

Letter

A NEWSLETTER OF THE LEOPOLD CENTER FOR SUSTAINABLE AGRICULTURE VOL. 11 NO. 3 FALL 1999

A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community.

— Aldo Leopold

Important issues, important questions

Another look at the bottom line

Does planting GMO seed boost farmers' profits?

By Mike Duffy, Associate director and agricultural economist, and Matt Ernst, Research assistant

Genetic modification of crops has taken the national and international spotlight in recent months. Depending on your perspective, crops classified as genetically modified organisms (GMOs) may be the only hope to feed a hungry world, or an inappropriate use of technology that should be halted. In Iowa, the latest wave of discussion occurred when some major United States grain trading companies, reacting to European resistance to GMOs, announced that they would only accept crops that can be certified as GMO-free.

Fueling this furor is a debate over the relative merits and safety of GMO crops—a debate that is far from being settled. Without arguing the pros and cons of genetic



Mike Duffy

GMO CROPS

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Should we worry about nitrate in our water?

EDITOR'S NOTE: Reports last spring of record nitrate levels in the Raccoon River, as well as growing concerns about groundwater contamination by nitrogen fertilizer, livestock manure, sewage systems and septic tanks, prompt another look at the safety of Iowa's rivers, lakes and reservoirs. At the heart of the discussion is the assumption that high concentrations of nitrate can be harmful to humans. But are they? Some say no.

To look at the science behind the debate, we called upon Peter Weyer, associate director of the Center for Health Effects of Environmental Contamination (CHEEC), which, along with the Leopold Center, was created by the 1987 Groundwater Protection Act. Weyer has worked on numerous studies on possible links between nitrate and cancer.

The following article is based on the latest research on nitrate in drinking water and public health concerns. A list of references used for this article is available from the Leopold Center upon request and at our web site.



Peter Weyer

By Peter Weyer
Associate director, Center for Health Effects of Environmental Contamination, University of Iowa

Nitrate levels in source water supplies fluctuate by season. Levels are usually higher in the spring after snowmelt, or following heavy rainfall. Nitrate occurs naturally and has

NITRATE

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A look back over 50 years of A Sand County Almanac (see insert)

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Important issues, important questions
Should we worry about nitrate?

NITRATE

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many sources including nitrogen fertilizers, crop residues, livestock waste, septic systems and organic matter from the soil.

Humans can be exposed to nitrate in a variety of ways. Nitrate is produced naturally in the human body. People ingest nitrate via drinking water and from a myriad of dietary sources including many vegetables (spinach is one of the largest accumulators of nitrate) and processed meats. Quantifying which sources have the biggest effects on the body has proven to be a daunting task. It is not nitrate *per se* that is a health concern, rather nitrite and N-nitroso compounds (NOCs).

Nitrite and NOCs are produced by a series of complex chemical reactions. In the human body, nitrate is turned into nitrite by the bacteria in saliva, the stomach or an infected bladder. Nitrite then reacts with certain substrates such as amines, amides and amino acids to produce NOCs, which have been found in numerous animal studies to be carcinogenic.

The historic area of concern with respect to nitrate exposure and human health is methemoglobinemia, or blue baby syndrome. Blue baby syndrome occurs when nitrite mediates the oxidation of the heme ion in hemoglobin (an oxygen-carrying protein pigment in red blood cells) to form methemoglobin. This can result in anemic hypoxia (oxygen-deficient blood), which can be life-threatening for an infant.

Because nitrate reduces to nitrite, there has been a longstanding concern about potential sources of nitrate, particularly in tap and well water used for infant formula. However, blue baby syndrome has been rarely diagnosed in the United States in recent years.

