ORGANIC FARMING RESEARCH FOUNDATION

Summer 2001 Number 10

INFORMATION BULLETIN

Mention the name "Avery" in organic circles and you're likely to cause a stir. Public perception is so important to the success of organic farming, and so often the Avery name is directly linked to information about organic that is false, misleading or hostile to the ideals and practices of organic agriculture.

What many don't realize is that there are actually two Averys: Dennis T. Avery is Director of the Center for Global Food Issues (CGFI) in Churchville, Virginia, a project of the Indianapolis-based Hudson Institute. Dennis's son Alex serves as CGFI's Director of Research and Education. For years this team has waged campaigns aimed at discrediting organic production systems, charging that organic is, among other things, low-yielding and environmentally harmful.

For those well versed in organic, it's easy to see many instances where the Averys' work is poorly supported factually. But unfortunately, they are frequently cited by the media to provide "perspective" on the "pros and cons" of organic and conventional agriculture.

CGFI's misinformation campaign on organic is a disservice and nuisance to all producers—organic, conventional , and those who integrate a variety of farming methods in pursuit of sustainability.

In this issue, Bill Liebhardt and Nancy Creamer take on some of the Averys' recent anti-organic rhetoric. —EW

Get the facts straight: Organic agriculture yields are good

by Bill Liebhardt

Last December, participants at a university conference in Valley Forge, Pennsylvania took up the debate on genetically modified (GM) organisms. Rebecca Goldberg, from the Union of Concerned Scientists, represented the cautionary environmental perspective, while Dennis Avery, of the Center for Global Food Issues at the Hudson Institute and author of *Saving the Planet with Pesticides and Plastics*, took the pro-GM position.

The crux of Avery's argument in support of genetically modified organisms was that the high yields necessary to feed a growing world population could only be possible with high inputs of fertilizers, herbicides and pesticides plus new genetically modified seeds. In fact, he argued, the use of such technologies would preserve fragile, marginal land that might otherwise be used to grow crops. He asserted that 18 to 20 million square miles of wild land habitat are preserved through high input agriculture compared to the use of organic agriculture, which only yields 55 to 60 percent of conventional yields.

Since his argument rested on the question of yield, I asked him for the source of his information. He replied that he had heard that organically grown wheat yields in England were 40 to 42 percent lower than conventionally grown English wheat.

Continued on page 4

Myth vs. reality: Avery's rhetoric meets the real world of organic

by Nancy Creamer

This past February, Alex Avery published his latest diatribe against organic agriculture, titled *Nature's Toxic Tools: The Organic Myth of Pesticide-Free Farming*[1]. I'm writing this response to Avery's report because it is full of misleading statements and false information. My attempt is to shed some light on the report's deceptive aspects.

The claims in the Hudson Institute press release about the article include: "A new report shows a shift to organic farming methods could increase pesticide use by hundreds of millions of pounds per year."; The 'natural' pesticides used by organic farmers are among the most heavily used, toxic, and persistent in American agriculture today"; "The myth that organic farming is toxics-free should be buried forever. The American public has been misled through poor reporting and aggressive marketing schemes to believe organic is 'pesticide-free' and safer for human and ecological health"; "One organic fungicide accounts for more than half of all U.S. fungicide use"; and, "Switching to all organic production would result in up to a 700 percent increase in U.S. fungicide use."

The way that Avery sets the stage, it is evident that he is purposefully manipulating information with intent to damage the organic industry. His opening statement proclaims: "Organic pesticides are the most heavily used agricultural pesticides in the U.S.,"

Continued on page 6

OFRF NEWS *by Don Burgett*

Changes at the top

This spring, we said farewell to board member **Woody Deryckx**. Joining the board in 1992, Woody lent his keen mind and broad farming expertise to OFRF's mission, ultimately serving as president from 1998 to 2001. We wish him the best as he turns his attention to the difficult issues facing farmers in southern Oregon, as Executive Director of the Klamath Basin Ecosystem Foundation.

Stepping into leadership as OFRF's fourth president is **Ron Rosmann**. An Iowa farmer, Ron is the first OFRF president from the midwest, and Executive Director Bob Scowcroft is fond of saying that we now operate on Central Time (read more about Ron in our "Board Profile" on page 12).

Departing the board in March were **Lew Grant** and **J.B. Pratt**. Lew served on the board for six years and chaired our Nominating Committee, leading the critical work of ensuring strength and stability to the organization. We are grateful to Lew and look forward to his continued participation as an advisor to the Research & Education Committee. Thanks, too, to J.B. for his time and service to OFRF, and we wish him well in his efforts to bring nutritious organic food to consumers in Oklahoma through Pratt Supermarkets.

Joining the OFRF board this spring were:

Frederick Payton, who has a Ph.D. from Cornell University in Vegetable Crops and is the director of the Southeast Regional Alternative Agriculture Project at the University of Georgia;

Steve Ela, a partner and manager of a 100-acre organic orchard for Silver Spruce Orchards in Hotchkiss, Colorado. Steve has an MS in Soil Science from the University of Minnesota and serves on the Colorado Agricultural Commission. He is also a coordinator and board member of the Colorado Organic Crop Management Association;

Juli Brussell, who is chief consultant for The Farm Gate, an agency specializing in sustainable agricultural enterprise development and food systems issues. She currently coordinates a marketing project for the Illinois Stewardship Alliance, teaches off-campus food systems courses for Eastern Illinois University, and coordinates the Small Farm Enterprise Project at the University of Illinois. Juli and her husband Kevin farm organically in southeastern Illinois.

Staff changes

Brise Tencer recently joined OFRF as our Policy Program Assistant. Brise previously worked as an environmental consultant and as an agricultural extensionist with the Peace Corps in Guatemala, and is currently completing her master's degree in International Environmental Policy.

We've also been very lucky to have two talented interns this year. **Natasha Unger** worked with Policy Director Mark Lipson for several months this winter and spring as our first OFRF Policy Intern.

On the administrative and "anything-urgent" side, **Natalie Lydon** has quickly become indispensable. Natalie interned with Program Associate Melissa Matthewson in the spring, and we asked her to stay on to help out with our busy summer.

OFRF INFORMATION BULLETIN No. 10

INFORMATION BULLETIN

Erica Walz, Editor

Jane Sooby, Contributing Editor

Dianne Carter, Illustration

Woody Deryckx, Helen Atthowe, Cynthia Hizer, Editorial Advisors

PRINTED BY
Community Printers
Santa Cruz, CA

The **Information Bulletin** is published by the Organic Farming Research Foundation, a non-profit foundation dedicated to fostering the improvement and widespread adoption of organic farming practices. Our mailing address: P.O. Box 440, Santa Cruz, California 95061, telephone: (831) 426-6606, fax: (831) 426-6670, email: <research@ofrf.org>, web: www.ofrf.org. Material in this publication may be reprinted with credit.

Research Reviews are the results of OFRF-funded research and education projects. Project reports presented in this newsletter are derived from materials submitted to OFRF by project coordinators. The use of trade names or commercial products published in these results does not constitute any product endorsement or recommendation by OFRF.

OUR MISSION • To sponsor research related to organic farming practices • To disseminate research results to organic farmers and to growers interested in adopting organic production systems • To educate the public and decision-makers about organic farming issues

Events Calendar

In March OFRF hosted an all-organic benefit luncheon in conjunction with the **Natural Products Expo West**. Record attendance and great support from **New Hope Natural Media** made it a very successful event. Many thanks to remarkable chefs **Donna Prizgintas** and **Chris Blobaum**, who again gave generously of their time to produce a lavish and delicious meal!

Look for us again at the **Natural Products Expo East** in October! New Hope and the **Organic Trade Association** are hosting an organic benefit dinner there on **Thursday, October 11th**, honoring pioneering women in organic. OFRF will be one of three groups to receive proceeds from the event, so plan now to join us for a great meal and hear from some of the leading women of the organic movement.

Finally, we just wrapped up our **5th Biennial Organic Business and Regulatory Conference** at the Claremont Resort and Spa in Berkeley at the end of July. Two hundred leaders from the organic world participated in three days of panels, roundtables and receptions.

At the conference, USDA National Organic Program leader **Keith Jones** unveiled his proposal to resolve the Organic Rule's conflict of interest issue by using an FDIC audit model for certifiers with farmer clients on their boards. Attorney **Robert Uram** presented a concept paper on what GMO liability legislation could look like. **Anthony Zolezzi** and others called for an organized campaign to promote organic foods and defend against attacks in the media.

Many thanks to all who contributed, financially and otherwise, to this event. We'd especially like to acknowledge the following companies for underwriting our conference:

Baccharis Capital
Frontier Natural Products Co-op
Goodness Greenness
Green Field Paper Company
New Hope Natural Media
New Organics Company
Newman's Own Organics
North Castle Partners
Sheppard, Mullin, Richter & Hampton LLP
Smucker Quality Beverages
Veritable Vegetable
Whole Foods Market

OFRF needs your support! Your donation is important to continuing our research and technical programs, policy initiatives, and getting OFRF's *Information Bulletin* to you. We've saved a great deal of valuable funding by not including an envelope with this newsletter. So, we hope you will take a moment to donate through our website at www.ofrf.org, call our office at 831-426-6606, or make a gift through our recent or future mailings. It's easier than ever—OFRF can now accept your donation by credit card!

LETTERS

Dear Bob,

Since your note in June, I've intended to reply to your question about how the article affected the MISA situation [An Experiment in Partnership: The Minnesota Institute for Sustainable Agriculture, OFRF *Information Bulletin* No. 9]. The MISA Board and the Dean have compromised on the bylaws and MISA is still a functioning entity. My article sparked a number of letters to the Dean and President of the University.

Governor Ventura put much less in his budget for the University, than the President had asked for. This put pressure on MISA again as base funding comes from the College of Agriculture, and MISA was a target for cuts. I know that the OFRF article was sent to legislators to urge them to keep MISA funded, and they did. Just this past week, the College of Agriculture renewed the contract for the Alternative Swine Program coordinator, which is a MISA position.

This is a much longer story than I am writing. But the gist of it is that the Dean knows we're in it for the long haul and he can't ignore the non-profit partners. I think the article kept him aware that the LSP has attentive constituents and that there are people all over the country who are serious about sustainable agriculture.

Sincerely,
Dana Jackson, Associate Director
Land Stewardship Project

I've spent a career in academic and research activities in both conventional and organic agriculture, and I am aware of comparative yield data and alarmed that someone should have a privileged forum for advocacy based on such limited information. When I returned to my office at the University of California, Davis, I began to gather scientifically replicated research results from seven major state universities: University of California, Iowa State University, Pennsylvania State University, Michigan State University, South Dakota State University, University of Nebraska and University of Wisconsin. I also looked into data from the research demonstration farm at Rodale Research Center in Pennsylvania and the Michael Fields Center at East Troy, Wisconsin on corn, soybeans, wheat and tomatoes grown under experimental controls for conventional and organic farming practices over the last 10 years.

For a total of 154 growing seasons for different crops, grown in different parts of this country on both rain-fed and irrigated land, organic production yielded 95% of crops grown under conventional high-input conditions.

Since less than 1% of agriculture research dollars are spent on organic practices, I assumed it would be difficult for organic methods to compete with conventional practices in the yield category, in particular since yield is an over-arching objective of conventional research. But that is not what I found. Here are the highlights:

◆ **Corn:** With 69 total cropping seasons comparing high input and organically grown crops, organic yields were 94% of conventionally produced corn[1,2,3,4,5,6,7].

◆ **Soybeans:** Data from five states with 55 growing seasons of data showed that organic yields were 94% of conventional yields[2,3,4,5,6].

◆ **Wheat:** Two institutions with 16 cropping year experiments showed that organic wheat produced 97% of the conventional yields[3,5].

◆ **Tomatoes:** At the University of California, 14 years of comparative research on tomatoes showed no yield differences between conventionally and organically grown crops[7].

In summary, for a total of 154 growing seasons for different crops, grown in different parts of this country on both rain-fed and irrigated land, organic production yielded 95% of crops grown under conventional high-input conditions.

Now let's step away from the fields of academic research stations and take a take a real-world look at organic yields. Here are a few selected examples of what organic farmers are yielding, looking at the same crops summarized above:

◆ **Corn and soybeans:** Ron and Maria Rosmann operate a diversified, certified organic farm in Harlan, Iowa, and consistently obtain yields on a par with their county averages: average corn yields between 1991 and 2000 for the Rosmann Farm were 131 bu/ac, compared with 130 bu/ac for Shelby County. For soybeans during the same period, Rosmann Farm yields matched Shelby County yields at 45 bu/ac[8].

◆ **Wheat:** Rex and Glenn Spray, operators of a 720-acre, diversified, certified organic farm in Mt. Vernon, Ohio, also consistently obtain wheat yields on a par with their county averages. Data provided for years 1990-1991 show yields averaging 46 bu/acre, matching Knox County, Ohio averages[9].

◆ **Tomatoes:** Small Planet Foods, parent company to Muir Glen organic tomato products, contracts with a variety of producers of organic tomatoes. Alec McErlich, Director of Agricultural Research and Development for Small Planet Foods, states that their growers generally obtain yields of 30-36 t/ac, and have seen 42 t/ac yields. This is compared with a conventional yield average in California of 31 t/ac. While noting that the best conventional yields can exceed those of organic, the quality of organically grown processing tomatoes is consistently higher. Muir Glen has a well established industry reputation for quality, with brix (solids) averages typically 1-2 points above conventional[10].

While this is admittedly a limited sample, what these figures illustrate is that organic systems have every possibility of matching conventional system yields. These are good yields produced by skilled farmers. But these yields are not considered exceptional in the organic industry, and similar results are maintained by hundreds--thousands-- of organic producers around the country.

What these figures do not reflect are the other benefits derived by organic producers and the land: increased profit per acre, and improved soil quality as measured by soil structure, organic matter, biological activity, water infiltration and water-holding capacity. This translates to higher yields during drought under organic systems, leading to production stability year after year. Nitrogen leaching is reduced considerably under organic agriculture, leading to less water pollution—a major ecological issue all over the world.

This leads to an example of the kind of information Avery is willing to ignore. Avery denies the threat of massive fertilizer pollution such as the Gulf of Mexico's Dead Zone south of the Mississippi River Delta—5,500 square miles of water with so little summer oxygen that it is unable to sustain aquatic life. While ten federal agencies, nine states and Native American tribes are cooperating to reduce nitrogen and phosphorus run-off that ends

Continued on page 5

up in the Mississippi and the Gulf of Mexico, the Hudson Institute's Center for Global Food Issues pronounces, "There is no water quality crisis in the Gulf."[11].

Why does the Hudson Institute ignore this? Perhaps because the Environmental Protection Agency estimates that to eliminate the dead zone, nutrient flow into the Mississippi must drop by 40 percent. Under its new plan, nutrient input would be cut just 30 percent but even this would certainly cut into the profits of the agribusinesses that support Avery and his institute. If we follow the money, we find that among the top contributors to the Hudson Institute are Monsanto, Dow and Lilly—huge agricultural chemical and pharmaceutical companies.

The advantages and risks of high-input and organic agricultural production systems need to be considered by both farmers and consumers, by individuals and by nations. The choices are too important to leave the generation and dissemination of decision-influencing information only to those who have a direct financial stake in the outcome.

The issues before the Valley Forge conference—choices that involve survival of the world's resource base—are complex and must be considered from the personal perspective all the way to the international policy level. What kind of information is being made available to us and to policy-makers as we face these choices? What kind of information is being generated by our research institutions to help us decide? ■

If we follow the money, we find that among the top contributors to the Hudson Institute are Monsanto, Dow and Lilly—huge agricultural chemical and pharmaceutical companies.

Bill Liebhardt, a sustainable agriculture specialist at the University of California, Davis, directed the statewide UC Sustainable Agriculture Research and Education Program (SAREP) from its inception in 1987 until 1999. SAREP, now in its 14th year, was the first university-based sustainable agriculture program in the U.S.

A view from the field

After working in processing vegetable production for 25 years, and solely in organic for 13 years of those 25 years, here's a summation of my experience: It is the caliber of the grower which has the greatest impact on yield and quality. Find a good conventional grower and they will be a great organic grower once they have learned to manage the organic system.

All too often yield comparisons are made when growers are new to organic, when the ground is relatively new to organic practices, compounded with a lack of expert advice for a grower to turn to and lack of infrastructure to support organic growers. I think the conventional vs. organic yield comparison is deceptive unless you can find an experienced grower with both conventional and organic components to their farming operation and the grower has been in organic for at least five years and the yields for the first four years are not counted in the comparison. So often, university side-by-side yield comparisons are completed on ground where organic practices were utilized for just the period of the trial and often by staff with no or limited experience with organic practices. If organic had the same billions of dollars spent on it as conventional, I am sure yields and quality would be on a par with conventional.

But at the end of the day it's not about yields anyway, its about profit per acre. This is the mainstay of any accurate comparison.

Alec McErlich
Director of Agricultural Research and Development
Small Planet Foods

REFERENCES

1 Duffy M. Crop Yields and Net Returns from Long-Term Cropping System Comparison, Iowa State University (selected data are for years 1990-1997). In: Rick Welsh. Economics of Organic Grain and Soybean Production in the Midwestern United States, Policy Studies Report No. 13. Greenbelt, MD: Henry A. Wallace Institute for Alternative Agriculture, May 1999. p. 24.

