests on plants appeared in the May 1993 issue of Popular Mechanics, entitled "Growing Corn to Music" [7]. It was seen that the "music" plants sprouted faster, were greener, and their stems were thicker and tougher than the "silent" plants. Although the results were interesting, this article is not scientifically grounded.

An interesting paper was obtained from the Internet by Bruce M. Pixton, titled "Plant Growth in a Sound Polluted Environment" [12]. He did not use environmental chambers, but built a box with three side-by-side sections with soil in the bottoms; one section was used for control seeds, and the other two were subjected to sounds (pure tones and random) from audio speakers at the bottom of each partition under the soil. The loud sounds were audible in the room. He played sounds of 5,000 Hz and 13,300 Hz to alyssum seeds, both before their germination and after they had sprouted. He compared the number of seeds sprouted and the sprouts which were 2 cm or taller with the control group of seeds, all under similar ambient conditions, i.e. room conditions and light from a window. He concluded that loud, high frequency, sound tones increased the rate of plants sprouting and growth. He noted that the random noise had the opposite effect. He did not venture a reason for this.

Pearl Weinberger and Mary Measures, at the University of Ottawa [8, 9], experimented with spring wheat [Marquis] and winter wheat [Rideau], exposing the plants to varying frequencies either during the germination period, or during the growth period, and sometimes during both periods. They observed a marked increase in the growth stimulation of plants treated with 5 kHz sound when compared with controls (with no sound). In these experiments, their time was limited, and hence it was thought that their results were not extended over a sufficiently long period of time.

The only other paper with any relevance to this project dealt with the effects of random noise on tobacco plants [10]. Woodlief, Roysier and Huang, did not use a control group as the technique of determining the growth rate for tobacco plants. It was found that there was a significant decrease in the slope of the growth rate curve after the noise was imposed, and the conclusion was that the random noise environment was detrimental to the growth rate of the plants. To quote from their paper, "the sensitivity of the plants to the random noise environment seemed to be coupled with initial plant size in that the smaller plants seemed to be more sensitive to this environment".

Many of the papers from the literature did not have applicability to this experiment, as was the explanation of results. However, Lord's idea about the rate of water transpired out of the leaves being affected by the sound provided the basis for the analysis made in this paper.

2. APPARATUS AND PROCEDURE

The plants were housed in environmental chambers, 162 cm high, 153 cm wide, 84 cm deep with 2 cm thick walls [Figure 1]. The environmental chambers were made by Percival Co. of Boone, Iowa, U.S.A. They controlled the temperature and

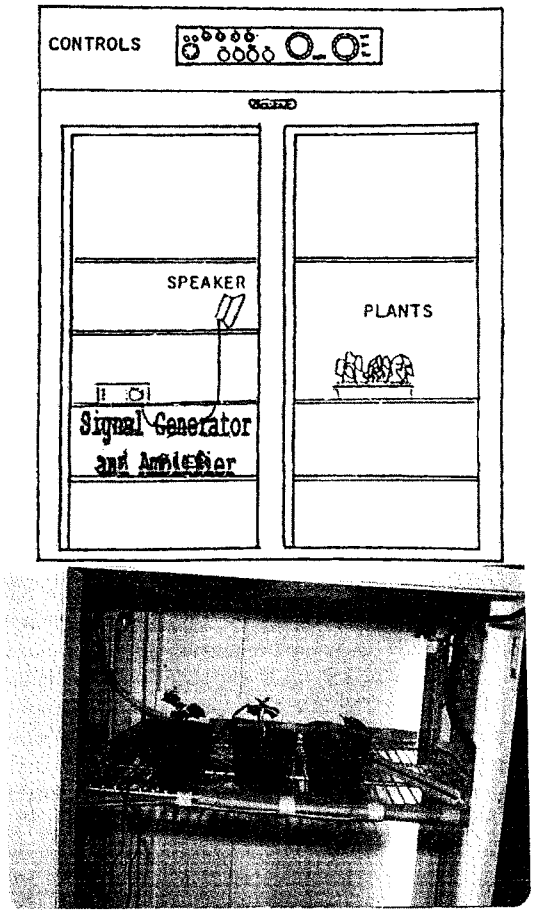

Figure 1. Environmental Chamber

lighting, and provided a constant flow of air by means of in-built fans and vents. The operating specifications of the chambers were: Photoperiod: DAY/NIGHT; Thermoperiod: 0 to 150 degrees F / 15 to 65 degrees C; and Fluorescent lighting: 6 tubes, cool white, 40 W

The chambers had separate controls to regulate light intensity, temperature and airflow. There was minimal air movement in the chambers. Either two or three of these chambers – all identical – were used during the twenty-eight day test period. The watering rate of the plants was monitored manually using a graduated cylinder. The sound was produced by a signal generator, amplifier and a speaker, which were placed inside the chamber [see Figure 1]. Each signal generator had a range of twenty to twenty thousand Hertz [cycles per second-Hz] and was capable of producing the frequency as a single sine wave or as a mixture of frequencies over a range [equal energy per unit bandwidth – white or random noise]. These signal generators and amplifiers were constructed by the Electronics Shop of the Faculty of Engineering Science. The speakers were co-axial, made by Altec and capable of a frequency response of twenty to fifteen thousand Hz. The sound pressure level was the same in all of the chambers, and averaged 91 to 94 decibels, measured on the linear scale with a Bruel and Kjaer Sound Level Meter and a one-half inch microphone. These measurements were taken at eight different positions around the plants, averaged, and monitored regularly. [See reference 16 for a description of the meter and microphone.]

The Plant Science Department at The University of Western Ontario offered its services in helping to set up an experiment, in choosing suitable plants, providing the environmental chambers, and helping to analyze the results. The Sound and Vibration Laboratory of the Faculty of Engineering Science provided the sound generating and measuring equipment.

The impatiens plants were started from cuttings four weeks before the start of the test days. From four to eight of the plants were used in each test. Cuttings from one impatiens plant were taken initially and placed in the potting beds in the greenhouse. All of the impatiens plants used later in the experiments were propagated from these initial cuttings. To take cuttings from the same plant is the only way to get plants as genetically close as possible [15]. This is termed cloning and is a fairly important genetic control. The beans, Dwarfbush Stringless Green Pod, were grown from seed seven days before the experiments started. It was not necessary to use cuttings from beans; they grow rapidly. Again, four to eight plants were housed in each chamber, along with the impatiens plants, during the testing.

It should be noted that, even though there was a reverberant sound field in the chamber [due to reflections], it is believed that the major sound which affected the plants was in the direct path of the sound from the speakers. This can be seen in the schematic drawing in Figure 1, and is explained in detail in References 1 and 13. (See Conclusions and Recommendations with regard to further study.)

Due to the fact that there was a minimum of space in the chamber, which was in the direct path of the sound, only two different species of plants were tested in each chamber. Ideally, a larger number of different species should have been tested, as the results may not be generally applicable to all kinds of plants. The ones used in this project were both green and leafy, and anything that was happening in the leaves or stem would be reflected in the subsequent height of the plant. Seven groups of plants were tested. The first four tests of sound experiments were chosen randomly. It was decided to test with random noise, a low frequency sound [500 Hz] and other higher frequency sounds. Those chosen were 5,000 Hz and 12,000 Hz. For reasons discussed later, 6,000 Hz and 14,000 Hz were selected as the last two frequencies to be tested.

The plants were watered daily, each species receiving the same quantity of water. The height measurements were taken every two days with the plant extended to its full length, and recorded. The measurements were taken over a twenty-eight day testing period.

3. DISCUSSION AND OBSERVATIONS

At the outset of these experiments, it was reasoned that there might be a relationship between the wavelength of the sound generated and a characteristic dimension of the leaf.