In the July 1999 issue of the journal *Environmental Health Perspectives*, Alex Avery of the Hudson Institute argues that evidence from clinical evaluation of 40 years of blue baby syndrome cases indicates that environmental sources of nitrate (particularly drinking water) may have little to do with development of the condition. He contends that gastrointestinal infection and related production of nitric oxide (which metabolizes to nitrite) may be the primary cause of many cases of blue baby syndrome. Avery

NITRATE

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FOOTPRINTS

The following comments come from *Visions for Iowa's Private Lands in 2010*, presented to Governor Tom Vilsack by a diverse group of Iowans who share a common interest in Iowa's natural resources, April 1999:

- To live in Iowa without appreciation for diversity, natural beauty and the joy of a spring flower is deprivation. — *Ted Stilwill, director, Iowa Department of Education.*
- One of the largest legacies anyone can pass to the next generation is the love and respect for the environment. We see Iowa as a place to make the heart grow. — *Sharon Powell, executive director, Moingona Girl Scout Council.*
- Today's children will be our managers in 2010. Let's see to it they are armed and have the opportunity to be good managers of our land. — *Paul R. Kelley, Iowa League, Inc.*
- We envision an Iowa in which rural and urban communities are interconnected with systems of trails, greenways, parks and wild places that form the "green infrastructure" of our state. — *Mark Ackelson, president, Iowa Natural Heritage Foundation.*



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The Leopold Center for Sustainable Agriculture seeks to identify and reduce adverse socioeconomic and environmental impacts of farming practices, develop profitable farming systems that conserve natural resources, and create educational programs with the ISU Extension Service. It was founded by the 1987 Iowa Groundwater Protection Act.

The Leopold Letter is available free from the Leopold Center at 209 Curtiss Hall, Iowa State University, Ames, Iowa 50011-1050; (515) 294-3711.

Editor: Laura Miller

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Important issues, important questions

Should we worry about nitrate?

concludes that the U.S. Environmental Protection Agency's 10 parts per million (ppm) limit for nitrate in drinking water is too stringent, and that the standard should be relaxed (see sidebar).

Avery takes his argument one step further in a June 24, 1999, *Des Moines Register* essay, and states that there is no proof that nitrate in drinking water poses a real threat for adults. He also questions the cost-benefit of nitrate removal processes in municipal drinking water treatment.

Let's assume that nitrate in drinking water does not contribute to the development of blue baby syndrome. Are there other human health concerns about long-term exposure to nitrate in water? Or are we overreacting to the presence of nitrate in our drinking water? Can an argument be made, from a public health standpoint, that it would be prudent to try and limit exposure to nitrate in drinking water?

The scientific literature includes many studies examining possible associations between nitrate in drinking water and chronic health problems. A few examples are:

- hyperthyroidism (goiter) linked to exposure to nitrate in drinking water;
- an increased risk for central nervous system malformations in newborns whose mothers had consumed private well water equal to or greater than 26 ppm $\text{NO}_3\text{-N}$;
- genotoxic effects at the chromosomal level reported in persons consuming water with very high nitrate levels, and
- an increased risk of developing insulin-dependent

What is nitrate?

Nitrate (NO_3) is a naturally-occurring form of nitrogen found in soil. Nitrogen is essential to all life, and most crop plants require large quantities to sustain high yields.

The formation of nitrate is an integral part of the nitrogen cycle in the environment. Nitrate forms when fertilizers, decaying plants, manures or other organic residues are broken down by microorganisms. Plants use nitrate from the soil to satisfy nutrient requirements and may accumulate nitrate in their leaves and stems. Nitrate also can leach into groundwater and periodically reach high levels.

Nitrate can be expressed as either NO_3 (nitrate) or $\text{NO}_3\text{-N}$ (nitrate-nitrogen). The U.S. Environmental Protection Agency has set a maximum contaminant level (MCL) for $\text{NO}_3\text{-N}$ in drinking water of 10 parts per million (ppm), or 45 ppm when expressed as nitrate.

"While one can argue about the weaknesses and strengths of specific study designs, it is obvious that we cannot say for certain that nitrate in drinking water poses no potential problems for human health."