2 Helmers *et al*. Crop Yields, Net Returns and Net Present Value for Selected Cropping Systems, University of Nebraska Study, 1978-1985. University of Nebraska. In: Rick Welsh. Economics of Organic Grain and Soybean Production in the Midwestern United States, Policy Studies Report No. 13. Greenbelt, MD: Henry A. Wallace Institute for Alternative Agriculture, May 1999. p. 32.

3 Smolik *et al*. Crop Yields by Study and Cropping System, South Dakota State University Experiment Station Trials, 1986-1992. South Dakota State University. In: Rick Welsh. Economics of Organic Grain and Soybean Production in the Midwestern United States, Policy Studies Report No. 13. Greenbelt, MD: Henry A. Wallace Institute for Alternative Agriculture, May 1999. p. 34.

4 Coch, R. Rodale Research Center. Personal communication. Data is for 1990-1999.

5 Harwood, R. Michigan State University. Personal communication. Data is for 1993 to 1999.

6 Riesterer J, Hall J. University of Wisconsin and the Michael Fields Center at East Troy, Wisconsin. Personal communications. Data at one site 1994-1999 and at other site1994-2000.

7 Temple S, Denison F. University of California Davis. Personal communication. Data is for 14 cropping years at two sites between 1992-2000.

8 Rosmann R. Ron and Maria Rosmann Family Farms, Harlan IA. Personal communication. April 20, 2001.

9 Stinner D. Yield Comparisons between Spray and Knox County Averages. Ohio State University, Personal communication, May 8, 2001.

10 McErlich A. Small Planet Foods, Sedro-Woolley, WA. Personal communication. April 13, 2001.

11 Avery DT. The World Can't Win a War Against Plant Nutrients. Presented before the Missouri Agricultural Institute, Columbia, Mo, Nov. 11, 1998.

followed shortly thereafter by: "two organic-pesticides alone accounted for over 23% of all U.S. agricultural pesticide use in 1997." Unfortunately, he erroneously ties these statistics to use on organic farms by saying, "These statistics raise important questions. With organic farming still representing less than 3 percent of total U.S. food production, what will happen to overall pesticide use if and when organic farming expands to supply a larger percentage of U.S. food?"

While the stated pesticide use rates are correct, that is because these "organic" pesticides are used heavily by conventional growers. Many conventional growers are seeking to use the least toxic materials available. According to the National Pesticide Use Database[2] website referenced in Avery's article, "oils" (refined petroleum products known as "dormant" or "summer" oils, used commonly on fruit trees and shrubs) are the most frequently used insecticides. Dormant oils, used to smother overwintering insects, are relatively benign, and are used widely in part because of their low toxicity. They are safe for humans and wildlife, and don't generally harm beneficial insects, which are not prevalent at the time they are sprayed. In other words, it is a *good* thing that dormant oil use is high among conventional growers, instead of something more toxic. Again, from the National Pesticide Use Database: 65% of all apple growers use dormant oils, 70% of all citrus growers, 97% of all nectarines are treated, 94% of all pears are treated, and 92% of plums. And a variety of other fruit trees are treated as well. But Avery draws a non-existent connection between the use of these oils and use by organic farmers (and potential increases in the future as the number of organic farmers increase). From the largest national survey of certified organic farmers in the country, published by OFRF in 1999, 65% of organic growers never use dormant or summer oils, 11% do so rarely, 13% do on occasion, and 11% do so regularly (of 1,032 responding)[3].

The amount of Bt used on organic farms is irrelevant when compared with the large acreages of genetically engineered Bt crops in production right now.

Sulfur, the next "organic" chemical on Avery's list, is also widely used in conventional agriculture. And Avery knows this, since again, the information is cited in his own article: 90% of blackberries are treated; 63% of cherries; 80% of all grapes; 58% of hops, 64% of peaches, 66% of raspberries, along with a wide variety of other fruits and vegetables. Again, sulfur is a relatively low toxicity fungicide and it's good that conventional growers are using it instead of other, more toxic compounds. OFRF's survey results show that 60% of organic farmers say they never use sulfur or sulfur-based materials, 14% rarely use them, 14% occasionally use them, and 12% frequently use them (of 1,046 responding).

Organic does not mean pesticide-free

Avery states, "Organic does not mean "pesticide-free," and makes the claim that toxicity is not important in determining which inputs are allowed, and that only origin of the input matters. While the origin of a material is one of the guides that determines whether a chemical is approved, disallowed, or restricted in organic crop production, to say that toxicity is not a factor is a blatant misrepresentation of the truth. Following are the criteria used by the National Organic Standards Board in evaluating substances that can be used in organic agriculture[4]:

The Act (7 U.S.C. 6518(m)) requires that the NOSB consider the following criteria for each substance evaluated:

(1) The potential of such substances for detrimental chemical interactions with other materials used in organic farming systems;

(2) The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment;

(3) The probability of environmental contamination during manufacture, use, misuse or disposal of such substance;

(4) The effect of the substance on human health;

(5) The effects of the substance on biological and chemical interactions in the agroecosystem, including the substance's physiological effects on soil organisms (including the salt index and solubility of the soil), crops and livestock;

(6) The alternatives to using the substance in terms of practices or other materials; and,

(7) Its compatibility with a system of sustainable agriculture.

This list of criteria is far-reaching and considerably different from those that guide traditional chemical use decisions. The certification process seeks to address sustainability so that organic agriculture does not just become the same old system with a different list of inputs. There is a focus on soil building, crop rotation, and other production practices that can enhance sustainability.

Next, Avery attempts to create an illusion of scandal by saying,"there is no way to determine the amount of use of Bt, the most heavily used pesticide on organic farms." The amount of Bt used on organic farms is irrelevant when compared with the large acreages of genetically engineered Bt crops in production right now (as of 1998 there were 14.4 million acres planted to Bt corn, 2.3 million acres planted to Bt Cotton, and .05 million acres planted to Bt potatoes). What is used on organic farms is miniscule in comparison and Avery knows this. According to the USDA Economic Research Service[5] there are only 1,346,000 certified organic acres in the U.S. Again, OFRF's survey results show that only 18% of organic growers use Bt regularly, 27% do on occasion, 12% rarely or as a last resort, and 43% never do. For Avery to make an issue of Bt from an environmental perspective is especially upsetting because the genetically engineered Bt (unlike the form organic farmers use) may have the potential to remain in the soil in its active form for long periods of time, and no one knows how soil biological communities may be affected[6].

Continued on page 7

What if the U.S. went all organic?

It's difficult to follow the line of reasoning that causes Avery to go from data that shows use of organic chemicals in predominantly conventional farming operations to: "Obviously, a switch to organic farming by a large number of U.S. farmers would result in a massive increase in U.S. fungicide use and significantly increased soil contamination." The assumption behind this statement is that organic growers would replace the amount of synthetic fungicides that conventional growers use with sulfur. First, he chose a compound for his example (sulfur) that is applied at a rate 30 times higher than synthetic fungicides (choosing the worse case scenario). Odd to choose sulfur when it is not even effective on most crop diseases.

To assume that organic farmers would substitute organic fungicides everywhere that conventional farmers use them ignores all of the data suggesting otherwise.

To assume that organic farmers would substitute organic fungicides everywhere that conventional farmers use them ignores all of the data suggesting otherwise, and ignores the other strategies that organic farmers use effectively to minimize disease. Organic farmers minimize disease through soil building (taking advantage of disease-suppressive soils and systemic induced resistance), crop rotation, cover cropping, cultural practices, resistant varieties, multi-cropping, and a variety of other production strategies. In fact, when ranking disease management strategies most frequently used, the OFRF survey results are in this order: Crop rotation (80%), disease resistant varieties (53%), compost or compost teas (38%), companion planting (22%), sulfur materials (12%), copper materials (7%), and solarization (4%). So, to say that organic growers would have to use the same amount of fungicide (or, per his example, 30 times more) as conventional growers is nonsense. Diseases are generally lower (but not always) on organic farms in the few comparative studies that have been conducted[7].

As far as soil erosion and organic agriculture goes, I cite an article in Nature by Reganold *et al.*[8] The authors conclude: "the organically-farmed soil had significantly higher organic matter content, thicker topsoil depth, higher polysaccharide content, lower modulus of rupture and less soil erosion than the conventional-farmed soil. This study showed that, in the long term, the organic farming system was more effective than the conventional farming system in reducing soil erosion, and therefore, in maintaining soil productivity." His study did not compare organic to no-till systems, but it is clear that the inputs of organic matter in organic farming systems yield some of the exact same soil quality results (that lead to the reduction of erosion) as no-till. I challenge Avery to show one scientific study where soil erosion was found to be greater on an organically managed farm than its conventional counterpart.

An article by Langdale *et al.*[9] compares the impact of cover crops on soil erosion in both till and no-till systems. Most of the time the impact of the cover crops is as great as the impact of no-till. Most organic growers do use cover crops, so the benefit of reducing soil erosion that no-till farmers receive, can also be received by organic farmers using cover crops and other organic amendments in their systems.

His final statement, "A major U.S. shift to organic agriculture would mean more pesticide use, not less; more toxicity, not less; and higher pressures on agricultural and other natural resources without any apparent offsetting benefits," just does not have any basis in fact.

Avery claims that the effectiveness of alternatives available to organic growers are minimal. We know this is untrue. Again, growers have been using a combination of these alternatives successfully for years. Proof is in the high quality, aesthetically pleasing, blemish-free, wide-range of organic products we find now in our markets and grocery stores. ■

Nancy G. Creamer is an Associate Professor and Director of the Center for Environmental Farming Systems, North Carolina State University.

REFERENCES

1 Avery A., Nature's Toxic Tools: The Organic Myth of Pesticide-Free Farming. www.cgfi.org/pdf/Natures%5FToxic%5FTools%2Epdf. Center for Global Food Issues, Churchville, VA, February 2001. 9 pp.

2 National Pesticide Use Database: www.ncfap.org/ncfap/indx.html.

3 Organic Farming Research Foundation. Final Results of the Third Biennial National Organic Farmers' Survey. Santa Cruz, California. 1999.

4 USDA National Organic Program website: www.ams.usda.gov/nop/nop2000/Final%20Rule/regtext/reg-natlist.htm

5 Greene C. USDA ERS April Ag Outlook: U.S. Organic Agiculture Gaining Ground. April 2000. www.ers.usda.gov/publications/agoutlook/apr2000/ao270d.pdf

6 Saxena D, Flores S, and Stotzky G. Insecticidal toxin in root exudates from Bt corn. Nature: 1999; 402:480.

7 van Bruggen, A.H.C. 1995. Plant disease severity in high-input compared to reduced-input and organic farming systems. Plant Disease. 79:976-984.

8 Reganold JP, Elliott LF, Unger YL. Long-term effects of organic and conventional farming on soil erosion. Nature:1987; 330:370-372.

9 Langdale et al. Cover Crop Effects on Soil Erosion by Wind and Water. In: Hargrove, W.L. Cover Crops for Clean Water. 1991. Soil and Water Conservation Society.

Policy Program Notes

by Mark Lipson, Policy Program Director

This has been an eventful year for OFRF's policy program. In addition to an extended medical leave for Program Director Mark Lipson (he's back now and everything is OK), we hired a Policy Program Assistant, launched the Scientific Congress on Organic Agricultural Research (SCOAR), established an internal structure for political lobbying, and continued our work on biotechnology issues, organic crop insurance, and other questions of national policy for organic farmers.

SCOAR glides into gear

Our biggest event was the **Inaugural Assembly of the Scientific Congress on Organic Agricultural Research** (SCOAR), held January 23-24 in Pacific Grove, CA. Under the theme, *Sewing the Quilt of Organic Knowledge*, the meeting focused on laying the foundations for a long-term organic research agenda. The meeting also included posters and writings about on-farm research results from farmers as well as professional researchers. A summary of the meeting is posted on the OFRF web site, and the full proceedings will also be posted there in the near future. On the following page we feature the meeting's opening statement by OFRF past president, Woody Deryckx.

SCOAR facilitators Kimberly Stoner and Mark Lipson shown leading the SCOAR Inaugural Assembly in Pacific Grove, January 2001. Nick Maravell (not shown) co-facilitated the meeting.

Participating members of the SCOAR Inaugural Assembly. The 100 attendees included farmers, researchers, information specialists and others.

SCOAR also played a role in the recent **Organic Tree Fruit Symposium** held May 30 in Colorado. This meeting featured research results from around the country on organic pome fruit production. SCOAR provided travel expenses for five growers to attend this meeting.

SCOAR's next event will be the **Second Assembly of the Congress**, on Nov. 4-5 in Rock Hill, South Carolina, held in conjunction with the **Carolina Farm Stewardship Association's** annual meeting. For more information, including applications for grower travel support, check the OFRF web site or call 831-426-6606. You can also enlist as a SCOAR participant and receive periodic bulletins about the project by filling out the participant form on the web site or emailing scoar@ofrf.org.

National policy stew

This spring the OFRF Board of Directors decided to establish the capacity for OFRF to conduct political lobbying activity by filing a **"501-h" option** with the IRS. This places us within a specific set of rules defining what counts as "lobbying," how this activity is documented and how much of our budget can be devoted to it. So far we have not activated this capacity, but we will probably begin to do so this fall.

A number of important areas of national policy that directly affect the organic farming sector are clamoring for our attention. These range from USDA agency actions (national organic rules, crop insurance, disaster payments, organic transition research) to Congressional proposals for major intervention in organic agriculture (certification cost-sharing, transition subsidies, new research programs). The new administration in Washington hasn't done much yet in the agricultural area (except some crisis management around foot-and-mouth disease) but we expect that will change soon. While our primary focus will remain on those matters closest to our research mission, we will continue to monitor other areas of national policy and take action when and how we can.

New Program Assistant

In June we hired **Brise Tencer** as a part-time Program Assistant. She is actually trained in agricultural policy, and will be finishing her Master's Degree at the Monterey Institute for International Studies this Fall. We are very glad to have her on board and learning the ropes.

Biotechnology policy

In March the Board of Directors adopted a new policy statement (previewed in our last *Information Bulletin)* on biotechnology. Mark has continued his service on USDA's **Advisory Committee on Agricultural Biotechnology** (ACAB), which has met in Washington, DC twice so far this year. ACAB's 38 members have not been able to agree on very much. However, the committee recently adopted a position paper on revitalizing the public plant-breeding programs that have withered in the last decade as molecular plant breeding in the private sector has dominated the field. This is an important development that could have significant impacts down the road. The paper will be posted at http://www.usda.gov/agencies/biotech/acab/meetings/acab_mtg_8-01.html, or you can call Mark Lipson at OFRF for a copy.

The ACAB continues to struggle and argue about the complex questions related to "gene flow" and trace levels of GMO

Opening statement by Woody Deryckx to SCOAR's Inaugural Assembly, January 23-24 in Pacific Grove, California.

As an organic farmer and the president of the Organic Farming Research Foundation, I just want to extend a personal, very enthusiastic and warm welcome to you all for coming here. You are making history today and tomorrow, embarking on an extremely revolutionary act and it's a darn good thing. Our task before us is nothing less than to frame a new agenda of research, not just to support organic farming and organic farmers, but also to accompany a whole new vision of agriculture for the next century, which will gain dominance in the next century. That is a vision of agriculture based on ecological principles, agroecology.

It is absolutely vital for us not to allow new resources devoted to organic agricultural research to be squandered just on input substitution and organic certification standard compliance, and continue to reside within the paradigm of industrial agriculture. Our mission is far greater than that. It is vitally important that we reach far and achieve building a foundation for really ecological agricultural research. As we do so we need to keep in mind that we are prioritizing how we address our limited resources in beginning this process.

At the Organic Farming Research Foundation, we do this by asking farmers with our surveys. It is really important, I want to point out, that as well as asking for research on practical matters such as controlling weeds without chemicals, the organic farmers that OFRF has surveyed have stressed over and over again, value-oriented, systems-approach questions like, "What are the effects of various management practices like crop rotation, soil amendment use and tillage regimes on soil quality? And the ecological factors of the microbes in the soil?" And in turn, "What effects do these have on the nutritional value of the produce that we produce? And on the abilities of our crop plants to withstand pressures of insects and pathogens?" So it's important for us to keep an eye on the big picture, and in addition to prioritizing like that it's important for us to consider the methods with which we conduct research, because in going for the big picture, the interconnections of an ecological examination of agroecosystems, it is probably very important for us to leave behind a lot of the reductionist, simplistic approaches to methods and experimental design and probably pave new pathways in methods and the ways we measure and evaluate our data as well.

The settings in which we conduct our research are very important, since organic farms operate very differently in the ecological sense compared to the farms of the industrial paradigm. They have to be studied in an appropriate setting, which is on certified organic farms. We can't expect to learn about organic farming on farms that have been subjected to industrial practices of soluble salt fertilizers and toxic technology.

Lastly, it is really important that we adhere to holistic and far-reaching methods of evaluating the results that we have, far more reliance on interdisciplinary approach and different and more diverse methods of evaluating the effects, because we are here to not only produce more organic bushels of wheat per acre, but also to produce better soils and better communities and more stable and secure families on the landscape. So biological diversity and things like that are the kinds of things we're going to be measuring, as well as productivity.

So it is a wonderful opportunity that we have. I invite you to approach this work with tremendous dedication and sense of purpose, face the obstacles that lie before us with a lot of courage, and celebrate the accomplishments that we're going to see with a lot of joy. This is a very important and good thing that we are doing. Thank you for coming.