Figure 2 represents the outline of a bean leaf, and there is a small particle of air moving back and forth on the surface of the leaf with velocities of positive and negative "u" [11, 13]. This wave movement occurs as a result of the diaphragm of the speaker moving back and forth, setting up a travelling compression and rarefaction wave. The compression results

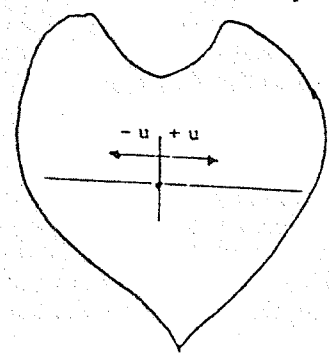

Figure 2. Sound Propgation along a leaf

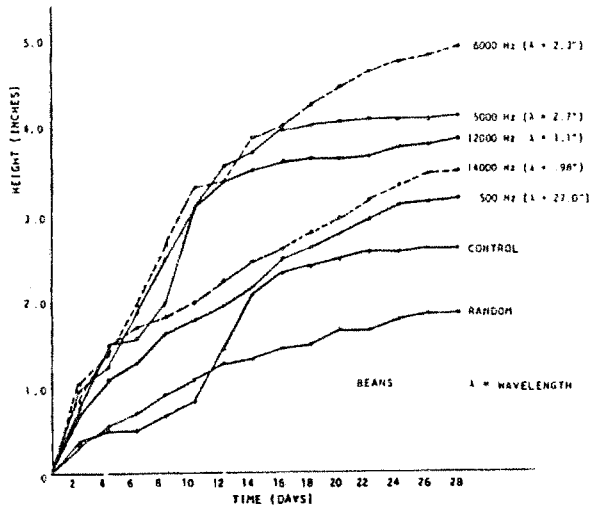

Figure 3. Plant Growth Characteristics Curves for Bean Plants

in a positive pressure [above atmospheric] and the rarefaction in a negative pressure [below atmospheric]. This is propagated across the surface of the leaf and is commonly represented as a sinusoidal air pressure variation. The particle velocity is proportional to the sound pressure [13], and a positive pressure results in a positive particle velocity, the magnitude of the velocity being proportional to the pressure at any point as it moves across the leaf. The same process results from a negative pressure, only with the particle velocity in the opposite direction. This creates a scrubbing or brushing action on the surface of the leaf, which wipes away any stagnant film of moisture and allows the plant to breathe [transpire] more freely [15, 19].

The first four sets of sound results obtained, which were for the random noise, 500 Hz, 5,000 Hz, and 12,000 Hz, seemed to bear out the contention that the relationship between the frequency [and its wavelength] and the dimension of the leaf had some effect [Figures 3 and 4]. The average dimension for the bean leaf [measured from the control group] gave values of 2.4 inches by 2.4 inches. A wavelength of 2.4 inches corresponds to a frequency of 5,600 Hz for the given conditions. The best results for the beans had been for 5,000 Hz [wavelength = 2.7 inches], so that 6,000 Hz was chosen as one of the two remaining frequencies to be tested. It has a wavelength of 2.3 inches and, as can be seen in the results [Figure 3], gave the best growth curve for the bean plants.

The average dimensions for the impatiens leaf [again measured from the control group] gave values of 1.0 inch by 1.7 inches. A wavelength of 1.0 inch corresponds to a frequency of 13,500 Hz and the 1.7 inches to a frequency of 8,000 Hz. For the impatiens, the best results had been for the 12,000 Hz frequency [wavelength = 1.1 inches], so the 1.0 inch dimension was narrowed in on [average width of leaf] and a frequency of 14,000 Hz was chosen with a wavelength of .98 inch [Figure 4]. This gave the best results for the impatiens plants.

When the growth changes, measured every two days, were plotted for the complete test period and all frequencies, the growth characteristic curves resulted [Figures 3 and 4]. The horizontal axis represents the time in days and the vertical axis the height in inches.

Higher frequencies, and hence smaller wavelength, would result in a wave with more nodal points on the leaf, which are points of zero pressure with respect to atmospheric, or points of zero velocity. This means that there are more places on the leaf surface where the film of moisture is not being removed. These higher frequencies were tested for the beans, and the results were not as good as the results for the higher frequencies close to the preferred one where the wavelength was approximately equal to the dimension of the leaf [Figure 3].

One might suspect that a wavelength that corresponds to two times the dimension of the leaf might give the best results. This has the least number of these nodal points, but there was insufficient time to test this idea.

As a result of previous work, it was expected that the effect of the random noise on the plants would cause a decrease in their growth rate [10]. Any experiments to date have found that this is the manner in which plants respond to random noise [4, 10 and 12]. The bean plants [Figure 3] responded as expected, but the impatiens plants [Figure 4] showed an improved growth rate [as compared to the control group].

Woodlief [10] did observe that the smaller tobacco plants

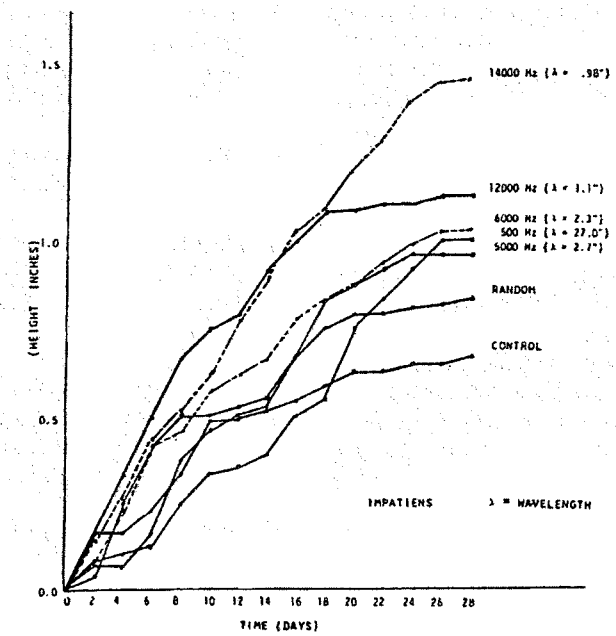

Figure 4. Plant Growth Characteristics Curves for Impatien Plants

that he tested were more affected by the sound. In this experiment, the beans were just beginning to germinate at the outset of testing, while the impatiens plants were well developed at four weeks. This could be the reason for the more pronounced effect on the bean plants. Had the testing extended further, it is possible that the random noise impatiens' growth rate would fall below that of the control group. This points warrants further investigation.

A statistical analysis of the results, as carried out by Wai Keung Li of the Faculty of Social Science, is given in reference 17. This analysis showed that of the fixed frequencies, random frequencies and control, the fixed frequencies have a significant effect on plant growth when compared with random frequencies and the control.

4. CONCLUSIONS AND RECOMMENDATIONS

From the results of the experiments as shown in Figures 3 and 4, it is clear that, in time, i.e. after 28 days of testing, the optimum growth of both the beans and the impatiens plants occurred when the wavelength of the sound coincided with the plant leaf dimension. This conclusion cannot be drawn for the growth periods of up to about 16 days. Below this the results are mixed and inconclusive. It should be noted that, for the beans, the growth with the random noise was less than the growth with any of the pure tones. There was not this marked difference between the growth in the impatiens plants when subjected to random and pure tones [Figure 4]. In the latter days of the testing, growth with the random noise was less with the bean plants [Figure 3] than with the impatiens plants [Figure 4]. This is something that warrants further testing, especially with a larger number of plants, perhaps a larger species variety, and a longer testing period.

It might be assumed that the growth rate of the plants when exposed to pure tones [with a wavelength coincidental with the leaf width] at a higher sound pressure level [above 90 decibels] would be even greater than measured in these experiments. Further, it is noted that the sound tone frequency where the wavelength equals twice the plant leaf dimension might be tested to determine if this would be the optimum frequency for the best growth results. These points should be investigated in further studies.

It should be noted that the correlation between wavelength and leaf size, and resulting increase in transpiration, is but one potential explanation of the observed plant growth. However, there are many physiological processes at play in the general phenomenon of growth. The effects of sound wavelength under several regimes of light intensity and relative humidity should be studied; physiologically, it would be interesting to explore the potential effect of sound wavelength on the rate of extension of the leaf after it is formed; and biochemically, it would be interesting to look at the effect of sound wavelength on the rate of photosynthesis in leaves of varying ages.