—Peter Weyer, University of Iowa

diabetes associated with 2 to 8 ppm $\text{NO}_3\text{-N}$ in water supplies.

With respect to cancer, there are numerous reports of epidemiological studies on drinking water nitrate and cancer risk, including:

- elevated mortality rates of stomach cancer associated with high levels of nitrate in water supplies;
- no correlation between nitrate levels in water and mortality rates of digestive tract cancers or bladder cancers;
- no association between nitrate in drinking water and mortality from stomach cancer;
- a positive correlation between mortality rates of bladder cancer and nitrate levels in drinking water;
- an inverse association between nitrate levels in drinking water and the incidence of laryngeal, esophageal and oral cavity cancers;
- increased risk for non-Hodgkin's lymphoma associated with nitrate levels in drinking water, and
- no association between nitrate in drinking water and non-Hodgkin's lymphoma.

While one can argue about the weaknesses and strengths of specific study designs, it is obvious that we cannot say for certain that nitrate in drinking water poses no potential problems for human health. The jury is still out, and further research is needed. In Iowa, we are currently studying nitrate in municipal drinking water and risk of a number of cancers. Researchers at the National Cancer Institute have ongoing studies of drinking water nitrate levels in the Midwest. Some of the problems we are faced with involve quantifying individual exposure levels to nitrate. Studies to date have used average municipal water supply levels as the exposure variable. Data are very scarce; in some cases, only a handful of values exist over a number of years.

Still, the question persists. Should the EPA raise the acceptable level for nitrate in drinking water at this time? Absolutely not. In Iowa and other Midwestern states where nitrate in water supplies is a common occurrence, public health safety demands we continue studying this, and common sense indicates EPA maintain the nitrate MCL at the current level.

The potential long-term health impacts and related costs to society could be staggering. Rather than relaxing the MCL, we should be working towards preventing contamination of water supplies by nitrate (whatever the source) as a prudent effort towards reducing potential risk to the public's health.

Important issues, important questions

Does planting GMO seed boost farmers' profits?

GMO CROPS

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modification, this report describes Iowa cropping practices in 1998.

The 1998 Iowa crop survey

Information was collected by the USDA's National Agricultural Statistics Service as part of its annual Cost and Return survey. The Leopold Center funded an expansion of the USDA's cropping practices survey to provide more reliable estimates.

This information was gathered in the late fall and early winter of 1998 during personal interviews with approximately 800 Iowa farmers. They were asked what crops they grew, and whether the seed they planted had been genetically modified. The results presented here represent a random selection of 62 continuous corn fields, 315 rotated corn fields, and 365 soybean fields. These numbers and the selection methods employed provide statistically reliable estimates at the state level.

It is important to emphasize that this is only a cross-sectional survey. It does not represent a side-by-side comparison of GMO and non-GMO crops. It represents a picture of what Iowa farmers experienced, under varying conditions and situations, during the 1998 crop year.

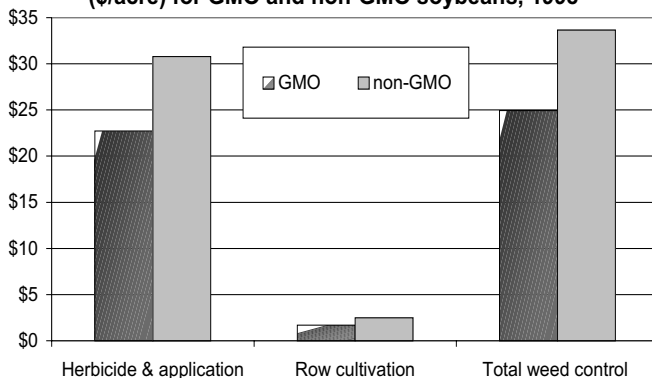
Genetically modified soybeans

Just over 40 percent of the Iowa acres planted to soybeans last year were GMO varieties. The number of soybean acres that a producer farmed had no relationship to whether or not GMO varieties were used.