Woody Deryckx, OFRF past president, is a certified organic farmer in Malin, OR, and serves as Executive Director of the Klamath Basin Ecosystem Foundation. Woody also serves as a member of the SCOAR project Steering Committee.

contamination in seeds, crops and handling channels. The seed trade representatives are looking for endorsement of a tolerance for "adventitious presence" of GMOs in non-GMO seed, of at least 1% and perhaps as much as 5%. The international shippers of grain products are asking for some type of standard to allow trace levels of GMOs in non-GMO grain. Organic growers and processors are mostly feeling that they are between a rock and a hard place: the process-based language of the National Organic Program requires that GMOs not be used, but even so there are buyers in Europe and elsewhere that insist on zero-presence of GMOs, even if the farmer did not use them. The organic industry is mostly opposed to establishing allowances for the presence of GMOs, feeling that this will remove responsibility of the GMO manufacturers for contamination that their products are causing. Look for this to be a hot issue in the future. ■

State of the States Update

State of the States: Organic Farming Systems Research at Land Grant Institutions 2000-2001, was released by OFRF earlier this year. Response to the report has varied from enthusiasm at having a clearly defined starting point, to dissatisfaction at perceived inaccuracies or omissions. We intend to update the publication as the quantity of information warrants; in the meantime, this column will provide immediate corrections, additions, and updates on the organic farming resources listed in the full report (available through our website or by contacting our office).

We remain interested in learning about any organic farming research, extension, or educational effort being conducted anywhere in the world, whether or not it is part of the U.S. land grant system. We encourage readers to tell us about projects not listed here or in the full report. In the future, we may expand the scope of this report to include private institutions, state and community colleges, Native American colleges, and/or international research entities.

What counts

In the report, we focused on research, extension, and educational activities that had identifiable organic content. Some researchers took issue with this narrow focus and described how their work, though not always 100% organic, could still benefit organic farmers.

An article printed in Maine's *Bangor Daily News* quoted University of Maine weed scientist Eric Gallandt as saying, "There are a lot of university projects out there that may not necessarily be primarily for organic growers, but certainly the research can be used and will benefit the organic community."

R. Ford Denison, director of the Long-Term Research on Agricultural Systems project (LTRAS) housed at the University of California--Davis, provides the following examples of such work: "The discovery that wild potatoes produce aphid alarm pheromone when injured doesn't immediately help either conventional or organic farmers, but this information could be used to develop aphid-resistant cultivars...Among my most important current research is trying to figure out what controls the evolution of rhizobia towards higher or lower nitrogen fixation rates. Neither conventional nor organic farmers would benefit immediately by reading my current work on the topic, but this work suggests that 1) rhizobia may be working at only a fraction of their potential, 2) it may be possible to breed legumes that selectively favor better rhizobial strains."

Practical concerns arise when one sets aside the criteria that we used of "work presented in an organic context" and attempts to document all research that may possibly be useful to organic producers. Undoubtedly, much work on cover cropping, rotations, green manures, and biological control can be applied to organic farming systems. But our task was not to compile a compendium of work that might possibly be used by organic farmers, it was to specifically identify work being done in an organic context. What kind of criteria might we use if we were to try to do a more general survey of research with possible value to organic growers?

Denison has some ideas on this point as well, suggesting four categories of research:

1) farmer-ready research most relevant to organic farms;
2) farmer-ready research most relevant to conventional farms;
3) farmer-ready research equally relevant to conventional and organic farms;
4) basic research.

"Only a fraction of important agricultural research is farmer-ready," Denison adds, "in the sense that the average farmer can read the paper and immediately apply it. It is unfair to compare farmer-ready research targeted at organic farmers with the total of the other three categories."

We appreciate researchers from Maine and California bringing up these concerns and invite other comments on this issue.

Omissions:

Nebraska

Research, production: A long-term comparison study was initiated in 1975 by agronomist Warren Sahs. Originally a comparison between 4-year rotations and continuous corn, the 4-year rotation was managed either conventionally, with chemical fertilizer only, or organically with cow manure only. The trial has been managed by agronomist and professor Charles Francis since 1985. The rotation treatments have been modified over the course of the experiment. The crop sequence in the rotations varies depending on system management. Weed counts were taken over a course of five years and weeds were found to cycle along with the crops in the rotation. Heavy foxtail growth in the corn years was almost entirely controlled with fall planting of wheat and was absent during the soybean year. Half of the 15-acre experiment, or 7 ½ acres, are managed organically though not certified because of the use of chemicals in the conventional plots. Contact Charles Francis, Dept. of Agronomy, 225 Keim Hall, Univ. Nebraska, Lincoln, NE 68583-0910; phone 402-472-1581; e-mail cfrancis2@unl.edu.

New Jersey

Research, economic/consumer: Part of the Rutgers Extension crop budget website includes an interactive "Smart Form" that allows growers to enter their variable and fixed costs of production and their receipts to calculate net returns for each crop. Organic is one of the three production methods that can be selected on the form: http://aesop.rutgers.edu/~farmmgmt/ne-budgets/SmartForm.html

New York

Research and funding source: In 1997, Anu Rangarajan of Cornell's Dept. of Horticulture formed an organic advisory council to advise the university on organic research needs, struc-

tured on the model of a commodity advisory group. A private donation to Cornell professor of horticulture Ian Merwin and Rangarajan has enabled them to organize and fund a competitive grants program for the past two years to support organic farming research in New York state. $40,000 was disbursed in 2000 and $45,000 in 2001. Funding is open to Cornell faculty, students, staff, extension educators, and New York farmers, with 25% of the total reserved to fund student-initiated or -led projects. The results of the funded projects will be posted on the web and have been printed in a booklet, "Summary reports for New York research projects in organic agriculture." Contact Ian Merwin, phone 607-255-1777, e-mail im13@cornell.edu, or Anu Rangarajan, phone 607-255-1780, e-mail ar47@cornell.edu.

Errors:

New York

The Cornell student farm, Dilmun Hill, is not certified organic by the Northeast Organic Farming Association-New York.

Colorado

Max Shane is the manager of the Western Colorado Research Station at Rogers Mesa, rather than Rick Zimmerman as reported, and Al Gaus is no longer with the station. Rick Zimmerman will be taking over the organic fruit project started by Gaus.

Montana

Research, production: The rotation study described did not include organic plot acreage. The large on-farm study in Moore, Montana, includes a comparison trial between high-input and low-input no-till and organic cropping systems. Spring 2000 was the first growing season of the trial. The researchers are documenting changes in agronomic characteristics, soil characteristics, and pest populations over time. They are especially wondering if they'll see an increase in weeds when using low or no inputs versus high inputs in a no-till system. The organically managed plots at the on-farm location in Moore total 0.66 acres. A smaller version of the study is being done at Bozeman, where 0.44 acres are managed organically. Annual reports on the study will be posted on the Montana State University weed science website at http://www.weeds.montana.edu/research/spm-summary.htm

New material:

Florida

Education: The Florida A&M University College of Engineering Sciences, Technology and Agriculture offered a Small Farm Organic Workshop on August 25, 2001, with a focus on hands-on, how-to-do-it organic agriculture. For additional information, contact J. Taylor, Coordinator Small Farm Programs, College of Engineering Sciences, Technology and Agriculture, Florida A&M University, Tallahassee, Florida 32307, 850-599-3546. http://www.foginfo.org/events.htm

Georgia

Extension publication: Suggestions for Organic Blueberry Production in Georgia, by Gerard Krewer. May 2001. University of Georgia Fruit Publication 00-1. http://www.smallfruits.org/Recent/00organi.htm.

Maine

Research, production: A SARE-funded cropping systems trial was initiated at the University of Maine's Rogers Farm in 2000 that compares three organic cover cropping strategies with a conventional rotation of broccoli and winter squash. Cover crops are being managed to optimize weed control and reduce reliance on tillage in the organic systems. Soil quality parameters are also being monitored. Farmers participated in planning the organic treatments. Contact Eric Gallandt, weed ecologist, phone 207-581-2933, e-mail gallandt@maine.edu.

Maryland

Research, production: Sites ranging in size from 1 to 7 acres have been identified at 7 research stations in Maryland that will be put through the transition to organic, then be permanently managed as organic research sites. An in-house competitive grants program administered by the College of Agriculture and Natural Resources will disburse funds to support organic farming research at these sites. The sites are representative of the range of climates and soils found in Maryland, from the Atlantic Ocean to the mountains. For more information, contact Tom Simpson, Chesapeake Bay program coordinator, Univ. Maryland, phone 301-405-5696, e-mail ts82@umail.umd.edu, or Jim Hanson, Extension Economist, phone 301-405-8122, e-mail jhanson@arec.umd.edu.

Minnesota

Extension publication: Organic Certification of Crop Production in Minnesota, by Lisa Gulbranson, revised in 2001, from the Minnesota Institute for Sustainable Agriculture in cooperation with the University of Minnesota Extension Service. May be ordered for $3 plus $2 shipping by calling 800-876-8636, or mail check to University of Minnesota Extension Service Distribution Center, University of Minnesota, 1420 Eckles Avenue, St. Paul, MN 55108-6069. Checks payable to University of Minnesota; state residents, add 7% sales tax. http://www.extension.umn.edu/distribution/cropsystems/DC7202.html. "This 40-page publication is a detailed and comprehensive description of the organic certification process. Although the information is specific to Minnesota, the concepts are applicable across the region."

Mississippi

Extension publication: Organic Vegetable IPM Guide, by Pat Harris, James H. Jarratt, Frank Killebrew, John D. Byrd, Jr., and Rick Snyder. Feb. 2001. http://msucares.com/pubs/pub2036.htm.

Washington

Researchers Carol Miles and Martin Nicholson at the Washington State University Vancouver Research and Extension Unit gained certification on 2.1 acres for vegetable crop research. The land is certified by the Washington State Department of Agriculture. Carol Miles, phone 360-576-6030, e-mail milesc@wsu.edu, website http://agsyst.wsu.edu. ■

Board member profile

Ron Rosmann, third generation farmer, and still a pioneer

by Melissa Matthewson

Wes Jackson, in an essay printed in *Meeting the Expectations of the Land,* quotes Wendell Berry describing the harmony of agriculture as similar to "...the craft of the mud daubers which, as they trowel mud into their nest walls, hum to it, or at it, communicating a vibration that makes it easier to work, thus mastering their material by a kind of song."

When talking to Ron Rosmann recently about his organic farm in Iowa and his history in the movement of organic agriculture, I could not help but think of the testimonial, "mastering their material by a kind of song" — a graceful and fitting description of Ron's approach to farming.

Growing up on the same farm that he now manages, Ron watched as his father experimented with organic practices such as crop rotation and diversity. After college, when Ron took to farming himself, he sensed that organic was the right way to farm. But when he began looking into alternative growing practices for his soybeans in 1983, he was initially afraid of the word "organic." At that point, there was not much information on such practices, although one of the best resources he found at the time was the Nebraska Sustainable Agriculture Society.

Left: Ron Rosmann, (standing with arms folded) regularly opens his farm to visitors through field days, which are very popular and well-attended.

As a founding member of the Practical Farmers of Iowa in 1986, a group formed with the purpose of doing research on the farm, Ron explained that at the time, "organic" meant a "narrow" approach to farming and it was considered "off the wall." A long time friend, farmer and neighbor of Ron's, Denise O'Brien says, "A lot of people were skeptical of Ron in those days. When you grow up in a rural community and you start to do something different, people think you are radical and might not respect you. It's changing now because he's been farming successfully for a long time and has gained some credibility in his community."

Ron has come a long way since then, and now runs, with his wife, Maria and three sons, a successful 600-acre certified organic farm in Shelby County, growing a variety of crops from corn, oats and soybeans to rye, barley and turnips. Ron and Maria also run a cow-calf operation of 90 cows (Red Angus and Simmiental cross) and are involved in both ends of the meat processing business. Ron is currently working on getting their chickens certified organic and he identifies the next challenge as "working to get the hogs certified."

There have been a number of struggles and challenges as a farmer — one in particular particular is locating markets for his beef and crops. "There was a lack of markets in the early days," said Ron. "I was one of the first ten members of the Heartland Organic Marketing Cooperative in 1993 and we were marketing soybeans at that time." Currently Ron and Maria are selling their beef under the Rosmann Family Farms label in Des Moines and surrounding regions of Iowa, emphasizing the importance of local food consumption.

Ron's success as an organic farmer can be seen in some of his distinctive growing practices. He explained that they use a form of no-till farming called ridge tillage. They have experimented with randomized, replicated trials on their farm and found that the results are similar in each: there are 7-10 times fewer weeds in the no-till beds. Another unique strategy is allowing the cows to forage on the greens and bulbs of turnips that are grown as a cover crop—which serve as an effective feed source when the pastures are losing their steam. Also, in their cow-calf operation, the Rosmanns fervently support the use of rotational grazing.

As a pioneer organic farmer and a leader in the preservation of small family farms, Ron emphasizes the importance of talking to other farmers and gaining more knowledge and experience with cultivation and management issues.

Ron identifies his parents as the source of inspiration for his farming and his leadership in the organic agriculture movement. "We were brought up feeling that we had a social responsibility. My father owned 800 acres and rented out parts of that land to beginning farmers in the community. My father didn't have to do that, but he did."

Ron has served on the OFRF Board since 1997. As the newly elected president of OFRF, Ron's leadership and guidance will continue to have an impact on organic agricultural systems and research. As Ron explained to me, he "hopes to change mainstream agriculture and continue to support the small family farmer." ■

Right: Ron & Maria Rosmann Family Farms is on 600 acres of rolling land in west central Iowa.

College farm turns food waste into multi-purpose resource

Food residuals are an under-utilized resource as a compost feedstock, and most are handled as a waste product and sent to landfills. On-site composting of food wastes, especially where farm or garden facilities exist close by, are a key means of closing energy and resource loops. In 1998 Sean Clark, Greenhouse Manager at Berea College, spearheaded an on-campus food residuals composting program, and evaluated several usage scenarios of the finished product to help determine values of this resource to the College and the College Farm. —EW

Berea College, a small liberal arts college in eastern Kentucky, operates a College Farm comprised of 200 acres of row crops, 400 acres of pasture and hay land, and a greenhouse and garden area that includes five acres of certified organic farmland and two greenhouses. The greenhouses produce ornamentals and vegetables, which are sold locally to support educational activities. The farm produces salad greens year-round and fruits, vegetables, herbs, and flowers for a 35-member community-supported agriculture (CSA) program during the summer months. The College Farm program averages 100 student majors each year.

In the fall of 1998, students developed an on-campus pilot food residuals collection and composting program. The primary goals of the project were to reduce waste, generate compost and to improve the overall sustainability of the campus. Additional objectives included measuring the value of compost as a heat resource for the on-campus greenhouses, and assessing the compost's value as material for a seed-starting mix for the farm operation.

The collection system

The Berea College food service facility feeds about 1,200 students during the fall and spring semesters and about 200 during the summer session. The estimated amount of pre-consumer waste generated per capita is about one-quarter pound per day.

Food collection begins with two 40-gallon plastic buckets placed in the campus kitchen—one in the preparation area and one next to the washing sink. Kitchen workers put all food waste in the buckets while trying to minimize the amount of non-organic waste such as plastic wrappers and gloves. Buckets are collected every day, emptied at the gardens and greenhouse, washed, and returned to the kitchen.

Over the course of a year the estimated yield is over 30 tons (wet weight) from the kitchen facility. Peelings, seeds, and bruised or spoiled produce typically comprise a significant portion of the waste collected. Considerable amounts of grain products, such as bread, pasta, and rice, that are prepared but not distributed to students, are also found in the waste.

Processing the waste

Once the food waste is collected it has a number of uses in the gardens and greenhouse area including:

1) a source of heat in a greenhouse during the composting process;

2) a feed for the farm's small livestock (chickens, ducks, and geese);

3) a raw material for compost that is high in nitrogen and water; and

4) a soil amendment or potting mix substitute after the composting process is completed.

Summer regime. During warmer months the food waste is either fed to

Project leader: Sean Clark, Assistant Professor and Greenhouse Manager, Department of Agriculture and Natural Resources, Berea College, Berea, Kentucky ✦ **OFRF support:** $1,100 ✦ **Project No.** 99-40 ✦ **Additional support provided by:** Appalachian College Association ✦ **Project period:** 1999 ✦ **Reported:** April 2000

Students at Berea College add collected food waste to spoiled hay for composting...

...and process compost made from food waste and hay to be used in potting mix.

mixed poultry flocks or composted directly. The poultry are maintained in mobile bottomless cages ("chicken tractors") or rotationally grazed using portable electric fencing. For composting, the food waste is mixed with dry materials that are high in carbon such as straw, wood shavings, or landscape wastes from campus.

Each day the food waste is layered with straw, leaves, or wood shavings. Once the piles are 5-7 feet wide at the base and 2-3 feet high, the temperatures are monitored and the piles turned with a front-end loader as necessary to reach and maintain temperatures of 150°F or more for several weeks. Water is added as needed during the process but the food waste usually contains adequate moisture to reach high temperatures. After the heating period the piles are allowed to cool and cure for several months with occasional turning and watering.