In addition to the recommendations mentioned above, there is a further aspect of the study which bears investigation. It

was assumed that the effect of reflection in the chambers would be of little consequence because the plants were placed in the direct path of the sound from the speaker. Ideally, the tests should be conducted in a non-reverberant environment (i.e. an acoustical or semi-acoustical chamber).

5. ACKNOWLEDGEMENTS

The author would like to express his appreciation to Professors D. Fahselt and A. Maun of the Department of Plant Sciences and the Sound and Vibration Laboratory of The University of Western Ontario for the use of equipment in this experiment. He is also grateful to Wai Keung Li of the Faculty of Social Sciences for his careful statistical analysis of data. Further, the author acknowledges the capable assistance of Mary Daniel in the preparation and typing of this manuscript.

6. EPILOGUE

This work was conducted in 1979 by Margaret E. Collins while she was a student in Mechanical Engineering at the Faculty of Engineering Science of The University of Western Ontario. I was her supervisor and we were assisted by the Department of Plant Sciences at the University [see Acknowledgements]. The work was recorded in her thesis as part requirement for ES 400 - Project, Thesis and Seminar. Ms. Collins is now deceased and this paper is written to her memory.
John E.K. Foreman, Professor Emeritus, May, 2001

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SHORT COMMUNICATION

Drought tolerance induced by sound in Arabidopsis plants

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ABSTRACT

We examined the responses of sound-treated arabidopsis adult plants to water deprivation and the associated changes on gene expression. The survival of drought-induced plants was significantly higher in the sound treated plants (24,8%) compared with plants kept in silence (13,3%). RNA-seq revealed significant upregulation of 87 genes including 32 genes involved in abiotic stress responses, 31 involved in pathogen responses, 11 involved in oxidation-reduction processes, 5 involved in the regulation of transcription, 2 genes involved in protein phosphorylation/dephosphorylation and 13 involved in jasmonic acid or ethylene synthesis or responses. In addition, 2 genes involved in the responses to mechanical stimulus were also induced by sound, suggesting that touch and sound have at least partially common perception and signaling events.

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Bioacoustics; mechano-stimulus; touch; water stress; white noise

Sounds are mechanical waves of pressure that propagate through a transmission medium such as air. As a wave of pressure, the sound can be considered as a mechanical stimulus and it could have an influence on developmental and physiologic plant processes[35,17,29] Different types of sound have been demonstrated to increase the growth of mung bean, rice, cucumber and arabidopsis seedlings[34,20,5] increased the leaf area in young strawberry plants[31] and increased the root length in *Actinidia chinensis* and paddy rice[3,43] Some sounds seems to be capable of orienting root growth[13,12] and significantly increased the callus growth in *Dendranthema morifolium*[47] and *Chrysanthemum*.[40] There are also evidences that determinate sounds can influence the development of fruits, for example, delaying tomato fruit ripening,[22] has an influence in pollination, for example, in buzz-pollination the pollen from anthers is only released upon vibration at a particular frequency produced by bee buzz.[9] In a similar way, bat dependent plants have adapted to the bats' echolocation systems by providing acoustic reflectors to attract their animal partners.[33] Active acoustic signaling in plants has been proposed although it is still under discussion.[11]

Sound-induced changes in plants have also been observed at the physiologic level. Some sounds increased the photosynthetic state of strawberry plants[48,28] The photosynthetic performance index in sound-treated arabidopsis plants was lower compared with the control,[14] and the expression of different genes encoding for RuBisCO subunits was altered.[15] In arabidopsis, sound altered the expression of several enzymes involved in light reaction, Calvin cycle, glycolysis and TCA cycle, with majority of them being upregulated.[15] Sound alters the levels of some phytohormones: increased polyamine content in chinese cabbage and cucumber,[32] ethylene production was lower in the sound-treated tomatoes[22] and sound increased the level of indole acetic acid (IAA) and decreased the level of abscisic acid in *Chrysanthemum* calli.[4] In arabidopsis, sound induced changes in the levels of gibberelins, auxins, jasmonic and salicilic acids, but not in ABA.[15] Sound has also the ability to alter antioxidant activities[18,41,29,15] and to increase oxygen uptake,[32] thus appears that ROS signaling is a player for sound-mediated signaling. Sound also induces the accumulation of ATP[39,43,29] increases plasma membrane H^+-ATPase activity[38,44] induces a higher electrolyte leakage in arabidopsis,[14] alters the calcium flux and increases the concentration of intracellular Ca^{2+}[25,38,44,29] Additional observed changes in cell composition induced by sound are an increase in soluble sugars[19,45,47] changes in free amino acid contents[27] and the induction of lipid peroxidation.[24] Sound-induced changes in cell structure have also been observed. Sound altered the secondary structure of cell-wall proteins[49] and the plasma membrane fluidity and permeability[21,46,43,29]

Sound produced no significant increase of DNA content but enhanced the synthesis of RNA and soluble proteins in *Chrysanthemum*.[42] A significant increase in the expression of the rice genes coding for a fructose 1,6-bisphosphate aldolase (ald) and ribulose 1,5-bisphosphate carboxylase (Rubisco) small subunit (rbcS) was observed and the ald promoter was shown to respond to specific sound frequencies.[18] The expression level of several ethylene biosynthetic and ripening-regulated genes was influenced by sound in tomato fruits.[22] A recent microarray analysis in arabidopsis plants noted that several genes were differentially expressed after sound treatment[15] and some of them are also induced by mechanical stimulus.[14] Changes in protein accumulation were observed in response to sound.[15] Many respiratory genes/proteins were upregulated as well as amino

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Supplemental data for this article can be accessed on the publisher's website.

acid biosynthetic enzymes, enzymes related to protein metabolism, folding and degradation and genes involved in sulfur, nitrogen and carbohydrate metabolism.[15] The arabidopsis transcriptomic and proteomic analyses showed the induction/accumulation of several stress- and pathogen defense-related genes/proteins.[15] Induction of defense mechanism by sound was previously observed.[8] Sound enhanced the resistance of strawberry against diseases and insects,[31] vibration in arabidopsis leads to the accumulation of defense molecules[1] and sound increased their resistance against *Botrytis* infection.[7] The treatment of plants with specific sound frequencies increased the disease resistance in pepper, cucumber, and tomato.[36]

All these data suggest the existence of molecular mechanisms for sound perception and signal transduction in plants and sound seems to induce plants defense mechanisms against pathogens and against different abiotic stresses.

Our results were focused on determining possible effects of sound on drought resistance of *Arabidopsis thaliana* plants and on the possible induced changes in gene expression. A precise description of the methods used is presented in the Supplemental File 1.

To explore a possible effect of sound in plant drought resistance, 6-week-old Arabidopsis plants grown at 22°C with a 8/16-h light-dark photoperiod were treated with 10 h 100 dB of white noise at the middle of the dark period during one week. Control plants were kept in silence. Irrigation was stopped at the beginning of the sound treatment. After the 2 weeks of drought the plants were re-watered. The survival rates were calculated one week after re-watering (Supplemental File 2). Sound treated plants showed an increased drought tolerance and resulted in significantly higher survival rates compared with untreated plants (Fig. 1): 24,8% (± 3.81) of the sound-treated plants surveyed compared with 13,3% (± 3.16) of the plants kept silence. This difference is statistically significant and indicate that the white noise increases arabidopsis drought tolerance.

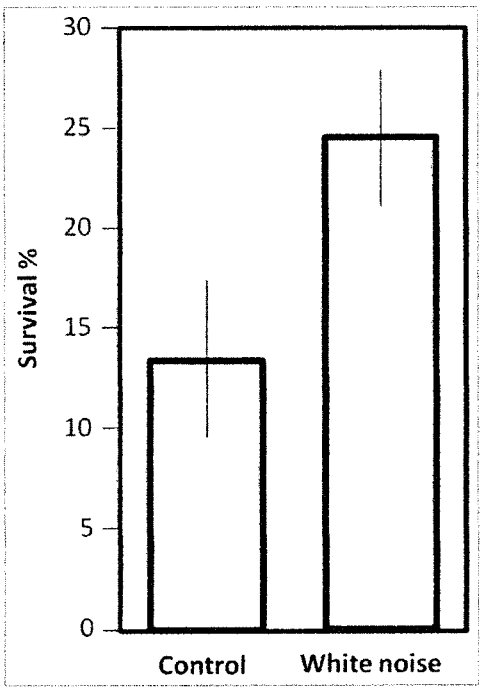

Figure 1. Increase in the drought resistance in arabidopsis plants exposed to white noise. The percentage of plant survival is indicated. Bars represent the standard errors.

The possible transcriptomic changes in arabidopsis upon exposure to sound were investigated through RNA-seq analysis. Six week old plants at the rosette stage were exposed during 10 h to 100 db white noise during the night and the samples were collected just at the end of the sound treatment. The samples corresponded to the eight youngest leaves of the rosette. The control samples were collected in the same moment with the only difference that the plants were not exposed to sound. Total RNA was extracted, cDNA libraries constructed and sequencing runs were performed in the Illumina HiSeq 2000 platform. A total of 3.65×10^8 reads were generated. Of the clean reads, 94.4% were uniquely mapped to the arabidopsis reference genome sequence. The normalized FPKM was used to quantify the gene expression level[37] to reveal differentially expressed genes. The expression of 89 genes was considered to be altered by sound (log2 fold change $> = 2$ and q-value < 0.05): 87 upregulated and 2 downregulated (Table 1). To validate RNA-seq results, RT-PCR was done to reveal the trend in the expression pattern of genes (Fig. 2). Expression of 6 genes was validated. In all the cases the RT-PCR results confirmed the patterns of expression obtained in the RNA-seq analysis.

A GO analysis was performed to determine the function of the identified differentially expressed genes (Supplemental Files 3 and 4). From the 87 upregulated genes, 44 (51%) are involved in responses to different types of stresses and the function of 22 is unknown. To confirm the enrichment in stress-related genes a GO enrichment analysis was performed (Table 2). Most of the 15 significantly overrepresented GO terms are related to stress, defense or response to stimulus.

Our results open new aspects of the discussion on the possible effects of sound on plants. Despite the growing data on different effects of sound in plants,[17,29] the detailed molecular events triggered by sound still remain mainly unknown. To get some more insight in this area, we performed an RNA-seq assay and we noted differential gene expression of many genes in arabidopsis rosette leaves and we found that sound treatment increases the tolerance to water deficit of the arabidopsis plants.

Different mechanisms have been proposed to explain sound effects on plants. For example, sound stimulation might cause leaves' stomata to open.[28] Another theory is that sounds induce in plants a similar response as touching (thigmomorphogenesis).[6] Like sound, touch is as an external mechanical force which interacts with the plant surface. Interestingly, described thigmomorphogenetic responses include resistance to other stresses. Transcriptomic studies had identified mechanoresponsive genes, including TOUCH genes (TCH) that mainly encode calmodulins or calmodulin-like proteins and xyloglucan endotransglycosylase/hydrolase (XTH),[6] genes encoding protein kinases,[30] transcription factors,[16] genes involved in jasmonic acid and ethylene synthesis[26,2] or genes involved in antioxidative responses.[10] A transcriptome analysis of touch-stimulated arabidopsis rosette leaves identified over 700 differentially expressed genes,[23] most of them upregulated. Up-regulated genes were specially enriched in calcium-binding proteins,

Table 1. List of the Significantly Induced Genes in arabidopsis leaves after white noise treatment (log2 fold change > = 2 and q-value < 0.05).

Gene_id	Gene	WN/CON	CON	WN	p-value	q-value
AT1G13607	Defensin-like	a	0,0	1,4	5,0e-05	0,00601
AT1G68825	Devil 5; Rotundifolia-like 15	a	0,0	0,4	2,0e-04	0,01862
AT2G31930	Unknown protein	a	0,0	0,9	5,0e-05	0,00601
AT4G01535	Unknown protein	a	0,0	1,4	5,0e-05	0,00601
AT5G38700	Cotton fiber protein	a	0,0	0,5	5,0e-05	0,00601
AT4G01360	BYPASS 3	41,6	0,2	7,9	5,0e-05	0,00601
AT4G30280	Xyloglucan endotransglucosylase /Hydrolase 18	26,5	0,5	12,0	5,0e-05	0,00601
AT1G35140	Exordium like 1; Phosphate-induced 1	25,1	0,5	12,0	5,0e-05	0,00601
AT5G52050	Detoxification efflux carrier 50	21,1	0,2	3,2	5,0e-05	0,00601
AT3G56790	RNA splicing factor-like	19,3	0,6	11,3	5,0e-05	0,00601
AT2G14247	Unknown protein	19,0	0,7	12,6	5,0e-05	0,00601
AT1G19210	DREB subfamily A-5 ERF/AP2 transcription factor	18,8	3,3	62,2	5,0e-05	0,00601
AT4G24580	ROP1 ENHANCER 1, Rho GTPase-activating protein	18,2	0,1	1,9	5,0e-05	0,00601
AT3G56970	Basic Helix-Loop-Helix 38; OBP3-Responsive Gene 3	15,6	0,7	11,0	5,0e-05	0,00601
AT1G50750	Aminotransferase-like mobile domain protein	14,3	0,2	3,1	5,0e-05	0,00601
AT2G17660	RPM1-interacting protein 4	12,6	0,9	10,7	5,0e-05	0,00601
AT3G02840	ARM repeat superfamily protein	11,5	11,1	126,7	5,0e-05	0,00601
AT3G44350	NAC domain containing protein 61	11,3	0,4	4,8	5,0e-05	0,00601
AT1G80840	WRKY DNA-binding protein 40	11,2	21,1	237,1	7,0e-04	0,04911
AT2G32130	Intracellular protein transporter putative (DUF641)	10,4	0,5	5,5	5,0e-05	0,00601
AT5G42380	Calmodulin like 37	10,4	4,5	47,2	5,0e-05	0,00601
AT3G23250	MYB domain protein 15	9,9	1,8	17,7	5,0e-05	0,00601
AT4G29780	Nuclease	9,9	17,8	175,2	5,0e-05	0,00601
AT3G01830	Calcium-binding EF-hand family protein	9,4	2,9	27,5	1,0e-04	0,01106
AT1G61340	F-BOX stress induced 1	8,9	4,6	40,7	5,0e-05	0,00601
AT5G22240	Ovate family protein 10	8,9	1,7	15,4	5,0e-05	0,00601
AT1G66090	Disease resistance protein TIR-NBS class	8,8	4,9	43,3	5,0e-05	0,00601
AT1G72520	Lipoxinegase 4	8,3	2,5	21,0	5,0e-05	0,00601
AT2G30020	MAPK phosphatase clade B of the PP2C-superfamily	7,9	33,0	259,2	5,0e-05	0,00601
AT5G57560	TOUCH 4; Xyloglucan endotransglucosylase/ hydrolase 22	7,5	20,4	153,5	5,0e-05	0,00601
AT2G35930	U-BOX 23; E3 ubiquitin ligase	7,2	7,8	55,6	5,0e-05	0,00601
AT5G45340	Cytochrome P450 family 707 Subfamily A Polypeptide 3	7,1	10,5	74,7	5,0e-05	0,00601
AT2G46400	WRKY DNA-binding protein 46	7,1	10,8	76,4	5,0e-05	0,00601
AT3G28340	Galactinol synthase 8; Galacturonosyl transferase-like 10	6,9	2,3	16,2	5,0e-05	0,00601
AT2G34600	Jasmonate-zim-domain protein 7; TIFY5B	6,9	1,2	8,6	5,0e-05	0,00601
AT3G46090	C2H2 and C2HC zinc fingers superfamily	6,8	1,6	10,9	5,0e-05	0,00601
AT1G22480	Cupredoxin superfamily protein	6,6	0,3	2,2	5,0e-05	0,00601
AT1G30135	Jasmonate-ZIM-domain protein 8	6,6	1,7	11,4	5,0e-05	0,00601
AT3G61190	BON Association protein 1	6,5	10,8	70,7	5,0e-05	0,00601
AT4G25490	C-Repeat/DRE Binding Factor 1; DRE Binding protein 1B	6,5	4,2	27,1	5,0e-05	0,00601
AT5G05390	Laccase 12	6,4	0,3	1,7	3,0e-04	0,02536
AT1G56660	MAEBL domain protein	6,4	7,2	46,1	5,0e-05	0,00601
AT3G52450	U-BOX 22 U-box domain E3 ubiquitin ligase	6,3	3,4	21,9	5,0e-05	0,00601
AT1G74930	DREB subfamily A-5 of ERF/AP2 transcription factor	6,1	43,4	263,4	5,0e-05	0,00601
AT1G17420	Lipoxynease 3	5,8	3,5	20,0	5,0e-05	0,00601
AT1G28480	Glutaredoxin GR480	5,7	5,1	29,2	5,0e-05	0,00601
AT1G76650	Calmodulin-Like 38	5,5	94,5	517,1	5,0e-05	0,00601
AT3G55980	Salt-inducible Zinc Finger 1	5,5	52,0	284,0	2,5e-04	0,02220
AT5G64870	SPFH/Band 7/PHB domain-containing membrane-associated	5,4	1,6	8,5	5,0e-05	0,00601