Winter regime. During colder months, compost and poultry are moved into one of the glass greenhouses. An area approximately 500 ft.^{2} is fenced off for the poultry providing about 15 ft.^{2} per bird. Food waste is brought to this area to feed the poultry and build the compost piles. The amount delivered is far in excess of what the birds can eat so only a small fraction is actually processed through the birds. However the birds help to mix and stir the carbonaceous materials in with the food which facilitates the composting process. Once a compost pile is of sufficient size (2-3 weeks) it is turned and moved into the larger greenhouse area.

Greenhouse Heating Experiments

Metal-mesh tables are placed over the piles and seeded planting flats are then set on the tables. The heat generated during the composting process, as well as that produced metabolically by the poultry, serves as a fossil fuel substitute in promoting seed germination and plant growth. A back-up heating system using natural gas is used only rarely when the greenhouse temperature drops to 32°F (0°C).

Energy Savings. Following the initiation of the compost-supplemented heating operation in the experimental greenhouse in mid-January, analysis of fuel use showed that fuel use in the experimental greenhouse supplemented with compost-generated heat was less than 5% of that in the control greenhouse (Fig. 1).

The thermostat in the experimental greenhouse was set at 32°F (0°C) to prevent snow or ice accumulation on the glass or frost formation on the plants while the composting experiment was in progress (mid-January through early May). During this period the experimental greenhouse used only 136 m^3 of natural gas while the control greenhouse used over 4000 m^3. Air temperatures in the experimental greenhouse often dropped to near freezing, especially at sunrise, but soil temperatures in the flats on tables above the active compost piles could be maintained high enough for rapid seed germination (data not shown). And once germination had occurred the plants could tolerate air temperatures just above freezing.

Fuel use in the experimental greenhouse supplemented with compost-generated heat was less than 5% of that in the control greenhouse.

Estimating baseline usage. The energy savings from the use of compost-generated heat was estimated by comparing baseline natural gas use during the 1998-1999 winter season between the experimental and control greenhouses. With the thermostats of both greenhouses set at 65°F (18°C) from October through December, the experimental greenhouse, prior to adding supplemental compost heat, used 20% less fuel than the control, when both greenhouses were heated solely by natural gas. We therefore determined that the experimental greenhouse would normally use about 80% of the fuel used by the control.

Potting Mix Trials

Finished compost was evaluated as a partial and full substitute for commercial

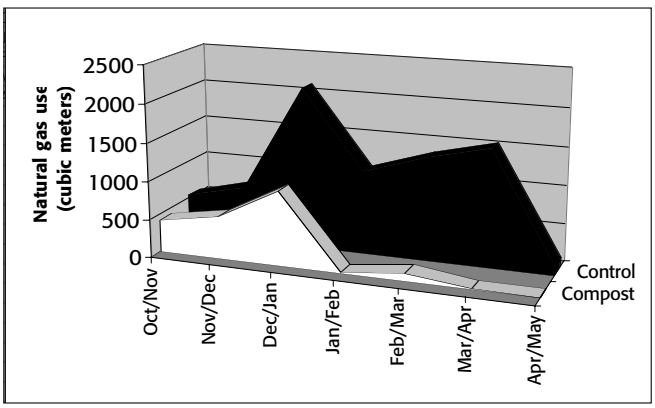


Fig. 1. Natural gas use during the 1998-1999 winter in the experimental greenhouse heated by composting (compost) and the adjacent greenhouse heated with natural gas fuel (control). The composting operation in the experimental greenhouse began in mid-January, 1999.

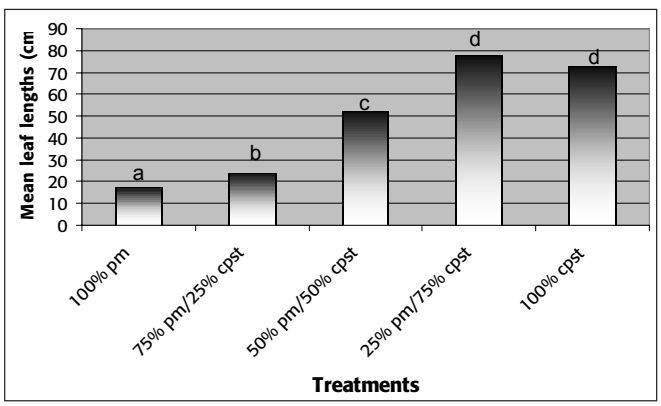


Fig 2. Leaf lengths of lettuce grown in mixtures of commercial potting mix (pm) and compost (cpst) made of food waste from Berea College food service. Leaf lengths were measured 36 days after planting. N = 5 replicates for the 5 treatments; ANOVA on ranked data and Student-Newman-Keuls test for mean separation, $P < 0.05$.

Above:
Planted flats placed above an active compost pile in the greenhouse for germination. Floating row cover is placed over the top to keep in the compost-generated heat.

Right:
Representative flats from the bibb lettuce trial showing differences among the five potting mix (pm) and compost (cpst) seed starting treatments. Front row, left to right, these are:

1)100% pm;
2) 75% pm/25% cpst;
3) 100% cpst;
4) 50% pm/50% cpst;
5) 25% pm/75% cpst

potting mix in two replicated trials in lettuce. The first trial evaluated the relative effects of five "soil" treatments, representing different mixtures of commercial potting mix and compost, on the germination and growth of lettuce (Green Bibb). Results showed that mixtures with up to 75% compost had no significant effect on percent germination or germination rates but that 100% compost resulted in slower germination. Lettuce growth, measured as leaf lengths 36 days after planting, showed that any amount of compost substituted for the commercial potting mix improved growth. Moreover, the treatment with 75% compost and 25% commercial potting mix demonstrated the fastest growth over the 36-day period (Fig. 2).

In the second trial only three treatments were assessed and 'Red Romaine' was used as the test-lettuce variety. This trial also demonstrated that the use of 100% compost resulted in slower germination than either a potting mix-compost mixture or 100% potting mix. Further, it demonstrated that a 50%/50% mixture of commercial potting mix and compost or the use of 100% compost resulted in faster lettuce growth, measured 37 days after planting.

Overall, these trials indicate that the use of 100% compost as a potting mix substitute will result in slower, and perhaps slightly lower, germination due to variable texture, which apparently leads to inconsistent soil-to-seed contact or uneven wetting. However, as a media for plant growth, the compost is superior to the commercial potting mix. Results suggest that substituting compost for 50-75% of commercial potting mix should result in improved plant growth without reductions in percent germination or germination rates.

Using the Compost

The compost has been used as a soil amendment to build fertility in the garden area and as a substitute for purchased commercial potting mix for starting vegetable transplants. The nutrient composition is comparable to commercial composts on the market (Table 1). Based on the estimated amounts of food waste generated at Berea College, the compost produced (=5 tons per year) should be adequate to replace all nutrients currently exported from the gardens as vegetables, fruits, and flowers, thus eliminating the need to purchase manure, compost, or fertilizer.

Table 1. Nutrient composition of finished compost (on a dry-weight basis) produced from Berea College pre-consumer, food-service waste, 1998-1999.

Element	Content (%)	Pounds of Nutrients/Ton
Nitrogen (N)	2.38	47.6
Phosphorus (P)	0.62	12.4
Potassium (K)	1.13	22.6
Sulfur (S)	0.40	8.0
Magnesium (Mg)	0.48	9.6

Economics

The economics of collecting, composting, and using the food waste from Berea College food service was initially assessed based on costs of acquiring and processing the waste and the value of the nutrients obtained. The costs included labor paid at $7.00 per hour and equipment (40-gallon, plastic buckets, dolly, and pitch fork) depreciated over 5 years. The value was determined based on plant-macronutrient content (nitrogen, phosphorus, potassium, sulfur, calcium, and magnesium) with all

The treatment with 75% compost and 25% commercial potting mix demonstrated the fastest growth over the 36-day period.

Substituting compost for 50-75% of commercial potting mix should result in improved plant growth without reductions in percent germination or germination rates.

macronutrients assumed to have equal value. It was also assumed that one-third of the nitrogen would be lost during the composting process, and this amount was subtracted from the estimated total nutrient content.

The estimated cost for the plant macronutrients collected was $1.76 per pound. If the savings in natural gas use are factored into the equation the cost-benefit analysis for the collection, composting, and use of the food waste is extremely favorable. The use of the compost heating system in the experimental greenhouse saved over $900 in fuel costs from mid-January to early May. This exceeds the total food-waste collection costs for an entire year by over $100. Thus, the collection of the food-waste as a source of plant nutrients is essentially free when the savings in natural gas use are considered. Additional benefits not factored into this analysis include the improvements to soil tilth from compost applications and the reduction in solid waste generation at Berea College.

❋

Sean Clark's complete project report: *Development of a biologically integrated food waste composting system* (Project #99-40) is available from OFRF by mail or by visiting our website at www.ofrf.org. The complete report is 8 pages, including 5 figures, 1 table and references.

In Context

A lowdown on food residuals

BioCycle magazine has collected data on trends in food residuals composting for more than five years. Their food residuals "census" distinguishes between on-site and off-site projects—on-site projects are not as highly regulated, and tend to process 100 tons or less per year, whereas off-site projects may process in the thousands of tons. In 1995, fifty-eight food residuals composting projects were counted in the US, and by 1999 this number had increased to 250, split just about in half between on-site and off-site programs. BioCycle cites a changing regulatory climate, the piggy-backing of food residuals onto existing yard-trimming sites and a growing market for compost as among the reasons for this increase.

Food waste was collected at the 2000 Olympics in Sydney, Australia, totaling a projected 4-5,000 metric tons. It is increasingly common for schools, prisons, hospitals, restaurants, conference centers, and public event organizers to gather food wastes for processing into compost.

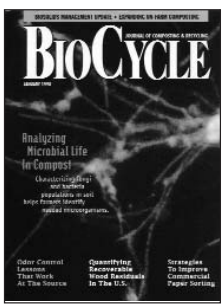
For institutional leaders interested in turning food residuals into a compost resource, the regulatory climate in some states can be quite favorable. In particular, regulations tend to be less stringent for sites taking only pre-consumer materials. In other cases, on-site projects at institutions and restaurants can fall into an on-site "exemption" status. Some states impose a quantity limit within this category.

There is a also a good web page that contains a state-by-state summary of permits and requirements for establishing a composting facility and marketing compost. For example, for California, the CA Integrated Waste Management Board contact is listed with a brief description of current regulations. Each state is listed with a link to that description and contact. The link is: http://www.recycle.cc/compostregs.htm.

For further details on food residuals, one can subscribe to BioCycle, or refer to their website: www.biocycle.net for related articles. In general, we highly recommend this publication for the latest information on the compost industry--where it is today, and where it's headed.*—EW, JS, & MM*

BioCycle *(JG Press, Emmaus, PA, 610-967-4135 or www.biocycle.net). Annual subscriptions for 12 issues are $69.*

BioCycle also sponsors east, midwest and west coast conferences.



Project update, Spring 2001: Adding post-consumer content to the mix

Berea College's food residuals pilot composting project has been so successful, organizers have now added post-consumer waste recovery to the program. The cafeteria's foodservice contractor, Marriott Corporation, while originally reluctant, has been very cooperative. They've agreed, for example, to order condiments (ketchup, mustard, creamer, etc.) in bulk rather than in packets, to reduce overall waste and the potential for contamination of the post-consumer food residual stream.

The program is now processing a total of 700-800 lbs of food wastes per day, about 45% of which is pre-consumer and 55% post-consumer—which includes both food wastes and napkins. The number of kitchen staff has remained the same. While it remains a challenge to get campus diners to change their disposal practices, signage and educational efforts are making headway. Overall, the program processes an estimated 100 tons of food waste per year.

Berea College student using a post-consumer food-waste collection bin in the school cafeteria.

Balancing soil nutrients in organic vegetable production systems: Testing Albrecht's base saturation theory in southeastern soils

William Albrecht was a soil scientist at the University of Missouri in the 1920s-50s whose theories on soil nutrient balancing are strongly influential in ecological agriculture today. Clay and humus particles in soil carry a negative electrical charge, which can attract and hold positively charged atoms (cations) on their surfaces. The cation exchange capacity (CEC) of a soil measures the strength of negative charge in the soil and represents the amount of cations it can carry. Cations such as calcium (Ca), magnesium (Mg), potassium (K), sodium (Na), and hydrogen (H) are important crop nutrients and also influence soil's physical properties. Ca, Mg, K, and Na are the most common cations in most soil systems and are referred to as the "base cations." Albrecht theorized that there is an optimum base saturation ratio, or proportion of sites occupied by these cations, for ideal crop yields and soil structure. Albrecht's recommended ratio was 60-75% Ca, 10-15% Mg, 2-5% K, 0.5-3% Na, and about 10-15% H. Agronomist Neal Kinsey is one of the best-known advocates of Albrecht's nutrient balancing system today. In this study, Mark Schonbeck experimented with changing the base saturation ratios at five organic on-farm research sites and measured the effects on crop production, quality, and numerous soil traits. —JS

The goal of this project was to determine whether an unfavorable balance of potassium (K), sodium (Na), calcium (Ca) and magnesium (Mg) in the soil might be limiting vegetable production on some organic farms in the southeastern U.S.

In Virginia and other southeastern states, many cultivated soils show Ca base saturation below Albrecht's recommended optimal ratio of 65%, with Mg and/or K well above their recommended ranges. This imbalance is believed to "tighten" the soil and degrade crumb structure, hamper aeration and drainage, cause surface crusting and hardpans, inhibit beneficial soil organisms and humus formation, aggravate weed, pest and disease problems, and generally harm crop and livestock health. Applications of high calcium lime or gypsum to restore the balance are claimed to correct these problems; to enhance soil biological activity and organic matter levels; to increase availability of phosphorus (P), nitrogen (N) and other nutrients; and to improve produce flavor, nutritional value and shelf life.

Many soil scientists, including some proponents of organic and sustainable agriculture, reject the base saturation ratio approach to soil management as unnecessary and potentially wasteful[1,2,3] (also communicated to me in 1999 by Raymond Weil, Professor of soil science at the University of Maryland). They cite a lack of evidence that Ca amendments benefit either crop yields or soil physical properties sufficiently to justify the costs, except when liming is required to correct soil pH. Farm consultants who use the Albrecht formula have not produced hard evidence in the form of replicated field trials, yet they report a high degree of grower satisfaction with application of this approach to their farms[4,5,6]. This also has been communicated to me by Virginia-based agricultural consultants Carl Luebben and Reid Putney.

Project leader: Mark Schonbeck, Virginia Association for Biological Farming, Floyd, VA ✦ **Cooperating farms:** Dayspring Farm, Screech Owl Farm, Seven Springs Farm, Abundant Dawn Farm, Holley Creek Farm ✦ **OFRF support:** $2,000 (1998); $5,600 (1999); $6,000 (2000) ✦ **Report No(s).** 98-16, 99-05, 99-40 ✦ **Reported:** December 2000 **Additional support provided by:** Southern Region SARE Producer Grant Program, Soil Foodweb, Inc. ✦ **Project period:** 1998-2000

Materials and Methods

Replicated field trials were established in 1998 at five organic vegetable farms in Virginia and eastern Tennessee. Low-Ca and high-Ca treatments were replicated three times at each site. Plots received four experimental amendment applications between spring 1998 and spring 2000. Plots measured at least 20 ft. x 30 ft., except at Site 2, where the small scale of operation necessitated a plot size of 10 ft. x 25 ft. Table 1 provides a description of each site.

Experimental amendments applied at each site and base saturation ratios for low-Ca and high-Ca treatments are shown in Table 2.

Other mineral amendments were applied equally to both treatments as follows: Borax was applied at 5 lb/acre at Sites 1 (1998) and 4 (1998 and 2000) to remedy a low boron (B) level. Greensand was applied at 1,040 lb/acre at Site 1 in fall 1999 after both soil and tomato foliar tests showed low K. Rock phosphate was applied at 500 lb/acre at Sites 1, 2, 3 and 4 in 1998 in the belief that existing soil P

Above: *Field day at Dayspring Farm, Cologne, VA (Site 1). Mark Schonbeck discusses the use of a heavy-duty broadfork (or chisel plow at the farm scale) and deep-rooted crops to relieve a hardpan that has not responded to cation nutrient balancing alone.*

Table 1. Descriptions of organic farms providing experimental sites for soil nutrient balancing study,

Site 1.	**Dayspring Farm King and Queen Co., VA**	Located in the Tidewater region. The experimental field is on a level, sandy loam with low organic matter and CEC. It has been under organic vegetable production with winter cover cropping since 1997, and had been in hay (grass + alfalfa) for several years prior to that. A strong, persistent hardpan exists between 6 and 12 inches depth. It appears to be associated with a long history of conventional agriculture and heavy machinery prior to 1990 under previous ownership.
Site 2.	**Screech Owl Farm Nelson Co., VA**	Located in the Blue Ridge foothills. The experiment is on a loam to clay-loam soil, on a ~5% south-facing slope, that has been in organic vegetable production with winter cover crops since 1996. Topsoil organic matter and tilth have been built up, but a moderately strong hardpan persists between 6 and 12 inches, again possibly resulting from heavy farm machinery traffic under previous ownership.
Site 3.	**Seven Springs Farm Floyd Co., VA**	Located in the Appalachian region, elevation *ca.* 2,700 ft. The experiment is on a level creek bottom loam with high organic matter and fertility. The soil has a high content of river stones, but is well drained and free of hardpan. It has been in organic/biodynamic vegetable production with winter cover crops since 1995.
Site 4.	**Abundant Dawn Farm Floyd Co., VA**	In the Appalachian region at *ca.* 2200 ft elevation. The experiment is on a level river bottom loam with physical properties similar to Site 3, but with fewer stones and somewhat lower organic matter, P and K levels. The field has been an organically managed homestead garden for at least 12 years.
Site 5.	**Holley Creek Farm Greene Co., TN**	Located in the Nolichuckey River valley. The experiment is on a nearly-level field with a clay to clay-loam soil with a long history of conventional tobacco production and heavy machinery traffic that depleted organic matter and degraded soil structure. Beginning in fall 1995, it was converted to organic vegetable production with winter cover crops, and the use of municipal leaves as mulch. Drainage is somewhat slow, and a severe hardpan persists at a depth of 4 to 12 inches.

levels were below optimum. Since then, however, we learned that a P-1 level of 20-25 ppm may be sufficient[7].