(Continued on next page)

Table 1. (Continued).

Gene_id	Gene	WN/CON	CON	WN	p-value	q-value
AT1G47400	Unknown protein	5,4	3,3	17,9	5,0e-05	0,00601
AT1G01560	MAP Kinase 11	5,4	4,1	22,3	5,0e-05	0,00601
AT5G35735	Auxin-responsive family protein	5,4	19,1	103,7	5,0e-05	0,00601
AT2G14610	Pathogenesis related 1	5,4	1,0	5,2	5,0e-05	0,00601
AT1G02400	Gibberellin 2-Oxidase 4	5,4	1,4	7,6	5,0e-05	0,00601
AT4G39670	Glycolipid transfer protein	5,3	5,4	28,6	5,0e-05	0,00601
AT5G47850	CRINKLY related 4	5,3	0,5	2,5	5,0e-05	0,00601
AT2G01180	Lipid phosphate phosphatase 1; Phosphatidic acid phosphatase 1	5,2	6,6	34,1	5,0e-05	0,00601
AT3G62260	Protein phosphatase 2C	5,1	11,6	59,2	5,0e-05	0,00601
AT1G74450	Unknown protein	5,1	24,6	124,1	5,0e-05	0,00601
AT5G66650	Calcium uniporter (DUF607)	5,0	4,2	21,0	5,0e-05	0,00601
AT2G14290	LL-diaminopimelate protein (DUF295)	5,0	0,3	1,3	5,5e-04	0,04080
AT1G18300	NUDIX Hydrolase homolog 4	4,7	92,6	438,8	5,0e-05	0,00601
AT4G11280	1-Aminocyclopropane-1-carboxylic acid synthase 6	4,7	32,3	152,8	1,0e-04	0,01106
AT4G25470	C-REPEAT/DRE binding factor 2; DRE/CRT-Binding protein 1C; Freezing tolerance QTL4	4,7	23,0	108,4	5,0e-05	0,00601
AT5G41750	Disease resistance protein (TIR-NBS-LRR class)	4,7	2,4	11,2	5,0e-05	0,00601
AT5G21960	DREB subfamily A-5 of ERF/AP2 transcription factor	4,7	7,7	36,0	5,0e-05	0,00601
AT1G66160	CYS MET PRO and GLY Protein 1	4,7	3,3	15,4	5,0e-05	0,00601
AT5G22545	Unknown protein	4,7	3,1	14,5	5,0e-05	0,00601
AT2G41640	Glycosyltransferase family 61	4,7	12,2	57,1	5,0e-05	0,00601
AT2G30040	Mitogen-activated protein kinase kinase kinase 14	4,6	9,0	41,8	5,0e-05	0,00601
AT5G64310	Arabinogalactan 1	4,6	20,7	95,7	5,0e-05	0,00601
AT2G23810	TETRASPANIN 8	4,6	39,9	182,8	5,0e-05	0,00601
AT1G47395	Unknown protein	4,5	8,6	38,7	5,0e-05	0,00601
AT1G60190	ATPUB19: U-BOX 19	4,5	14,4	64,8	5,0e-05	0,00601
AT1G72950	Disease resistance protein (TIR-NBS class)	4,5	2,0	8,9	5,0e-05	0,00601
AT2G40140	Salt-inducible Zinc Finger 2	4,5	26,5	118,3	1,0e-04	0,01106
AT1G02660	α/β-Hydrolases superfamily	4,5	1,2	5,2	5,0e-05	0,00601
AT4G24380	Dihydrofolate reductase	4,5	21,1	93,8	2,5e-04	0,02220
AT2G44840	Ethylene-responsive Element Binding Factor 13	4,4	6,9	30,5	5,0e-05	0,00601
AT5G05410	Dehydration-responsive element binding protein 2	4,4	1,1	4,8	1,5e-04	0,01528
AT1G17380	Jasmonate-ZIM-domain protein 5; TIFY11A	4,3	8,8	38,2	5,0e-05	0,00601
AT3G50930	Cytochrome BC1 Synhtesis; Outer Mitochondrial Membrane Protein	4,3	8,6	36,4	5,0e-05	0,00601
AT3G10930	IDA-LIKE7, IDL7	4,2	28,0	116,9	5,0e-05	0,00601
AT1G76600	Polymerase	4,2	20,2	84,3	5,0e-05	0,00601
AT2G39650	Cruciferin (DUF506)	4,1	6,4	26,1	5,0e-05	0,00601
AT3G46620	RING and DOMAIN of unknown function 1117 1	4,1	57,1	234,8	3,0e-04	0,02536
AT5G03210	DBP-Interacting-protein 2	4,1	30,2	122,3	5,0e-05	0,00601
ATCG01130	Translocon at the inner envelope membrane of chloroplasts 214	4,3[b]	0,7	0,2	5,0e-05	0,00601
AT4G03445	miR447A, targets several 2-phosphoglycerate kinase-related	c	1,1	0,0	6,0e-04	0,04335

[a]expression was only detected in the sound treated samples
[b]expression was higher in the control sample
[c]expression was only detected in the control samples

cell-wall proteins, disease resistance proteins, kinases and transcription factors.

Our RNA-seq results present similarities to what was observed after touch induction, for example, we also observed a predominant upregulation, and two genes directly involved in mechanical responses are among those upregulated genes: TCH4, encoding a xyloglucan endotransglucosylase/hydrolase, and ACS6, encoding the 1-aminocyclopropane-1-carboxylic acid synthase 6. White-noise upregulated genes include at least 32 genes involved in abiotic stress responses, 31 involved in pathogen responses, 11 involved in oxidation-reduction processes, 5 involved in transcription regulation, 2 genes involved in protein phosphorylation/dephosphorylation and 13 involved in jasmonic acid or ethylene synthesis or responses. Similar results were obtained in a microarray analysis based on single frequency treatments in Arabidiopsis.[15,12]

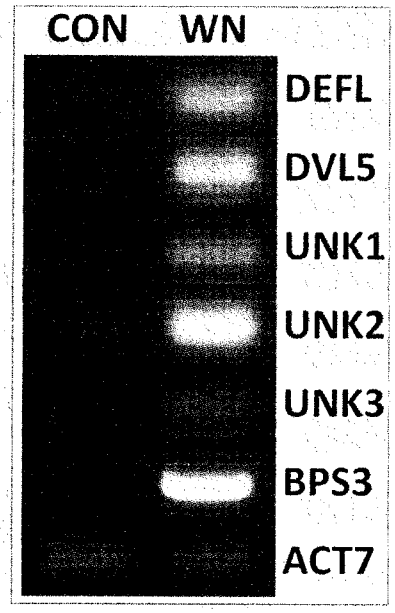

Figure 2. RT-PCR analysis of the expression profiles of 6 arabidopsis genes identified as differentially expressed by RNA-seq, all them significantly overexpressed in the sound treated plants (WN) respect to the controls (CON). Ethidium bromide stained 1.5% agarose gels showing RT-PCR products. The genes are (see Table 1): DEFL, At1g13607; DVL5, At1g68825; UNK1, At2g31930; UNK2, At4g01535; UNK3, At5g38700; BPS3, At4g01360. ACT7 corresponds to actin7 (At5g09810) and was used as control of non-induced gene. In each case, the size of the band shown is those expected.

Cell-walls play an important role in the perception of the mechanical stimulus.[35] We have identified at least four genes whose function is related to cell-walls: TCH4, laccase12, GOLS8 and XTH18. TCH4 encodes a cell-wall modifying enzyme that breaks the xyloglucan chains and make the cell-wall more elastic. The cell-wall interacts with the cell membrane, which, in turn, interacts with the cytoskeleton, which can modify the activity of ion channels, resulting in changes in the concentration of ions like calcium in the cytoplasm, which can activate several calcium binding proteins and kinases which can induce huge changes in the transcriptome and proteome, which eventually affect several vital processes, like growth, development and defense against pathogens or abiotic stresses. Supporting this hypothesis, two upregulated genes encode calcium related proteins: a calcium-binding EF-hand family protein and a calcium uniporter. Previous results also indicate that ROS signaling is another player for sound-mediated signaling.[32,18,41,29,15] We identified 11 upregulated genes involved in different aspects of oxidation-reduction processes. It thus appears that ROS signaling is an important player also for sound perception. Calcium, ROS and possibly hormonal changes may probably explain most of the effects of the sound response signaling previously observed as changes in the development and the induction of pathogen resistance, and also the induction of at least 32 genes involved in different aspects of abiotic stress, including 9 genes directly involved in water stress responses, and may explain our observed increase in water deficit tolerance.

We can conclude that sound has an impact on plants probably through a perception mechanism at least partially common to that of mechanical stimuli. Previous and our experiments demonstrate that plants can respond to sounds but each experiment has been performed using different parameters, so it is difficult to systematize the results. The conditions needed may depend on each species, the tissue and the phenomenon studied, or the frequencies, intensity or duration of the sound. Another interesting question is whether sound responses are relevant in natural conditions or just a side effect of mechanoperception. The acoustic responses of plants can offer insights into innovative practical applications such as reducing the negative effects of water deficit or a reduction in the use of pesticides. In

Table 2. GO ontology enrichment analysis showing significant over-represented functional categories in the leaves of sound treated arabidopsis plants compared with all genes.

Name of the annotation data category	Total[1]	Induced[2]	Expected[3]	Fold Enrichment[4]	P value[5]
Response to chitin	109	9	0,35	25,66	2.35E-07
Response to organonitrogen compound	154	10	0,50	20,18	2.08E-07
Response to nitrogen compound	228	11	0,73	15,00	5.15E-07
Response to wounding	182	8	0,59	13,66	3.31E-04
Response to jasmonic acid	172	7	0,55	12,65	3.40E-03
Response to acid chemical	886	21	2,85	7,37	1.37E-09
Response to oxygen-containing compound	1144	26	3,68	7,06	3.55E-12
	356	8	1,15	6,98	4.51E-02
Response to inorganic substance	690	13	2,22	5,86	7.38E-04
Response to organic substance	1466	22	4,72	4,66	2.25E-06
Defense response	1253	18	4,03	4,47	1.87E-04
Response to chemical	2084	28	6,70	4,18	8.04E-08
Response to stress	2639	31	8,49	3,65	1.50E-07
Response to abiotic stimulus	1491	17	4,80	3,54	1.05E-02
Response to stimulus	4612	40	14,84	2,70	8.66E-07

[1]Total number of genes in each annotation data category in *Arabidopsis thaliana*.
[2]The number of induced genes in each annotation data category.
[3]The number of genes you would expect in each annotation data category in *Arabidopsis thaliana* according to the total number of induced genes supposing a random distribution.
[4]Number of induced genes in each annotation data category divided by the expected number. If it is greater than 1, it indicates that the category is overrepresented.
[5]The p-value determined by the binomial statistic. This is the probability that the number of genes you observed in this category occurred by chance (randomly).

addition, the use of sound-induced promoters may have interesting biotechnological applications.

Disclosure of potential conflicts of interest

No potential conflicts of interests were disclosed

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Declaration of authorship

ILR performed the RNA extractions. CMV conceived and designed the experiments, analyzed the data and wrote the manuscript.

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Update on the Effects of Sound Wave on Plants

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Plant growth is considered the sum of cell proliferation and subsequent elongation of the cells. The continuous proliferation and elongation of plant cells are vital to the production of new organs, which have a significant impact on overall plant growth. Accordingly, the relationship between environmental stimuli, such as temperature, light, wind, and sound waves to plant growth is of great interest in studies of plant development. Sound waves can have negative or positive effects on plant growth. In this review paper we have summarized the relationship between sound waves and plant growth response. Sound waves with specific frequencies and intensities can have positive effects on various plant biological indices including seed germination, root elongation, plant height, callus growth, cell cycling, signaling transduction systems, enzymatic and hormonal activities, and gene expression.

Keywords : Frequency, Plant growth, Sound wave

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Introduction

Plants are complex multicellular organisms that are exposed to nature under various environmental conditions. Environmental factors have a great influence on the growth and development of plants, which interact with their environment through epidermal cells. A series of biological changes occurs in living plant systems that reflects its speed of growth. Accordingly, the growth of plant cells and tissues in response to different physical stimuli is a cardinal field of study in cell biology (Braam and Davis, 1990).

Sound is an external factor that has a great impact on the biological index of plants (Bochu *et al.*, 1998, 2001; Zhao *et al.*, 2000; Liu *et al.*, 2001; Yiyao *et al.*, 2002; Yang *et al.*, 2002; Yi *et al.*, 2003a) and can either promote or suppress growth. Sound is an oscillation of waves of pressure transmitted through gases, liquids or solids. As waves propagate, they transport energy. In addition, sound disperses information about the surrounding and living organisms adhere this information /and or communicate through wave motions. The amount of the energy in the wave determines the measures of the sound wave and its travelling time. The audible sound that humans can hear falls into frequencies ranging from 20 Hz–20,000 Hz (Hertz) (Dorrell, 2005), while sound above this range is known as ultrasound and that below this range is known as infrasound. Sound waves transported through a medium via the mechanism of particle interaction are characterized as mechanical waves (Pierce, 1989). In nature, almost all living organisms are immersed in a variety of sound waves and interact with them.

The use of sound and music to improve the health of living organisms is not a novel idea. Indeed, the beneficial and harmful effects of sound in terms of music were recognized by the ancient Greeks and Romans (Rooke, 1985). Music, which is made up of sound waves with different frequencies and intensities (Telewski, 2006), has been used for the treatment of illnesses, including neuropathy and depression (Wicke, 2002). Dr. TC Singh first studied the effects of music on plants in the 1950s (Tompkins and Bird, 1989). In 1973, D Retallack published a book titled, "The Sound of Music and Plant", which described experiments involving plants and music. In these experiments she played sounds and particular styles of music to plants and found that the best growth results were obtained when classical music was played. Moreover, stimuli such as sound fields, supersonic sound, electromagnetic fields, micro gravity, and mechanical

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vibrations impacted plants (Bush, 1995; Fraze, 1996). Indeed, sound vibration has also been shown to stimulate seed germination and plant growth (Braam and Davis, 1990). Moreover, various studies have investigated the effects of music and sound on paddy crops (Subramanian *et al.*, 1969), wheat (Weinberger and Measures, 1979), purple passion vine plants (Tompkins and Bird, 1989), and Arabidopsis (Braam and Davis, 1990). Taken together, these studies belong to the field of acoustic biology. Overall, little research has been conducted in this field due to the lack of precise instrumentation to measure the response of plants to sound as well as a lack of confirmed scientific information in this area of study. Therefore, we are conducting research to determine the relationship between the exposure of plants to sound and subsequent plant growth. Growth response depends on the frequency and intensity of sound (Liu *et al.*, 2001). It is known that different frequencies and intensities of sound impact different plants; however, further studies are needed to clarify these variations. Here, we have summarized the impact of sound waves and music on plant response in terms of growth and development.