At all sites, organic matter management, compost and organic fertilizer applications, and tillage were conducted according to growers' normal practices.

During the 2000 season, broccoli and other brassicas were grown at Sites 1, 2 and 3, and tomatoes were grown at Site 5. At Site 4, the plots were divided into 4 beds, which have been in a 4-year rotation of onions, brassicas, tomatoes and winter squash since 1998.

Soil analyses were conducted in spring of 2000. For each plot, 8 cores (0-6") were taken and mixed thoroughly in a clean bucket. Subsamples were used to determine soil organic matter, pH, cation exchange capacity, active (permanganate-oxidizable) organic matter, and major nutrients. Additional samples (8 cores per plot, 0-3" depth, pooled) were submitted for a complete soil foodweb analysis including active and total bacteria; active and total fungi; amoeboid, flagellate and ciliate protozoa; and beneficial (microbial-feeding) and pest (root-feeding) nematodes (Soil Foodweb, Inc., Corvallis, OR). The standard soil analysis was repeated in fall of 2000.

The following properties were measured in each plot in May-June and again in September-October, 2000: soil strength, infiltration rate, bulk density, moisture-holding capacity and soil respiration. Earthworm populations were recorded in June and September at Site 4.

Foliage samples were collected from broccoli at the mid-growth stage at Sites 1-4 and from tomato at early fruit set at Sites 4 and 5 and submitted for nutrient analysis. Total soluble solids (Brix) was measured with a hand-held refractometer for stalks of broccoli side-heads (5 samples per plot) at Sites 1, 3 and 4, and for tomato (4 fruits per plot, blended together) on 2 harvest dates at Site 4. For winter squash, shelf life was evaluated at Sites 3 and 4 in the 1999 season by storing 10 apparently-sound fruit from each plot at room temperature until early winter.

During the growing season, participating growers took observations on pest, disease and weed problems in the experimental plots and recorded any apparent treatment-related effects.

Marketable and total yields were recorded in 2000 for broccoli (Sites 1, 2, 3 and 4), tomatoes (Sites 4 and 5) and winter squash (Site 4). Percent marketable yield was computed as: 100 x (marketable yield)/(total yield). Plantings of Chinese cabbage (Sites 3 and 4) were insufficient for yield measurements, and onions failed at Site 4 because of root maggots.

Data were subjected to standard statistical analyses across sites to evaluate overall treatment effects. Site-specific trends were evaluated qualitatively, since replication at a single site (3 reps x 2 treatments) was insufficient for meaningful statistical analysis

When results were averaged across the 5 study sites, no net benefits to other soil properties were observed. In particular, soil physical properties related to tilth showed no apparent response to the Ca treatment.

Results and Discussion

Soil tests verified substantial differences between treatments in cation balance as of September 2000. Application of Ca amendments (gypsum and/or calcitic lime) brought soil base saturation ratios substantially closer to the guidelines proposed by Dr. William Albrecht. Four applications of calcitic lime and/or gypsum, totaling 2000 to 3300 lb/acre, lowered Mg base saturation levels by 4-8%, raised Ca saturation by a similar amount, and reduced K saturation by about 1% (Table 2).

However, when results were averaged

across the 5 study sites, no net benefits to other soil properties were observed. In particular, soil physical properties related to tilth showed no apparent response to the Ca treatment (Table 2). Soil strength values below 200 psi are considered favorable to root growth and function, and values above 300 psi generally restrict root growth. Strong hardpans occurred at about a 6" depth at Sites 1, 2 and 5, resulting in high maximum soil strength, regardless of treatment. Topsoil bulk densities and water infiltration rates at all sites were generally favorable, and again unaffected by treatment.

Whereas the high-Ca treatment had little effect on soil properties averaged across the five study sites, some trends were observed that indicate possible site-specific treatment effects. Summarized here, details are described in the full project report.

Soil chemical and biological properties showed no clear benefits from the Ca treatment. As expected, Ca amendments augmented soil Ca and reduced Mg, and gypsum caused a sharp but temporary increase in S. However, Ca treatment did not enhance organic matter or available P (Table 2). Field respiration and active organic matter levels were essentially the same in low-Ca and high-Ca treatments (Table 4). Apparent differences in populations of fungi, bacteria, protozoa, and both pest and beneficial nematodes were too small to indicate a treatment effect.

Whereas the high-Ca treatment had little effect on soil properties averaged across the five study sites, some trends were observed that indicate possible site-specific treatment effects.

At Site 4, June earthworm counts were 43/sq. ft. in the high-Ca treatment versus 27/sq. ft. for low-Ca. However, this trend did not hold in September: 34 for high-Ca versus 37 for low-Ca.

The high-Ca treatment consistently increased broccoli foliar Ca levels and reduced foliar Mg, but the changes were relatively small. Notably, foliar Ca levels were near optimum at all four sites, regardless of treatment. Foliar N, P and K levels were ample, and were not affected by Ca treatment. The high-Ca treatment pushed foliar S to very high levels, almost certainly because of the gypsum used to supply Ca. At Site 1, where the low-Ca plots received sul-po-mag in spring of 2000, both treatments resulted in extremely high foliar S (>2%).

Tomato foliar tests at Site 4 showed very high Mg levels, with Ca, N, P and K near the lower end of their sufficiency ranges (data not shown). At Site 5, tomato foliar Ca was definitely low. The high-Ca treatment enhanced foliar Ca and reduced foliar Mg at both sites, but the changes were fairly small, especially at Site 5. The gypsum applied to high-Ca

Table 2. Total amendments applied 1998-spring 2000, and fall 2000 soil test results for low-Ca and high-Ca treatments at each site.

Site	Treatment	Cation amendments applied[a]	pH	OM	ppm P-1	% base saturation:			
						S	K	Mg	Ca
1	Low-Ca	spm 500, grn 1040	6.5	1.9	53	5	7.8	18.9	64.7
	High-Ca	gps 2000, grn 1040	6.3	2.0	58	5	6.1	11.2	70.9
2	Low-Ca	none	7.0	4.0	45	5	8.0	21.4	70.0
	High-Ca	gps 3000	6.9	4.1	39	14	6.7	16.6	74.8
3	Low-Ca	none	6.5	5.7	19	10	6.6	26.7	59.0
	High-Ca	gps 2000	6.5	5.6	19	23	6.2	22.9	63.1
4	Low-Ca	dol 1230	6.3	3.3	11	7	3.4	28.1	57.7
	High-Ca	cal 1230, gps 1500	6.4	4.6	9	15	3.2	21.0	66.5
5	Low-Ca	dol 2720	6.6	3.8	52		6.5	23.9	63.0
	High-Ca	cal 2800	6.7	3.8	61		5.8	16.4	72.8
Mean of 5 sites:	Low-Ca		6.6	3.7	36	8	6.5	23.8	62.9
	High-Ca		6.6	4.0	37	14	5.6[b]	17.6[b]	69.6[b]

[a] Figures give lbs/acre: dol=dolomitic limestone; cal=calcitic (high-calcium) limestone; gps=gypsum; spm=sul-po-mag; grn=greensand.

[b] Difference between treatments is statistically significant at the 5% probability level.

When soil pH was 6.3 or below, the high-Ca treatment received calcitic limestone and the low-Ca treatment received dolomitic limestone at equal rates. Lime was applied at 500 to 2,000 lb/acre depending on soil pH and CEC. When soil pH was 6.4 or higher, the high-Ca treatment received gypsum (500 to 1,000 lb/acre), and the low-Ca treatment received no amendment, with one exception. At Site 1, the low-Ca treatment received sul-po-mag (potassium-magnesium sulfate) at 500 lb/acre in spring of 2000, since K and Mg levels were possibly sub-optimal on this sandy loam soil.

plots raised foliar S levels significantly, but not to excessive levels.

Tomato foliage samples were taken somewhat later in crop development (early fruit set) than recommended by the laboratory (early flowering). This may have played a role in the apparently low N, P and K values. However this is probably not true for Ca, since Ca is not translocated from leaves to fruit as are other nutrients[8].

Effects of Ca treatment on marketable vegetable yield were inconsistent. In the 1999 season, the Ca amendments had little effect on cabbage or winter squash yields, and seemed to reduce tomato yield at two sites. In 2000, the high-Ca treatment apparently enhanced broccoli yield at two out of four sites. When data were analyzed across all 4 sites, broccoli yields averaged about 11% higher in the Ca-amended plots, and the difference was just significant at the 5% probability level. At site 4, broccoli, tomato and butternut squash all showed higher average marketable yields in the high-Ca treatment. At site 5, yields were measured only for a late planting of tomato, which became severely blighted before maturity. An earlier tomato planting in the experimental plots gave much better yields.

Several problems were observed in the vegetable crops during the 2000 season. We did not observe any differences between Ca treatments in the severity of any of these problems.

Percent weed cover was estimated in spring and summer of 2000 at Sites 1 and 4. Again, no differences between Ca treatments were detected.

The high-Ca treatment did not enhance the total soluble solids content (Brix—data not shown) of tomato or broccoli, and did not significantly improve percent marketable yield. Brix values of both crops were much lower in 2000 than in 1999. This was most likely related to the cool, moist conditions during summer 2000, and not to soil cation balance. Butternut squash grown in low-Ca and the high-Ca treatments showed very similar percent marketable yield and shelf life.

Conclusions

Findings to date do not support the application of a single formula for optimum base saturation ratio to all soils. Instead, a site-specific and resource-conserving approach to soil cation balancing may better serve the overall goal of sound nutrient management. Furthermore, base saturation ratio is just one component of soil quality, which may be more dramatically enhanced by improving the health and diversity of the soil life.

Results show some benefits to some soils: Mineral amendments or other measures to adjust soil cation balance may confer some of the following benefits on some but not all soils that depart from the Albrecht formula:

- Improved tilth, reduced hardpan, especially on loam or clay with very high K levels;
- Higher marketable yields in brassicas and other crops with a high Ca requirement.

Claims not supported by results: Limited data gathered on foliar nutrient levels, produce quality, and weed, pest and disease pressures, did not support any of the following claims for cation nutrient balancing:

Table 3. Effects of Ca treatments on soil physical properties.

	Soil strength 200 psi at (depth, in.)	Max psi at 0-12 inches	Dry bulk density	Moisture content (%)	Infiltration (minutes/inch)
Low-Ca	6.4	410	1.17	23.4	3.5
High-Ca	6.1	410	1.18	23.2	3.6
L.S.D. 0.05[b]	0.8	40	0.03	1.0	2-fold[c]

[a] Mean across five study sites and three sampling dates (fall 1999, spring and fall 2000), except that soil strength was measured at four sites in spring 2000, and at three sites in fall 2000.

[b] Least significant difference at 5% probability level. Apparent treatment differences smaller than this are considered "not significant," or likely to have occurred by chance.

[c] Infiltration data were so variable that a log-transformation was used for statistical analyses. A two-fold difference between treatments would be just significant at the 5% probability level.

Table 4. Effects of Ca treatments on soil biological properties.

	Active OM, ppm	Respiration, late spring	lbs C/acre-day: early fall	Microbial biomass, ppm dry soil --Bacteria-- active	--Bacteria-- total	--Fungi-- active	--Fungi-- total
Low-Ca	1,680	26.8	22.4	25.6	190	24.8	116
High-Ca	1,680	26.9	21.9	28.0	182	22.8	113
L.S.D. 0.05[b]	132	4.8	2.8	9.7	35	11.7	32

	Protozoa, flagellates	1000s per gram soil: Amoebae	Ciliates	Nematodes, individuals per gram soil: total	Root feeders (pests)
Low-Ca	35.5	107.2	0.93	3.3	0.65
High-Ca	38.0	107.2	1.12	4.4	0.74
L.SD 0.05[b]	1.7-fold[c]	2-fold	3-fold	1.6	0.57

[a] Mean across five sites.

[b] Least significant difference at 5% probability level.

[c] Protozoan counts were highly variable; thus data were log-transformed for statistical analysis.

- Increased availability and crop uptake of N, P or micronutrients;
- Increased crop resistance to pests, diseases and environmental stresses;
- Fewer weeds;
- Higher soluble solids (Brix);
- Longer shelf life.

Findings to date do not support the application of a single formula for optimum base saturation ratio to all soils.

In general, there appears to be little evidence that moderately high Mg levels (20-25% base saturation), and moderately low Ca levels (55-65% base saturation), are harmful to soil or crop health on most soils in the southeastern US.

Claims neither refuted nor supported: Ca amendments had no apparent effect on soil biological activity level (respiration) or humus formation (active organic matter). However, because of the great complexity of the soil's web of life, and the potentially long time needed for such effects to become manifest, the following claims cannot be fairly evaluated based on data collected thus far:

- Stimulation of beneficial soil life and humus formation;
- More balanced and diverse soil life, fewer root pathogens.

In general, there appears to be little evidence that moderately high Mg levels (20-25% base saturation), and moderately low Ca levels (55-65% base saturation), are harmful to soil or crop health on most soils in the southeastern U.S. If Mg is high, it makes sense to choose high-Ca lime if the soil's pH merits liming; conversely, dolomitic lime should be used on an acid soil with low Mg (<60 ppm or <8% base saturation). However, using lime to "correct" the base saturation ratio of a nearly-neutral soil may be counterproductive, as overliming can tie up micronutrients and possibly inhibit soil life.

Gypsum applications may be appropriate on soils that are low in both Ca and S. However, we found extremely high foliar S in broccoli planted after gypsum was applied at just 500 lb/acre. Possible effects of such high S on the crop are not fully known.

Either lime or gypsum may correct the Ca deficiency and aluminum excess of a highly-acid subsoil (pH <5.0) that restricts crop root growth. However, gypsum can cause excessive leaching losses of K and Mg from sandy soils, and must be used with caution on these soils.

There is some evidence that excessive soil K (>350 ppm, or >8% base saturation on a loam or clay soil) can upset plant nutrition and contribute to a deterioration in crumb structure and tilth. High soil K levels are fairly common in intensive vegetable production, both conventional and organic. In this case, cation balancing measures consist primarily in reducing inputs, particularly K-rich materials such as manure, hay mulch and NPK fertilizers.

Other considerations include the economic and environmental costs of amendment applications to "correct" the soil's base saturation ratio. Apparently, about 1-2 tons/acre of either high-Ca lime or gypsum must be applied to shift the soil's base saturation ratio by 5-10 % (a typical goal on a moderately "out-of-balance" soil). This may cost anywhere from $40 to $300 per acre, including shipping and application. If high-value vegetable crops with a high calcium requirement are grown, this investment may pay off on some soils. For example, a 10% yield increase in broccoli might fetch an extra $150 per acre if the broccoli is wholesaled at $0.50/lb. This would pay for the amendment application in a year or two. However, growers should try this strategy on a small area to verify benefits before applying it to the entire farm. Treating large acreages of hay or agronomic crops with lime or gypsum simply to adjust base saturation ratio may not be good economics. It would also entail significant environmental costs in the mining, transport and application of the materials.

❋

Mark Schonbeck's complete project report: *Soil nutrient balancing in sustainable vegetable production* (Project #00-10) is available from OFRF by mail or by visiting OFRF's website at www.ofrf.org. The complete report is 24 pages, including 10 tables, 2 figures, and extended references.

Mark also reports ongoing project results in the Virginia Biological Farmer, available from the Virginia Association for Biological Farming, (subscription $15; VABF, Box 1666, Louisa, VA 23093). The newsletter and additional materials on soil nutrient balancing are also available on on their website: www.vvac.org/vabf/

References

1 Eckert DJ. Soil test interpretations: basic cation saturation ratios and sufficiency levels. In: Soil Science Soc. Amer. Special Publ. 21, Soil Testing, Sampling, Correlation, Calibration and Interpretation. 1987; 53-64.

2 Goldstein W. Cation Balancing: is it Beneficial or Bogus? East Troy, WI: Michael Fields Agricultural Institute; 1990. 6 pp.

3 Liebhardt WC. The basic cation saturation ratio concept and lime and potassium recommendations on Delaware's coastal plain soils. Soil Sci. Soc. Amer. J. 1981;45:544-549.

4 Kinsey N, Walters C. Neal Kinsey's Hands-On Agronomy. Kansas City, MO: Acres USA; 1993. 352 pp.

5 Young G A. A Training Manual for Soil Analysis Interpretation in Northern California. Master's Thesis, Sonoma State University;1999. 158 pp. Available through Y&B Agricultural Services, P.O. Box 246, Talmage, CA 95481; tel. 707-485-5121.

6 Zimmer G. Biological Farming. Oral presentation to the Acres USA Eco-Farming Conference. 1999.

7 Magdoff F, van Es H. Building Soils for Better Crops. Burlington, VT: Sustainable Agriculture Publications, Hills Building, Room 10, University of Vermont, 05405-0082. 2000.