Role of Sound Waves on Plant Growth and Development

A key feature of living organisms is the ability to sense and respond to different physical stimuli. Light, temperature and a variety of chemical signals are common environmental physical stimuli detected by biological organisms. In addition, organisms perceive a variety of external mechanical stimuli, including those induced by pressure gradients of wind in the atmosphere as well as pressure gradients in aquatic systems created by currents or tidal flows. These types of mechanical stimuli, which are collectively known as touch or thigmostimuli, produce a number of thigmoresponses in plants including thigmomorphogenesis, thigmotropism, thigmonasty and thigmotactic response (Jaffe *et al.*, 2002; Braam, 2005). Pressure waves created by sound waves are transmitted in aerial, solid and aquatic environments. However, it is not clear if plants can respond to sound that impact them as mechanical waves transmitted through wind pressure.

The interaction between living organisms and audible sound is usually neglected in biological research. Nevertheless, sound waves with appropriate length of action time and proper intensity or frequency are known to stimulate cell growth in some plants (Bochu *et al.*, 1998; Yiyao *et al.*, 2002). Additionally, some studies have investigated the relationship between plants and sounds and scientists have reported the response of plants to sound waves and music via different aspects of plant growth and development. The effects of music to improve crop yield and quality have been reported in tomato plants, barley and other vegetables (Hou and Mooneyham, 1999; Spillane, 1991; Xiao, 1990). Weinberger and Measures (1979) reported the effects of intensity in audible sound on the growth and development of Rideau winter wheat. The authors concluded that the vegetative growth response of winter wheat to audible sound was mainly dependent upon both frequency and intensity. They reported that sonication at 5 kHz and 92 dB (decibel) led to stimulate tiller growth with an increase of plant dry weight and number of roots. Hou *et al.* (1994) reported 100 Hz frequency of an external sound showed positive impact on philodendron plant growth. Qi *et al.* (2010) showed the influence of sound wave stimulation on strawberry leaf area/dimensions, the photosynthetic characteristics, and other physiological responses. The authors reported that the sound waves promoted the growth of strawberry, as well as sound waves enhanced the resistance of strawberry against diseases and insects.

Two plant species such as beans and impatiens were affected by sounds of varying frequencies. The authors reported that optimum plant growth occurred when the plant was exposed to pure tone sound in which the wavelength coincided with the average of major leaf dimensions. The plant growth was decreased when exposed to random noise (Collins and Foreman, 2001).

Seed Germination. Different metabolic activities including enzyme activation and hormonal changes occur during seed germination, and sound is known to directly affect biological systems including those involved in seed germination. Creath and Schwartz (2004) compared effects of music, noise, and healing energy using seed germination assay. Musical sound has been shown to significantly enhance the sprouting of okra and zucchini seeds than the noise effect. This effect is independent of temperature, location of the experiments, seed type, specific petri dish, and person doing the scoring. The healing energy also had significant effect like sound compared to the untreated control of seed germination. The authors concluded that sound vibrations such as music and noise as well as biofield such as bioelectro-magnetic and healing intention directly affect living biological systems (Creath and Schwartz, 2004). Seeds of *Echinacea angustifolia*, a medicinal plant, showed improved germination rate to chemical and physical factors, such as scarification, chilling period, light, applied chemicals (6-benzylaminopurine, gibberellic acid), and sound stimulation (Chuanren *et al.*, 2004). The seeds showed the highest germination rate with the least germination time when subjected to sound wave at 100 dB and 1,000 Hz. The author concluded that the germination rate was greatly enhanced and seed dormancy was completely reduced. Sound waves were also found to enhance the germination index, height of the stem, relative increase rate of fresh weight, activity of the root system, rooting ability, and the penetrability of the cell membrane of paddy rice seeds. The authors reported that 400 Hz and 106 dB showed positive effect on the growth stimulation of the paddy rice seed, but high frequency and intensity of sound wave were shown to be harmful (Bochu *et al.*, 2003). Hageseth (1974) investigated the effects of sound on the mathematical parameters that described quantitatively the

barley seed germination process. The author found differential germination rate as a function of time using various frequencies of noise from 100 to 9,000 Hz.

Root elongation is related to cell metabolism, and positive relationships between root growth and different types of music have been reported (Seregin and Ivanov, 2001). Moreover, rhythmic classical music and rhythmic music with dynamically changing lyrics positively affected root elongation and mitotic division in onion root tips during germination. The authors found the correlation between root elongation and mitotic index (MI) and further showed improved growth when compared to control (Ekici *et al.*, 2007). The contents of soluble sugar, protein, and the amylase activity in chrysanthemum increased significantly in response to sound waves with certain intensities (100 dB) and frequencies (1,000 Hz) which indicated that sound stimulation could enhance the metabolism of roots and the growth of *Chrysanthemum* (Yi, 2003b). Sound waves of certain frequencies also enhanced root development of paddy rice (Bochu *et al.*, 2003). There are many reports about the effect of mechanical vibration including frequency and amplitude on seed germination. It promotes seed germination in *Cucumis sativa* and *Oryza sativa* using 50 Hz (Takahashi *et al.*, 1991). When the authors used the fixed amplitude of vibration at 0.42 mm and vibration frequencies above 70 Hz in *Arabidopsis thaliana*, the seeds showed increased rate of germination. The increase in the germination rate was based on the acceleration calculated from the frequency and amplitude of vibration (Uchida and Yamamoto, 2002). The percent of germination and seedling growth of trees such as red pine, tamarack, and white spruce showed no significant positive effect to sonication at 1 MHz with an intensity in the range of 0.5–1.0 W/cm^2, but jack pine showed significant increase in number of seedlings as well as its total length (Weinberger and Burton, 1981). The authors concluded that the stimulation of jack pine seed germination and seedling growth were related to localized micro heating and nuclear effects. Enhancing the rate of corn seed germination and reduction of time needed for germination have been achieved by immersing the seeds in an aqueous solution including dissolved inert gas with sonication at a frequency between 15–30 kHz and energy density between 1–10 W/cm^2 (Shors *et al.*, 1999).

Biochemical and Physiological Activities. The division and growth of plant tissues are greatly affected by soluble proteins in tissues. The accumulation of soluble protein contents affects cell division, the content of enzymes and metabolization level (Yiyao *et al.*, 2002). Sound waves at different frequencies and strength have been shown to alter the secondary structure of cell wall proteins of tobacco by changing Amide I and Amide II bonds (Ziwei *et al.*, 1999). Moreover, sound at specific frequencies and intensities promoted the content of soluble proteins and sugars in the cytoplasm of *Dendranthema morifolium* callus (Zhao *et al.*, 2003). The optimum intensity and frequency of sound field stimulation enhanced soluble protein contents and the growth of chrysanthemum calli remarkably (Bochu *et al.*, 2001; Yiyao *et al.*, 2002; Yi *et al.*, 2003b). An audible sound frequency by sonication for 4 weeks at 5 kHz enhanced the amount of alanine and glycine, whereas asparagine content was lower in the sonicated endosperm tissue of Rideau wheat grains compared to untreated controls (Measures and Weinberger, 1973). Sound stimulation increased the cell wall and membrane fluidity, which facilitated cell division and growth (Keli *et al.*, 1999; Zhao *et al.*, 2002). Sound stimulation also increased the fluidity of the physical state of lipids in plasmalemma and influenced the secondary structure of proteins in cell walls and plasmalemma (Yi *et al.*, 2003c). These structural changes of protein and membrane fluidity aided membrane trafficking modulation (Apodaca, 2002) and metabolic activity acceleration (Yi *et al.*, 2003c). Moreover, the polyamine content and oxygen (O_2) uptake rate in Chinese cabbage and cucumber increased in response to sound at 20,000 Hz, and "green music" which consists of a classical music with some natural sounds (Qin *et al.*, 2003). It has also been reported that polyamines are involved in plant developmental processes such as cell division, root growth, reproductive organ development, floral initiation and development, embryogenesis, tuberization, and fruit development and ripening (Evans and Malmberg, 1989; Bais and Ravishankar, 2002).