8 Kirkby EA. Maximizing calcium uptake by plants. Commun. Soil Sci. Plant Anal. 1979; 10(1-2)):89-113.

EVALUATING THE EFFECTS OF ORCHARD FLOOR MANAGEMENT ON BIOLOGICAL CONTROL IN PEARS

The nature of the interaction between orchard ground cover and the tree is not well understood, particularly whether ground cover is a valuable source of natural enemies (beneficials). This study was done to determine whether mowing frequency affects natural enemy densities in the ground cover and pear trees of organic pear orchards and conventional orchards using mating disruption, and if so, whether these changes in natural enemy densities translate into improved control of key insect pests. We looked in particular at parasitism of pear psylla nymphs and predation of late instar codling moth larvae.

Project objectives

- To determine the effects of mowing frequency on the density and diversity of pests and beneficials on the orchard floor, in the ground cover, and on the pear tree; and
- To estimate the impact of beneficials, such as parasitism and predation rates, on pear pests in each mowing regime.

Experimental design

Mowing frequencies were varied to alter ground cover composition at two orchards: an experimental organic orchard located in Moxee, Washington (owned by USDA-ARS) and a mating disruption pear block located in Hood River, Oregon. Three mowing frequencies were established at both orchards:

(1) weekly (7-10 days);
(2) monthly;
(3) mowed once in early spring (referred to as "unmowed").

At both orchards, the experiment was set out in a completely randomized block design, with 3 replicates per treatment. At the mating disruption orchard, blocks were each 15-21 tree rows wide (= 5-7 tree rows per treatment plot) by 100-200 feet long. At the organic orchard, blocks were 9-12 tree rows wide (= 3-4 tree rows per treatment) x 80 feet long. At both locations, perimeter tree rows were used as buffer rows, and sampling was restricted as much as possible to interior trees.

Beneficials were sampled every three weeks beginning in April and ending in late August. Sampling methods used were: **pitfall traps** (for ground-dwellers); **sweep nets** and whole plant samples (for ground cover dwellers); and, **beat trays** and leaf samples (for beneficials on the pear tree).

To determine whether community changes between mowing treatments might translate into benefits for the grower, two sources of impact were quantified: parasitism of pear psylla nymphs; and predation of late instar codling moth larvae.

In all three mowing regimes, broadleaf species comprised about 15% of total leaf area, and were dominated by dandelion, clovers, mallow, dock, and knapweed (Hood River site), or by dandelion and clovers (Moxee site).

Results and discussion

◗ **Natural enemy (beneficial) populations - seasonal averages:** The relative composition of the natural enemy communities was similar among the three mowing treatments. Beneficials in the pitfall samples were dominated by ground beetles (60% of those commonly found), spiders (15%), staphylinid beetles (5%), and harvestmen ("daddy long legs"; 5%). Sweep net samples of beneficials were dominated by parasitoids (60%), spiders (15%), and damselbugs (Nabidae; 5%). Beat tray samples of beneficial arthropods were dominated by spiders (60%), parasitoids (20%), earwigs (10%), and *Deraeocoris brevis* (a predatory bug; 5%).

Mowing frequency had a larger effect on total numbers of beneficials. In pitfall traps, decreased mowing frequency was accompanied by slight reductions in numbers of harvestmen, earwigs, spiders, and ground beetles (based upon season-long averages for each group).

◗ **Seasonal trends:** Different groups of predators peaked in densities at different times of the year. For the ground dwelling predators, spiders peaked very early in the season, ground beetles and staphylinid beetles peaked in late July, and harvestmen peaked in mid-August. Arthropods associated with the ground cover tended to peak in early July. Those that feed extensively on aphids (including damselbugs and lacewings) showed sharp drops in numbers in mid-July, coinciding with a crash in the aphid populations occurring in the ground cover. On beat trays (i.e., in the pear tree), spiders and parasitoids were more abundant in late summer than early summer.

◗ **Mowing effects:** Counts of lacewings, spiders, damselbugs, parasitoids, syrphid flies, ladybug beetles, big-eyed bugs *(Geocoris* spp.), and minute pirate bugs *(Orius tristicolor)* were considerably larger in unmowed and monthly mowed plots than in weekly mowed plots, suggesting

Above: *Regularly mowed plot (every 10 days or so), at mid-summer.*

Project leader: David Horton USDA Agricultural Research Service (ARS), Wapato, WA ◆ **Grower cooperators:** George Ing Farm, White Salmon, WA, USDA-ARS 1-acre block, Moxee, WA ◆ **OFRF support:** $4,700 (1998) ◆ **Report No.** 98-06 ◆ **Additional support provided by:** Winter Pear Control Committee, USDA-SARE Western Region ◆ **Project period:** 1998 ◆ **Reported:** May 1999

that mowing frequency may affect or enhance biological control in orchards.

Of the various natural enemies affected by mowing, only spiders and parasitoids showed the same population trends in the pear tree (i.e., had higher densities in the less frequently mowed plots).

Several common predators on the orchard floor or in the ground cover (ground beetles, harvestmen, earwigs) were only marginally affected by mowing frequency.

of their life cycle (e.g., cutworms, late instar or diapausing codling moth larvae). Note that ground beetles and harvestmen are both thought to be effective natural enemies of codling moth, thus their presence in the orchard should be conserved as much as possible.

Certain predators of pear psylla *(Anthocoris spp., Deraeocoris brevis)* were occasionally abundant in the pear tree but were never encountered in the ground cover. Mowing frequency or ground cover

Of the various natural enemies affected by mowing, only spiders and parasitoids showed the same population trends in the pear tree.

Certain beneficials (ground beetles, harvestmen) were exceptionally abundant on the ground but were never collected from the pear tree.

◗ **Block-to-block variation:** For several natural enemies, differences among blocks were much larger than differences among mowing treatments. Densities of ground beetles and earwigs were extremely high in a block of very young trees with open canopies, and were much lower in adjacent blocks of older trees. These results suggest that population densities of these ground dwellers may be affected more by factors such as soil type, aspect, slope, tree age and openness of canopy, or surrounding habitats than by mowing frequency.

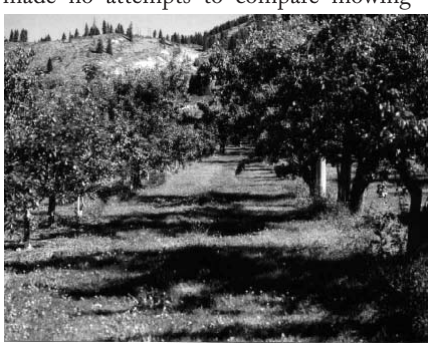
◗ **Ground cover/tree community correlations:** Certain beneficials (ground beetles, harvestmen) were exceptionally abundant on the ground but were never collected from the pear tree. Thus, these species may impact those pear pests that also occur near ground level at some stage

management is unlikely to have significant direct effects on densities of these important predators.

◗ **Pest densities:** *Spider mites*—weekly-mowed plots kept broad-leaf weeds virtually free of spider mites although densities never reached damaging levels. *Pear psylla*—populations were not affected by mowing frequency. Psylla counts on beat trays were low all year at both orchards. *Lygus* and *stinkbug*—populations in the ground cover were significantly higher in the unmowed and monthly mowed plots compared to the weekly mowed plots. However, neither pest was recovered in damaging numbers on beat tray samples taken in the pear tree.

◗ **Impact of beneficials on pests.** *Psylla*—parasitism rates were atypically low most of the year (<<10% in all plots), thus I made no attempts to compare mowing treatments for effects on parasitism rate. Generally, parasitism rates at this orchard are much higher than observed in 1998 (often >50%).

Codling moth—disappearance rates of larvae from cardboard monitoring strips placed on pear trees (presumably due to predation) was 10-20% per strip in 48 hours, and no relationship was noted between disappearance rate and mowing frequency. Correlation analyses to determine whether disappearance rates were related to densities of natural enemies surprisingly showed no relationship between density of ground beetles and disappearance rates of codling moth ($r < 0.1$). However, there was a significant relationship between numbers of earwigs recovered in strips and numbers of codling moth disappearing from strips ($r = 0.80$), suggesting that earwigs are predators of codling moth.



***Above:** Monthly-mowed plot (left) and unmowed plot (right), both at mid-summer.*

Conclusions

In this study, mowing frequency had striking effects on densities of natural enemies in the orchard, but it remains unclear just what impact this has on orchard pests. Parasitism rates of pear psylla nymphs in all three mowing regimes showed no effects of mowing treatment. However, parasitism rates were atypically very low during the 1998 season. Results did not show any effects of mowing frequency on predation rates of codling moth. These studies have continued on a larger scale in the same orchards, incorporating the same mowing treatments. ❋

David Horton's complete report: *Enhancing biological control in mating disruption and organic pear orchards by understory management* (OFRF project #98-06) is available from OFRF by mail or by visiting OFRF's website at www.ofrf.org. The complete report is 8 pages plus 14 figures including data on population densities of beneficials among treatment groups.

A continuation of this study is in place through December 2001; results can be monitored by visiting http://nps.ars.usda.gov/projects/projects.htm?accession=402529

Efficacy of homeopathic preparations of autogenous mastitis-causing organisms in the prevention of mastitis in dairy cattle

Homeopathy is a tradition of medicine developed by German physician Dr. Samuel Hahnemann in the 1800s. Based on the theory of "like cures like," homeopathy is guided by the principle that a remedy that produces symptoms similar to the disease in question can have a curative effect on that disease. Homeopathic remedies are prepared through a series of dilutions, referred to as potentizations–the more dilute a solution, the greater its potency. Homeopathy is described as an "energy treatment," like acupuncture, working on the body's vital force, as opposed to the illness itself. While there are many anecdotal observations of the efficacy of homeopathy in livestock, few studies have been conducted. In his report, Dr. Fernando Moncayo provides a literature review of homeopathic research related to livestock treatments, as well as the results of a three-part study of homeopathic preparations for mastitis. Two treatments involve nosodes–preparations made from disease material–and one treatment evaluates more commonly-used herbal- and mineral-based remedies. –EW

Dependence on antibiotics to prevent and treat mastitis in dairy cows is a major obstacle in the transition to organic dairying. Mastitis prevention in conventional herds depends on hygiene and antibiotic treatment at drying-off. No prevention other than hygiene is available for the late dry period and early lactation when susceptibility to infection is high.

Homeopathic preparations called "nosodes" are potentized high-dilutions of pathogens or of products of disease (secretions or exudations). To prepare a nosode, the pathological material is initially conserved in alcohol/water solution for 7 days; next, following a sequential dilution where at each dilution step the solution is forcefully shaken (succussed) the solution is taken to high dilution levels. Above the 12th Centesimal dilution, nosodes do not contain any detectable remnants from the original pathogen. However, the unique preparation process seems to give the solvent medicinal properties. As such, nosodes are safe and do not leave any residues in animal products, making them an ideal tool for organic dairy herd health management. Some studies support the use of nosodes for the prevention of infection.

The efficacy of homeopathic medicine in general and of nosodes in particular has not been established. Similarly, the efficacy of nosodes for prevention of mastitis has not been determined. Research in veterinary homeopathy, particularly in mastitis, is extremely limited. However, two studies (Fredeen, and Day, 1984.) as well as personal observations have led to a determination that an autogenous mastitis nosode may be effective for prevention of clinical and subclinical mastitis when given frequently during the periods of higher risk of infection.

Following are the methods and results of this three part-project.

Terms

Autogenous: self-produced;self-generated.

Mother tincture: the undiluted tincture from which potentized remedies are made

Nosodes: a special category of remedies prepared from disease material

Potentization: a process of diluting a mother tincture in a water/alcohol solution and then shaking vigorously

Potency: a means of describing the dilution of homeopathic remedies;
Decimal remedies are those diluted by a factor of ten (e.g. a D4 remedy is diluted by a factor of 10 four times);
Centesimal remedies are those diluted by a factor of 100 (e.g. a C6 remedy is diluted by a factor of 100 six times)

Repertorization: the process by which a remedy is chosen that best matches the symptoms identified and selected for treatment

Project leader: Fernando Moncayo, DVM, MSc, Paradise, Nova Scotia ✦ **Collatorator:** Alan Fredeen, PhD PAg ✦ **Grower cooperators:** Robert Banks, Peter DeNuke, Alan Jackson ✦ **OFRF support:** $3,534 (1999) ✦ **Project Period:** 1999-2000 ✦ **Reported:** September 2000

Part I.

Comparison of an autogenous mastitis nosode to antibiotic as dry cow treatment for the prevention of mastitis in three commercial herds.

Materials and methods

Herds: No commercial organic dairy herds were available in Nova Scotia for study, and three conventional herds located in the Annapolis Valley of Nova Scotia (Canada) were used: Banks', Jackson's and DeNuke's. All herds had fixed stall systems with housing from November to May and grazing from June to November. All herds used milk pipe milking systems where cows are milked on the extensions twice daily. Hygiene methods were standard with pre- and post- milking teat dipping. Banks milked between 90-100 cows, DeNuke and Jackson milked 25-30 cows. All three farms milked cows year round.

Autogenous nosode: The California Mastitis Test was conducted on all cows and milk samples taken from those that tested positive. Samples were submitted for culture to the Provincial Veterinary Pathology Laboratory. At the lab, cotton swabs were impregnated with isolated bacteria and placed in a glass tube containing ethanol and ultra distilled water 50/50 by volume. The tubes were sealed and left undisturbed for 7 days.

Afterwards, tubes belonging to the same farm from which the samples came were combined and used as the mother tincture (MT), which was processed as follows:

1) 0.01 ml of the MT were added to a glass test tube containing 10 ml of ultra distilled water;
2) The tube was forcefully shaken (succussed) by hitting its bottom 100 times on a hard cover book;

3) 0.01 ml were withdrawn from this tube and added to a second tube containing 10 ml of ultra distilled water;
4) The second tube was succussed 100 times;
5) 0.01 ml were withdrawn from the second tube and added to a third tube containing 10 ml of ultra distilled water;
6) The third tube was succussed 100 times, etc.

The steps of dilution and succussion were repeated 29 times. Finally, 0.04 ml were withdrawn from the 29th tube, added to an amber glass bottle containing 40 ml of ethanol/ultra distilled water 80/20 by volume, and succussed 100 times. The bottle was labeled with the name of the farm and the organisms included in the solution and used as the base solution from which the medication administered to the cows was prepared. The base solution was kept in a dark cupboard away from other medications and electric devices.

Throughout the experiment, new succussed bacteria solutions derived from mastitis cases and cows that presented persistently high Somatic Cell Count (SCC) were added to the base solution.

The solution for administration to the cows was prepared by adding 0.04ml of the base solution to an amber glass bottle containing 40 ml of ethanol/ultra distilled water solution 20/80 by volume and succussion of the bottle 100 times. This formulation was given to the farmers and replaced monthly when not used entirely. The organisms isolated and included in the nosode were:

Banks: *Staphylococcus aureus, Staphylococcus epidermicus, Streptococcus dysgalactiae, Streptococcus agalactiae, Bacillus spp, Klepsiella spp.*

DeNuke: *Staphylococcus aureus, Staphylococcus epidermicus, Streptococcus dysgalactiae*

Jackson: *Staphylococcus epidermicus, Streptococcus dysgalactiae, Staphylococcus aureus*

Treatment groups: Forty-eight cows were divided in two groups that were balanced for number of lactations and history of mastitis. By the toss of a coin the groups were allocated to either Antibiotic (A) or Nosode (N) treatment. This was done monthly from the expected calving list and for each farm.

Twenty-four cows in the A group were treated with a dry cow antibiotic formula of common use: Cephapirine benzathine (Cefa-Dry-Ayers) for most cows; or Cloxacillin benzathine (Dry Clox-Ayers) when it was determined that the cow was infected with *Staphylococcus aureus.*

Twenty-four cows in the group N were given 2 ml of nosode in the feed every other day during two weeks after drying-off and during two weeks before the calving due date and for two weeks after calving.

Data for SCC were collected from monthly test reports done by Atlantic Dairy Improvement Centre. The variable of interest was the SCC on the first testing postpartum. Data for SCC were transformed to the logarithm and analysis of variance was performed to test for the effect of treatment, farm and interaction of farm and treatment.

Results and discussion

SCC for cows included in the trial is presented in Table 1. The number of observations constitutes a small sample where significant differences may not be detected. The analysis of variance indicated that there were no significant differences in the SCC between treatments but that there was a significant farm effect (P=0.093)*. Lower SCC were observed at DeNuke's and Jackson's.

There were very few cases of clinical mastitis encountered. Banks reported two cases for each treatment group; DeNuke reported two cases for each treatment group; Jackson did not report any clinical cases. These data are insufficient to be analyzed. Farmers confirmed that, in their perception, clinical mastitis was not a problem. They were more concerned with cows that presented a persistently high SCC.

Conclusions

A larger sample size is required to draw a more solid conclusion regarding the comparative efficacy of an autogenous nosode in the prevention of mastitis in the post-partum.

Farmers' perception on the efficacy of the nosode and management styles seemed to be important factors on deciding whether to continue using the nosode. The treatment with nosode required that at drying-off, cows had to be kept in the barn for two weeks, and were brought in the barn two weeks prior to their due date. As a result, the labour demands for the farmer increased.

Banks, who operates a relatively larger farm, felt that the nosode was not effective, was unpractical and would not continue using it. In contrast, Jackson and DeNuke, who are operating small herds, were satisfied and would consider using the nosode in the future.

Table 1. Somatic cell count within the first month post-partum of cows treated with either nosode at drying off and early post-partum, or with antibiotic at drying off. Data show combined observations from each farm.

Banks		
Mean ± SE	559 ± 251	680 ± 323
Range	45 to 2654	27 to 3274
Standard deviation	834	1012
No. of cows observed	11	10
DeNuke		
Mean ± SE	1522 ± 75	607 ± 418
Range	21 to 697	19 to 3876
Standard deviation	225	1254
No. of cows observed	9	9
Jackson		
Mean ± SE	582 ± 559	81 ± 36
Range	26 to 2256	18 to 219
Standard deviation	1116	82
No. of cows observed	4	5

*Probability (P), or statistical significance, refers to the chance that the measured differences are due to the treatments rather than to random variation or error. For example, P<0.05 means the probability is less than 5% that the analysis is picking up on non-existent differences, or not measuring real differences, and thus has a 95% confidence level.

Part II.

Effect of an autogenous nosode on the somatic cell count (SCC) of lactating cows

Materials and methods

Herd. Three trials were conducted at the Banks' farm in the Annapolis Valley of Nova Scotia.

Homeopathic treatment. Homeopathic treatment consisted of Sepia 30C (10^{-60}) and nosode at the 30C (10^{-60}) potency.

Sepia is a homeopathic medication derived from cuttlefish ink. It was selected using the classical homeopathy method of prescription known as the *genus epidemicus* whereby a homeopathic medication required to treat a population afflicted by a common disease is selected based on the peculiar signs and symptoms observed in the population. The signs of homeopathic value observed at the Banks' that indicated Sepia were:

- Edema, both mammarian and ovarian
- Obesity
- Disease aggravated by rain
- Rich diet: cows fed large quantities of grain and silage
- Abscesses: suppuration in the mammary gland

The nosode was prepared from organisms isolated from milk from the cows involved in the study. It was prepared manually following the process described in Part I.

Both Sepia and the nosode were prepared separately in an 80/20 ethanol/water solution added to white sugar in a proportion of 20 ml of medicine to 4 kg of sugar. The medicated sugar was mixed into 11 kg of crushed barley.

Treatment groups:

- **Trial 1:** Thirteen cows with SCC over 100,000 were selected and randomly allocated to two groups of 7 and 6 cows. The group of 7 cows received homeopathic treatment. The group of 6 cows was treated with homeopathy as well as with the antibiotic cephapirin sodium (Cefa-Lak).
- **Trial 2:** Twenty-one cows with SCC over 100,000 were allocated to two groups of 10 and 11 cows. Groups were balanced for number of lactations and history of mastitis. With the toss of a coin the groups were allocated to either homeopathic treatment or untreated control.
- **Trial 3:** Twenty cows that had SCC over 100,000 were randomly allocated to two treatment groups: homeopathic and untreated.

Cows were fed about 1 cup of medicated feed as follows: *Sepia* 30C for three days; no medication for 4 days; second Sepia 30C treatment for 3 days; no treatment for 4 days; nosode for 3 days; no treatment for 4 days; second nosode-treatment for 3 days.

Data and analysis: Data for SCC were collected from the ADIC reports using the analysis taken closest to before the start of and after the treatment. Data was transformed to the logarithm and the values before treatment were compared to the values after treatment using a paired t-test.

Results and discussion

Summary results of the trials are shown in Table 2.

- **Trial 1:** Cows given homeopathic treatment experienced a decline in the SCC. In contrast, the group treated with homeopathy and antibiotic experienced a mild increase.
- **Trial 2:** Both treated and untreated groups experienced a significant decline in the SCC.
- **Trial 3:** Both groups presented a decline in the SCC, but not as significant as the group in Trial 2.

Overall, pooling the data for cows that received homeopathic treatment only for the trials, a significant reduction is observed from 1255 ± 213 to 699 ± 166; the means were different at a significance level of 0.006.

Similarly, the SCC in the control groups for Trials 2 and 3 pooled together showed a significant reduction from 936 ± 275 to 706 ± 254 with a significance of 0.081.

It was our objective to determine whether homeopathic treatment could help reduce the SCC at this farm. Homeopathic treatment had the expected effect but there was no response when homeopathy was combined with antibiotic treatment. According to basic homeopathic principles, any substance with high medicinal power can potentially interfere with a homeopathic medicine. Antibiotics are strong medicine compared to homeopathic remedies. Antibiotic failure in the treatment of high SCC was not uncommon at this farm.

The results of Trial 2 were unexpected since both treated and untreated cows experienced a significant reduction in the SCC. No management changes other than the treatment given to the cows was made, and cows had not yet been turned out to pasture. Some cows may have inadvertently received medicated feed from a neighbouring treated cow. It has been reported in homeopathic provings both in humans and animals that individuals receiving placebo experience signs and symptoms of the remedy in experimentation. Hypothetically, by an unknown mechanism the effect of a homeopathic medicine can be shared by individuals living in close contact.

Table 2. Somatic cell count (SCC) of cows (mean ± SE) receiving homeopathic treatment, homeopathic treatment plus antibiotic and untreated control before and after treatment.

Treatment period	29Jan00 to 20Feb00		13Apr00 to 6May00		14Aug00 to 9Sep00	
Treatment	homeopathy	homeopathy + antibiotic	homeopathy	untreated control	homeopathy	untreated control
Before (SCC x 1000)	1063 ± 52	2348 ± 888	1477 ± 471	863 ± 233	1165 ± 257	1016 ± 533
After (SCC x 1000)	296 ± 66	2930 ± 1406	832 ± 239	582 ± 166	850 ± 370	842 ± 513
Significance	P=0.108	P=0.381	P=0.052	P=0.041	P=0.246	P=0.50

However, Trial 3 did not replicate the results and a less significant difference was observed in the homeopathic group; the untreated group experienced an insignificant reduction in the SCC.

The individual trials were composed of small samples where statistical differences are more difficult to detect. When the data for all treated cows was pooled, the reduction in the SCC proved to be highly significant (p=0.006) suggesting that indeed the treatment had a real effect on reducing the SCC. The control groups for Trial 2 and 3 pooled also revealed a significant reduction in the SCC but the reduction in the treated cows was 13.5 times more significant. The three trials were slightly different which may invalidate the results of pooling the data. However, the highly significant differences detected in the SCC between before and after the treatment in the three groups treated with homeopathy suggests that the treatment effect was real.

Conclusion

Lactating cows on the Banks' farm receiving homeopathic treatment showed significantly reduced SCC. Factors other than direct administration of homeopathic treatment might be significant.

Part III.

Case study: Homeopathic treatment of chronic mastitis in lactating dairy cows (without nosodes).

At the DeNuke's farm several cows presented chronic mastitis manifested as persistently high SCC and periodic mild clinical signs, e.g. swelling of udder and milk clots. A higher than usual incidence of mastitis had occurred in 1999, and several cows were treated during the summer with antibiotic but the response had been marginal.

Initially, four cows that failed to respond to antibiotic were treated with homeopathic medicine with no success. Homeopathic remedies that have been recommended for mastitis treatment were used, e.g. *Belladonna, Bryonia, Lachesis.*

However, homeopathic theory states that the treatment of chronic disease requires the use of medicines prescribed according to the individualizing characteristics of the disease and personality of the individual. Further, when various individuals in a population are afflicted by a common disease, one remedy that covers the characteristics of the disease *(genus epidemicus)* as it appears in the population must be used.

It was decided to treat a group of cows with both 1) a remedy of the population; and 2) a remedy of the individual.

Carbo Vegetabilis (vegetable charcoal diluted in alcohol) was chosen as the remedy of the population. This is a remedy prepared from charcoal. *Carbo Vegetabilis* was believed to suit the population because: 1)It is reported to be useful for treating mastitis in humans: 2) It applies to chronically ill individuals who consume rich food that is difficult to digest. This may be analogous to the feeding of concentrated grain to ruminants whose natural diet is grass; and 3) It applies to diseases that are insidious and develop slowly.

Remedies of the individual were selected studying the characteristics of each animal according to classical homeopathy.

- **Dolly**: Startles with sudden movements; docile, can be approached and touched; slim body with fine long bones. Rx: *Phosphorus*
- **Polka dots**: tame, mild and calm character when she is outside, startles to sudden movements when she is in the barn. Rx: *Pulsatilla*
- **Lily:** shows dislike at being touched; she is the leader of the herd. Rx: *Aurum Metallicum*
- **Charity:** generally tame in the barn but cannot be approached when she is outside; dislikes to be touched. Rx: *Antimonium Crudum*

Treatment. Cows were treated with the following remedies in sequence:

Remedy of the population:

1) *Carbo Vegetabilis* 30C two doses (1 dose=5-10 pellets) 12 hours apart repeated every three days for two weeks.
2) *Carbo Vegetabilis* 200C two doses 12 hours apart once per week for two weeks.

Remedy of the individual:

3) From prescriptions listed above, two doses twelve hours apart.

The medication was in the form of coated pellets. The dose was dissolved in 30 ml of water and sprinkled over the feed.

Results and discussion

Dolly, Polka dots and Lily presented a gradual decline in the SCC after the start of the homeopathic treatment. The SCC reached acceptable levels within two months. Dolly presented a sharp decline in the SCC but it soared again to pretreatment levels after 3 months. Then, it was treated with antibiotics resulting in a sharp decline in the SCC. Charity did not appear to respond to treatment and was culled.

Three of the four cows receiving the treatment exhibited the desired effect. It is interesting that one of the cows that responded temporarily to treatment responded rapidly to antibiotic treatment when antibiotic alone had failed.

This was a very small sample of animals and does not intend to be proof of efficacy but an encouraging first approach to a modality of treatment that might be useful for organic dairy farmers. ❋

Fernando Moncayo's complete report: *Efficacy of homeopathic preparations of autogenous mastitis-causing organisms in the prevention of mastitis in dairy cattle* (OFRF project #99-03) is available from OFRF by mail or by visiting www.ofrf.org. The report is 13 pages, plus 1 figure and 9 tables describing the SCC counts related to treatments for each farm.

News from Agri-Food Canada : Government to Fund Organic Center in Nova Scotia

In early July the Canadian government announced allocation of $854,700 in funding to develop the Organic Agriculture Centre of Canada, to be based at the Nova Scotia Agricultural College in Truro. Agri-Food Minster Lyle Vanclief commented at the announcement, "Organic agriculture is presenting producers with excellent opportunities and this new centre will ensure they stay on top of the learning curve and that Canada continues to enhance its reputation as a world class supplier of organic food."

This is a great development for organic research in North America, in a recent conversation, Dr. Moncayo expressed hope that this support will lead to the development of organic dairy herds in the region for further studies. —*EW*

Is homeopathy effective in farm animals?

Fernando Moncayo, DVM

In homeopathy, the application of medicines is based on the Law of the Similars or "like cures like". Remedies are experimented with in double blind trials, called "provings," to determine the symptoms and clinical signs that they induce. When prescribing a remedy, the practitioner attempts to replicate the proving in the patient, and by the Law of Similars, to induce a cure. As such, homeopathy appears as a scientific medical system because it is based on experimentation and replication. Therefore, it may be expected that the effectiveness of homeopathy is equally reproducible under the scientific method. Our objective was to establish whether there is published scientific evidence that homeopathy is effective for the treatment of diseases in farm animals.

Searching for the "H-word"

We searched the literature through electronic databases and information from practitioners. Databases searched were: Medline and Health Star 1966-1997; Science Citation 1995-1996; Life Sciences 1990-1996, and Agricola 1992-1996. We searched on the key words: homeopathy; veterinary homeopathy; homeopathic; alternative medicine; complementary medicine. We contacted practitioners in Argentina and Canada and the United States. Through a Canadian practitioner we obtained information about research conducted in France. A US practitioner informed us about research conducted in England. We looked at papers in English, French, Spanish and English translations of German papers.

Selection criteria for papers to be reviewed and analyzed were: 1) that studies be published in a report, book, proceedings or journal; 2) that reports include a sufficient description of methodology as to allow replication; 3) that the studies include a control/no homeopathic treatment group; 4) that statistical analysis be presented to establish significant difference between homeopathic and other treatments and/or control; and 5) that the studies not include laboratory animals.

Search results

Eighteen trials met the selection criteria. (Only two trials were found through the database searches.) Trials dealt with 6 species including bovine, swine, equine, poultry, rabbits and water buffalo. Clinical applications involved: parturition [birthing] aid in sows; reproductive management in dairy cows; mastitis in dairy cows; feet ulcers in rabbits; gastrointestinal disease in veal calves; bovine lungworm; hemoparasites in water buffalo; and retarded growth in swine. A series of experiments in growth promotion in poultry and swine were also reviewed.

Fifteen trials (79%) claimed that homeopathy had the expected effect. An equal number included randomization and all of them showed an effect from homeopathic treatment. Five trials (27%) included randomization and blinding (4 were double blind), all of these showing effect. Only 7 (39%) trials appeared in peer reviewed journals; six of them showed positive effect of homeopathy. Four of these trials were published in journals dedicated to homeopathy, all of them showing positive effects (1,2,3). Only three trials were published in generic veterinary journals (6,7,8), two of them showing an effect of homeopathy (6,8). Eleven trials were collected from author's reports (4,5).

Does the medium affect the message?

Homeopaths may be as eager to demonstrate that homeopathy works as others may be at trying to discredit it. Therefore, publication bias is a concern. From the already limited number of trials that stand up to scientific scrutiny, literally a handful were published in peer-reviewed journals including alternative journals. No trials with negative results were published in alternative journals (i.e. Cahier de Biotherapie and The British Homeopathic Journal). The only peer-reviewed journal that published negative results was a mainstream journal. A mainstream journal also published a trial with positive results. The size of our sample is too small to assess whether alternative journals tend to publish only positive results and main stream journals negative results. An extensive review of homeopathic research in humans found no evidence of publication bias against or for homeopathy in either alternative or main stream journals (11). However, it is possible that homeopathic researchers only submit positive results for publication. All of the articles published in the alternative journal Homeopatia (Argentina) show positive results. Yet, it is clear that homeopathic researchers reach negative results. Two out of ten experiments conducted by Briones showed no effect. The fact that Briones published negative as well as positive results gives confidence in the veracity of his studies. In addition, Briones conducted most of the research in an institutional setting at Universidad Austral de Valdivia in Chile and presented the results at various Chilean veterinary conferences where some scientific scrutiny took place; Briones

Literature Reviewed

1 Mahe F. Comparaison en aveugle d'un traitement homeopathique et d'un placebo dans un cas collectif d'ulc6rations chroniquez chez le lapin. Cahiers de Bioth6rapie 1986; 91:81-84.

2 Mahe F. and Roger C. Evaluation en double aveugle de 1'effet d'une cure homeopathic collective sur la morbidite et les qualites boucheres de veaux a 1'engrais. Cahiers de Biotherapie 1998; Suppl 91:1-6.

3 Williamson AV, Makie WL, Crawford WJ and Rennie BA. A study using Sepia 200C given prophylactically postpartum to prevent anoestrus problems in the dairy cow. Brit Hom J 1991;80:146-156.

4 Fredeen AH, Penny GA, Anderson D, Mackay D and Farid H. Efficacy of parabiologics in the prevention of mastitis in commercial dairy herds. Final Report Canada/Nova Scotia Agri-Food Development Agreement. Technology Development Programme, Project #TDP 21.

5 Briones F. Estudios sobre la aplicacion de la homeopatia en produccion animal. Santiago de Chile, 1987.

6 Day CEI. Control of stillbirths in pigs using homeopathy. Vet. Rec. 1984; 114:216.

7 Taylor SM, Mallon TR and Green WP. Efficacy of a homeopathic prophylaxis against experimental infection of calves by the bovine lungworm, *Dictyocaulus viviparus* Vet. Rec. 1989;124 (1):15-17.

8 Kumar V, Joshi HC and Kumar M. Therapeutic trials in buffaloes naturally infected with microfilariae of *Setaria cervi* Vet. Parasitol., 1989;3(2):125-129.

9 De Medio H. Introducci6n a la Veterinaria Homeopitica. Buenos Aires, Albatros, 1993;177-180.

adjusted the experimental design in response to critique from peers. The experiment by Fredeen et al. (4) is likewise credible as it was conducted under an institutional setting with collaborators from the Nova Scotia Department of Agriculture.

Sorting out the evidence

The number of trials published is too limited to allow an evaluation of the efficacy of homeopathy in any of the conditions involved. The analysis is further confused because of the different approaches used. Eight trials used the classical approach. However, in only two trials was the remedy selected by repertorization. Remaining trials selected the remedy based on common clinical application [e.g. Silica was selected to treat feet ulcers in rabbits because it is believe to aid healing of suppurative conditions (1); Caulophylum was tested for stillbirth in sows because it is believed to promote cervix dilation and uterine contraction (6)]. Nine trials tested complexes of homeopathic medicines (4,5,8) and two trials used Isopathy (4,7). However, all authors used potentized remedies with clinical application somewhat based on the Law of Similars which characterize them as homeopathy. It is possible that the effectiveness of homeopathic treatments depends on the condition and the approach taken. Schutte (10) found that a number of clinical applications of homeopathic remedies that German veterinarians were using did not show an effect under experimental conditions; homeopathy was more effective when remedies were prescribed by repertorization rather than by a clinical application defined *a priori.* Perhaps further experiments will show under which conditions homeopathy is consistently effective.