Plasma membrane H^+-ATPase is a type of glycoprotein across membranes, which plays an important role in the growth and development of plants. Certain intensity (100 dB) and frequency (1,000 Hz) sound waves increased the activities of plasma membrane H^+-ATPase (Wang *et al.*, 2002; Yi *et al.*, 2003a), which regulated physiological and biochemical processes such as growth, development, turgor pressure and maintenance of plasma pH (Serrano, 1989; Grouzis *et al.*, 1990; Michelet and Boutry, 1993). Plasma membrane H^+-ATPase is sensitive to Ca^{2+} concentration. Specifically, plasma membrane H^+-ATPase activities and the concentration of Ca^{2+} increased in response to sound wave stimulation (Wang *et al.*, 2002; Yi *et al.*, 2003a). Moreover, sound wave stimulation increased the cytosolic Ca^{2+} in chrysanthemum callus cells (Liu *et al.*, 2001). Ultrasound also stimulated the callus cells of *Aloe arborescens* to adapt the environmental stress through increased plasma membrane Ca^{2+}-ATPase activity (Liu *et al.*, 2006). Certain frequencies and intensities of sound reduced the penetrability of the cell membranes of paddy rice, but high frequency and intensity was harmful and increased the cell membrane penetrability (Bochu *et al.*, 2003). Overall, these findings indicate that proper sound waves can improve cell function under a variety of unfavorable conditions by reducing the cell membrane penetrability, which facilitates plant growth and development.

Cellular Response. High frequency and intensity of sound can cause cell damage, but at a proper frequency and strength it can promote the growth of plant cells (Bochu *et al.*, 1998). Sound at specific frequencies and intensities significantly increased

the callus growth of different plants such as *Dendranthema morifolium* (Zhao *et al.*, 2003) and *Oryza sativa* (Liu *et al.*, 2003). Moreover, audible sound significantly increased the colony formation of *E. coli* under normal growth conditions. The response of bacterial cells to audible sound was stimulated due to the involvement of several potential mechanisms (Shaobin *et al.*, 2010). Specifically, sound at 1,000 Hz and 100 dB increased the ATP content of *Actinidia chinensis* callus, which was favorable for vigorous growth and plant development (Xiaocheng *et al.*, 2003b). Sound waves also greatly affected the cell cycle in *Chrysanthemum* (Xiujuan *et al.*, 2003a). Specifically, the number of cells were increased in the S phase due to sound waves (1,000 Hz and 100 dB), indicating that sound waves accelerated the growth of chrysanthemum. Ultrasound effectively increased the conversion frequency of *Dendrobium officinale* protocormlike bodies (PLBs) to shoot production in micro propagation when administered at 28,000 Hz and 300 W for 5 min (Wei *et al.*, 2012). In addition, ultrasound was reported to cause the transient formation of callose in cotton seeds (Currier and Webster, 1964). Plant growth and development reflect the increase of different growth parameters including plant height, branching, flowering and fruiting, and fresh and dry weight. Moreover, 400 Hz sound waves, as well as cuckoo, cricket and mixed insect songs reportedly showed a positive effect on the height of cowpeas (*Vigna unguiculata*) during the seedling stage (Jun and Shiren, 2011).

Plant acoustic frequency technology (PAFT) is the treatment of plants with a specific sound frequency. This treatment was found to increase the yield and quality, and strengthen disease-resistance in pepper, cucumber, and tomato (Tian *et al.*, 2009). Moreover, the net photosynthetic rate, maximum fluorescence, photochemical efficiency of photosystem II and non-photochemical quenching were also markedly increased by sound in strawberry leaves (Zhou *et al.*, 2010; Meng *et al.*, 2012).

Protective Enzyme Activities. Free radicals including O_2^-, OH^- and $^1O_2$ are generated by plant cells through various processes (Xiujuan *et al.*, 2003b; Gadjev *et al.*, 2006). These free radicals have a strong capacity to oxydate many functional molecules. Accordingly, elimination of H_2O_2 is an important consideration for maintenance of low free radical levels in plant cells because it can generate more OH^- and $^1O_2$ free radicals. Peroxidase (POD) and catalase (CAT) primarily decompose H_2O_2, and superoxide dismutase (SOD) eliminates O_2^-. Sound wave stimulation increased the activities of various plant protective enzymes such as SOD, POD, and CAT, which had a great influence in reducing the accumulation of active oxygen species (AOS) which may protect cells from oxidative damage. Also, different cell compartments might activate different defensive system, which directly avoids the excessive production of AOS. Sound wave stress also induces the lipid peroxidation in *Dendrobium candidum* plant by increasing the content of malondialdehyde, a decomposition product of polyunsaturated fatty acids hydroperoxides (Li *et al.*, 2008). The effect of sound wave on the synthesis of nucleic acid and protein in chrysanthemum was investigated by Xiujuan *et al.* (2003b). The authors reported that sound wave had no significant increase of DNA content, but they enhance the synthesis of RNA and soluble protein. The authors concluded that some stress-induced genes might be switched on under sound wave stimulation resulting in increased level of transcription.

Genetic Response. Gene expression levels are known to be related to the biological function of plants. Rapid and dramatic fluctuations of gene expression occur in response to different environmental conditions and lead to physiological and developmental changes in plants. These molecular responses facilitate acclimatization of plants to different environmental conditions. The genetic response of plants to sound waves is similar to their response to touch and wind as sound is a mechanical wave vibration. However, limited research has been conducted to investigate gene expression.

Several genes are up or down-regulated in response to different external stimuli. For example, mechano stimulation induced expression of the touch (*TCH*) genes (Braam, 1992; Braam *et al.*, 1997; Sistrunk *et al.*, 1994; Braam, 2005), and frequency specific sound led to significant upregulation of the expression of genes encoding a putative fructose 1,6-bisphosphate aldolase (*ald*) and ribulose 1,5-bisphosphate carboxylase (Rubisco) small subunit (*rbcS*) in rice plants (Jeong *et al.*, 2008). The 1,506-bp *ald* promoter was also found to be a sound-responsive promoter, indicating that specific frequencies of sound can regulate the expression of any gene fused with the *ald* promoter (Jeong *et al.*, 2008). The authors concluded that gene expression was up-regulated at 250 Hz, but down regulated at 50 Hz. Moreover, sound wave stimulation accelerated the synthesis and total content of RNA (Xiujuan *et al.*, 2003c; Hongbo *et al.*, 2008), but had no influence on DNA content (Xiujuan *et al.*, 2003c). Several biotic stresses down-regulated the expression of genes involved in photosynthesis (Bilgin *et al.*, 2010). The authors concluded that the down-regulation of photosynthesis related genes and up-regulation of genes coding for the synthesis of jasmonic and salicylic acid were part of a defense response to various stress.

Conclusions

The growth, development, and genetic characteristics of plants are greatly influenced by different environmental factors. However, the mechanisms by which sound wave stimulation influences plant growth and development remain obscure. Nevertheless, physiological and developmental changes including gene expression occur in plants due to physical environmental stimuli. Several investigations of the relationship between sound wave and plant growth promotion were discussed in this review, and the results of these studies indicated

that there is a strong relationship between sound waves and plant growth. Sound waves with specific frequencies and intensities have been shown to have significant effects on a variety of biological, biochemical, and physiological activities including gene expression in plants. However, sound waves with high frequency and intensity can be harmful to the proper growth and development of plants. Further studies are needed to confirm and elucidate the relationship between sound waves and plant response.

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