We found several reports that did not fit the selection criteria but showed results consistent with those of the reviewed trials. Day documented a case of a dairy herd where 18 heifers required assistance at calving with 7 stillbirths. After treating 7 heifers yet to calve with Caulophylum 30C, only 2 of the treated heifers required assistance (12). These findings are consistent with the experience with Caulophylum in sows (6).

Other observations on mastitis

Other work done in mastitis provided observations that are consistent with those made by Fredeen. In an informal trial Day, (12) treated 41 cows with a nosode of mastitis-causing organisms and the incidence of mastitis was compared to that of a 41-cow control group in the same herd. During the trial there were 10 cases of mastitis in the control group and one in the treated group. After the end of the trial the whole herd was treated with the nosode. Four months later the bulk milk cell count fell to 374,000 compared to 598,000 in the previous year.

In a second trial (12), 50 cows identified as high risk for contracting mastitis in a herd with SCC of 1,000,000 were treated with a nosode and the results were compared to a low risk, non-treated, 80-cow group. Before treatment the incidence of mastitis in the high risk group was three times that of the low risk group. After four months of treatment the incidence of mastitis was 25% less in the high risk (treated) group compared to the low risk (non-treated) group. Throughout the trial, the SCC increased in the non-treated group while decreasing in the treated group.

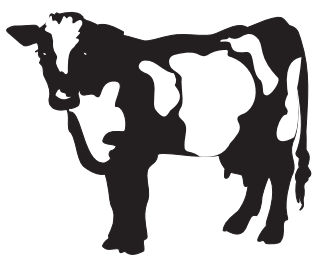
Poultry studies

Observations made in Argentina on New Castle disease in poultry are also interesting. A group of 12,140 chicks developed New Castle at 14 days of age and was treated conventionally (not defined). A second group (B) from the same lot developed New Castle at 17 days of age and was treated homeopathically using classical methods. At 55 days group A had a total accumulated mortality of 53%. Group B had an accumulated mortality of 28% (13). In another instance, a group of 7,596 meat birds was treated homeopathically and compared to a group of 7,017 treated conventionally (undefined). At the end of the experiment, on day 53, accumulated mortality of birds treated with homeopathy was 9.72% while the accumulated mortality of the group treated conventionally was 19% (14). Briones made a similar serendipitous observation in a case of viral hepatitis in poultry. During a 56-day trial, an outbreak of viral hepatitis caused 62% mortality in the control (placebo) group, 25% mortality in T2, 12.5% mortality in T3 and 0% mortality in T1. No statistical analysis of these results was reported. Saad did not statistically analyze the data and, unexplainably, Briones does not report whether the mortality was statistically analyzed. However, the apparent differences between homeopathy and non-homeopathy groups are large enough to wonder whether they might be real.

Conclusion

We cannot conclude that homeopathy is or is not effective because the evidence available is limited. However, the trials reviewed and the evidence from case reports suggest that homeopathy may be effective in certain conditions. Briones suggested that homeopathy may promote growth in pigs and poultry particularly when management is deficient, and the potential of homeopathic treatments to prevent mortality in poultry operations should be carefully examined. Likewise, the work of Fredeen et al. and Day suggests that there is a potential in homeopathy to prevent clinical mastitis. The possibility that homeopathy can aid in parturition particularly in conditions of high levels of abnormal labour cannot be disregarded.

We suggest that the application of homeopathy in the areas identified above should be carefully examined under an institutional setting and in conditions that are highly discriminating of the effects.



10 Schutte A. Is homeopathic research in veterinary medicine justified? Fundamental thoughts and results of five years investigations at the field station of the Free University of Berlin in Schawarzenbek. Proc. 3rd Int. congr. Vet. Homeop. Int. Assoc. for Vet. Homeop., Germany 4-6 Sept. 1992; pp 339-354.

11 Kleijnen J, Knipschild P. and ter Riet G. Clinical trials of homeopathy. BMJ 1991; 302:316-23.

12 Day CEI. Clinical trials in bovine mastitis. Brit Hom J 1986; 75 (1):11-14.

13 Saad SD. Tratamiento homeopatico en un lote de pollos parrilleros afectados de enfermedad de Newcastle. Homeopatia 1991; 55:13.

14 Saad SD. Experiencia con una crianza completa de pollos parrilleros tratados con homeopatia. Homeopatia 1991; 55: 9-11.

A grower-managed biorational program for artichoke pests (BIORAPP)

Resistance to insecticides, increasing costs of substitute insecticides, interest in organic production and markets, and regulatory pressures limiting the use of materials for artichoke plume moth control have stimulated research in control alternatives. These alternatives have included pheromones, microbial controls and native natural enemies.

Previous research has shown native natural enemies to be poorly synchronized and economically ineffective in suppressing artichoke plume moth (APM). However, natural enemy augmentation could help overcome the poor searching ability of native natural enemy species. Insecticide use reduction could increase populations of native and augmented natural enemies. Our research began with these methods, and later included use of pheromones to mass trap adult male artichoke plume moths.

Two species of APM egg parasitoids were first collected by Dr. Mohammed Bari in 1986: *Trichogramma thalense* (Salinas) and a new species, T *nr. pintoi* (Tomales Bay). Both species were later collected in 1991 and mass-reared in the laboratory at the University of California-CASFS for this study.

Project objectives

This cooperative effort, called BIORAPP (BIORational Artichoke Pest management Program), had the following objectives:

◆ Establish commercial, on-farm comparisons between biointensively-managed (BIORAPP) and conventionally managed artichoke production systems;

◆ Release *T. thalense*, mass-reared at the CASFS insectary, into the BIORAPP-enrolled fields and evaluate the effects of this parasitoid on APM eggs;

◆ Incorporate pheromone-based mating disruption (1998-1999) and mass trapping (1999-2000) into the BIORAPP fields for APM suppression; and

◆ Compare APM activity and damage in both systems during the 1998-1999 and 1999-2000 production seasons.

Materials and methods

Four artichoke growers, two conventional and two organic, volunteered for the project.

Shortly after cutback in June of both years, growers provided five-acre fields: B1, B2, and B3 in 1998-1999 (year 1); B1, B3, B4, and B5 in 1999-2000 (year 2) for biointensive (BIORAPP) management, and conventional fields (C1, C2, and C3 in year 1; C1 and C3 in year 2) for comparison. All fields were in traditional perennial (globe) artichokes except for B5, an annual (Imperial Star) artichoke field monitored in 1999.

To assess the performance of the BIORAPP fields, APM infestation and adult moth trap capture and *T. thalense* populations were monitored, and damage data was collected during harvest.

The observed seasons lasted from June 1998 to May 2000, with treatment and monitoring beginning in mid-June of each year, after all fields were double-cut back* at the start of the season to physically suppress initial APM infestation. The harvest season occurred from September to April of each year.

* Double-cut back refers to an APM control method in which the crop is cut back, grown for one month, and then cut back again.

The annual artichokes were grown from mid-February through August 1999, and were monitored from mid-May through the end of August.

Experimental treatments: A replicated complete block design incorporating the two management system treatments was established in 1998, with 5 acres in each treatment. Production practices, with the exception of BIORAPP APM control methods, were the same for both treatments.

APM controls in the two conventional fields consisted of two winter synthetic insecticide applications.

APM controls in BIORAPP fields both years consisted of combined biological methods: *Trichogramma* release and mating disruption; and in year 2 mass trapping of APM adults was included. Insecticides were applied once to a BIORAPP field (B2), in March 1999.

Nine (B3) to thirteen (B1, B2) releases of *T. thalense* were made to BIORAPP fields in 1998. The APM Degree Day Utility was run for each BIORAPP field to bracket APM generations. Biofix (first egg discovered) was set for June 19 in 1998 and June 10 in 1999. Degree day - based predictions were used to help time *Trichogramma* release dates in 1998.

Mass releases of *T. thalense* adults from the laboratory culture were made in three central acres in each BIORAPP field. Parasitoids were released as pupae developing in host eggs glued to 1 in. sq. release cards with 1,500 parasitoids per card, taped into small, screened paper boxes (2 cards per box), at a density of 12-16 boxes/acre. Pupae were scheduled for emergence on the release day.

During 1998-1999, a mating disruption system using pheromone lure ropes were placed in the artichoke plants at the rate of 480 per acre in July 1998.

A mass trapping system was employed in year 2 due to a shortage in the availability of pheromone ropes. This involved set-up and monitoring of pheromone/oil traps (consisting of plastic cups attached to a grape stake) every 40 feet in the BIORAPP treatment fields.

Principal investigator: Sean L. Swezey, Specialist, Center for Agroecology and Sustainable Food Systems (CASFS), University of California-Santa Cruz; Mohammad Bari, Entomologist, Artichoke Research Association, Salinas, CA; Reggie Knox, Central Coast Lighthouse Farm Coordinator, Santa Cruz, CA ✦ **Cooperating Growers:** Steve Bontadelli, Pfyffer Brothers Ranch, Santa Cruz, CA; Tim Hudson, Coastways Ranch, Pescadero, CA; Jim Cochran, Swanton Berry Farms, Davenport, CA; Mitchell Torres, Tierra Farms, Salinas, CA ✦ **OFRF support:** $4,839 (1998), $4,939 (1999) ✦ **Project period:** 1998-2000 ✦ **Reported to OFRF:** August 2000

Results and discussion

◗ **APM flights**: The degree day model predicted four APM flight periods during year 1. Based on a biofix date of June 19, flights were predicted in mid-August and late October, 1998, and early April, 1999. Fields B2 and C2 had the highest APM incidence, and APM trap captures match the predicted flight periods fairly closely.

Biofix in year 2 occurred on June 10, 1999. The adult APM capture data do not completely correspond to the degree day models in some of the fields. This reflects the effect of mass-trapping in year 2, which captures male moths and disrupts normal trap patterns.

Biofix for the annual artichokes (field B5) occurred on February 11, 1999, and subsequent generations were predicted in mid-June and mid-August 1999. Few APM were captured in this field, evidence of the success of the annual system at escaping APM detection.

Average seasonal APM trap captures were not significantly different between BIORAPP and control fields in year 1.

◗ **APM damage:** Bud damage generally was below 4%, an acceptable level, in all fields except B2, where damage levels exceeded 4% on four dates, reaching about 10% during the period between January and March 1999. With this exception, growers expressed satisfaction with these damage levels.

Average bud damage over the 1999-2000 season was below 3% in all fields, with maximum damage on any one date at 8%, in the annual artichokes (B5). Control fields during year 2 showed low infestation of buds (0-2%).

◗ **APM in-field reproduction:** In both years, there were no significant differences between BIORAPP and control fields in number of APM eggs found or APM larvae found.

◗ **Parasitization of APM by *T. thalense:*** Field B2 in year 1 was the only field with sufficient infestation from which to recover parasitoids. Detectable parasitization of APM eggs began on August 27, 1998 after four releases. One parasitized egg was found out of four APM eggs (25%) recovered from B2 on that date. Parasitized APM eggs were also found on two other dates in 1998; four parasitized of six viable APM eggs were recovered on September 3 (66%) and one parasitized egg (100%) was recovered on September 17. No other parasitized APM eggs were found in this study.

◗ **Costs:** Total costs for field monitoring were $20 per week. If used in conjunction with degree-day predictions, annual monitoring costs would be about $800. This level of monitoring could be applied to a field of up to about 40 acres with no additional costs, which would bring annual monitoring costs to $20 per acre. Total costs for rearing and releasing parasitoids were about $12,000 for the year, or about $4,000 per 5 acre field ($800 per acre). These rearing costs, prohibitively high for artichoke growers, reflect the small scale of current rearing facilities. A larger and more efficient rearing operation could bring rearing costs down considerably, and we have given a small stock culture of *T. thalense* to a commercial insectary (Rincon-Vitova) for development.

Conclusions

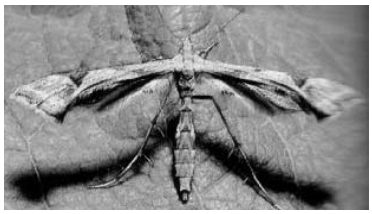
Release of *T. thalense* parasitoids into BIORAPP fields during 1998 added detectable mortality of APM eggs in the field with the highest APM infestation rates (field B2). Additionally, a six-month insecticide-free period was achieved in all BIORAPP fields in the first project season and in the second year BIORAPP fields did not receive any insecticide applications. Our results demonstrate that we can successfully rear a wild, adapted *Trichogramma* species in the laboratory, release it into a commercial production field (free of insecticide stress), and collect parasitized APM eggs in the release area. While costs of this program are currently prohibitively high, future improvements in efficiency could make the program economically feasible for growers.

Based on data from the field B5 in 1999, it appears that APM population sizes and damage levels in an annual artichoke production system are similarly effective to those in the perennial system. However, the annual site in this study was located in a different production area and an annual control site was not available in the current study.

The BIORAPP approach could be further optimized. First, the degree-day model did not consistently result in accurate predictions of APM, perhaps because of low APM numbers, insecticide applications in the C fields, and/or use of long-term temperature averages in the second project year. Second, the percent APM parasitism by laboratory-reared parasitoids reported here is lower and less consistent than those obtained in prior years of our research. Parasitization rates could possibly be increased by improving *Trichogramma* colony quality. Enhancing the efficiency of release organisms could improve control of APM larval hatch and damage to buds, and would help make mass release of *Trichogramma* an economically viable control option. ❋

"The artichoke plume moth (APM) is the most serious pest confronting growers of perennial artichokes. This insect is present in 100% of the 5,813 acres of perennial Green Globe acreage in the Castroville area of northern Monterey County. All stages of the pest are present in the fields year-round, although the infestation level drops somewhat during the period November - March. Economic damage occurs when APM larvae feed on the floral buds, rendering them unmarketable. If untreated, yield losses could reach 70%."

Source: http://pestdata.ncsu.edu/cropprofiles/docs/caartichokes.html



The artichoke plume moth (APM) (1/8" wingspan) is found throughout the U.S.

Sean Swezey's complete project report: *A grower-managed biorational program for artichoke pests (BIORAPP) on the north central California coast* (OFRF project No. 99-16) is available from OFRF by mail or by visiting www.ofrf.org. The report is 7 pages plus references, 1 table and 11 data figures describing adult male APM captures, percent bud damage by APM larvae, and APM egg and larvae counts.

Grants Awarded

OFRF awards grants for organic farming research and education projects two times per year. Grant application deadlines are January 15 and July 15. Projects may be farmer initiated, and/or should involve farmers in project design and execution and take place on organic farms whenever possible. OFRF considers funding requests within the range of $1,000 to $10,000.

To obtain our **Procedures for Grant Applications**, please contact OFRF at: tel. 831-426-6606, or visit our website at www.ofrf.org.

New Public Funding to Support Organic Research through OFRF!

We are pleased to announce that the Environmental Protection Agency has granted $84,000 to OFRF to support research project grants in fourteen states. With leadership from Agricultural Initiative staff in Region IX, EPA has chosen to back OFRF's grant-making program as one approach to achieving the research objectives of the Food Quality Protection Act.

Next year, OFRF grants for organic weed and pest management research in Alaska, Arizona, California, Colorado, Hawai'i, Idaho, Montana, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming and the U.S. Pacific Islands will be made in partnership with EPA Regions VIII, IX and X. All review and decisions on the grants will remain with the OFRF Board of Directors, and applications may be submitted as usual.

Thanks EPA for supporting organic farming research!

Spring 2001 Grants:

This spring, the OFRF Board of Directors awarded a total of $74,110 in competitive grants for the following projects:

Trap crop management in organic strawberries
Sean Swezey, University of California, Santa Cruz, CA $9,896

Biological and mechanical control of perennial weeds
Bob Quinn, Organic Farmer, Big Sandy, MT $7,239

Organic soil management and induced systemic resistance in vegetable crops
Alexandra Stone, Oregon State University, Corvallis, OR $9,352

High-residue cover crop mulches to manage weeds in no-till organic potatoes
Ronald Morse, Virginia Polytechnic Institute & State University, Blacksburg, VA $3,100

Corn trap crop to control European corn borer damage in bell pepper
Beth Kazmar, Tipi Produce, Fitchburg, WI $6,711

Forage brassicas as a component of organic production systems
Nancy Callan, Montana State University, Corvallis, MT $9,480

Intercropping to manage plant disease in organic tomatoes
James Kotcon, West Virginia University, Morgantown, WV $8,940

Biological control of *Delia* sp. in cole crops with rove beetles, *Aleochara* sp.
Renee Prasad & Deborah Henderson, E.S. Cropconsult, Vancouver, B.C. $1,400

Shade cloth and mulch to extend the greens season in the Midwest
Katherine Kelly, Full Circle Farm, Kansas City, MO $5,835

Long-term organic vegetable rotation systems and conservation tillage
Greg Hoyt, North Carolina State University, Mountain Horticultural Crops R&E Center, Fletcher, NC $5,157

Targeted mowing to increase allelopathy in rye
Neda Diab, University of Maryland, College Park, MD $7,000

ORGANIC FARMING RESEARCH FOUNDATION
INFORMATION BULLETIN
P. O. Box 440 Santa Cruz, California 95061

RETURN SERVICE REQUESTED

Non-Profit
Organization
U.S. Postage
P A I D
Permit No. 616
Santa Cruz, Ca.