When asked why they planted GMO soybeans, 53 percent of the farmers cited increasing yields through improved pest control. Another 27 percent listed decreasing pesticide costs, 12 percent said increased flexibility in planting, and 3 percent listed adoption of a more environmentally-friendly practice. The remaining farmers listed some other reason.

Farmers who did not use GMO varieties in 1998

Figure 1. Comparison of weed management costs (\$/acre) for GMO and non-GMO soybeans, 1998



reported a slightly higher yield than those who used GMO varieties. The average yield for non-GMO soybeans was 51.21 bushels per acre; the average yield for GMO soybeans was 49.26.

Farmers who used GMO varieties experienced significant savings in herbicide costs, spending nearly 30 percent less than farmers who grew non-GMO soybeans. As shown in Figure 1, farmers using GMOs held a cost advantage in all aspects of weed management.

Costs differed in other areas, too. The biggest difference was in seed cost. Farmers who planted GMO varieties reported an average seed cost of \$26.42 per acre, compared to \$18.89 per acre for non-GMO varieties. Total costs without land or labor were \$115.11 for GMO soybeans, and \$124.11 for the non-GMO soybeans.

To estimate returns, we used the 1998 yearly average price of \$5.27 per bushel. Figure 2 shows that returns to land and labor were essentially identical for GMO and non-GMO soybeans. GMO soybeans had a return of \$144.50 per acre versus a return of \$145.75 for non-GMO soybeans. Results from these 365 soybean fields indicate that 1998 yields from GMO soybeans were slightly lower than conventional varieties, but so were the costs. According to this analysis, Iowa farmers had identical returns in 1998, whether they raised GMO or non-GMO soybeans.

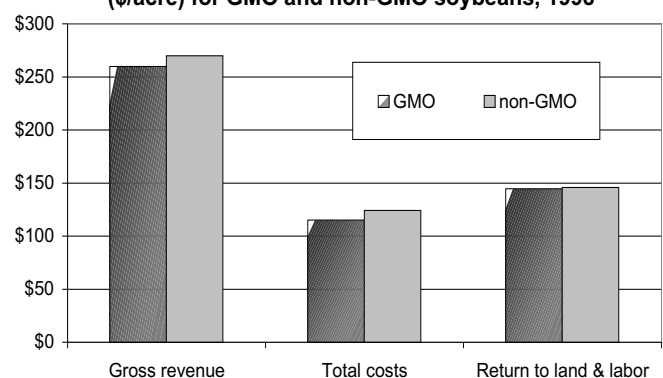
Bt corn

Another genetic modification that is being used is the addition of *Bacillus thuringiensis* (Bt) to corn to fight a major pest, the European corn borer. Last year almost a fourth (23 percent) of Iowa corn contained the Bt gene. The overwhelming majority of farmers (77 percent) said they planted Bt corn to increase yields. Only 7 percent said that they planted it to decrease pesticide costs, and the remaining 16 percent gave a variety of other reasons. Of the Bt corn fields, 7 percent were continuous corn while 93 percent

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Figure 2. Comparison of returns to land and labor (\$/acre) for GMO and non-GMO soybeans, 1998



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were corn following some other crop.

Iowa farmers were right about yields. In 1998, the average yield for Bt corn was 160.4 bushels per acre. The average yield for non-Bt corn was 147.7 bushels per acre.

Use of Bt corn didn't necessarily reduce insecticide costs. Farmers applied insecticides on 12 percent of their Bt corn fields at an average cost of \$17.56 per acre. They applied insecticides on 18 percent of their non-Bt corn fields at an average cost of \$14.94 per acre.

Based on a cross-sectional examination of Iowa cropping practices in 1998, genetically-modified crops provided farmers with no significant difference in returns.

—Mike Duffy, Associate director

The biggest cost difference between Bt and non-Bt corn was in seed. Seed for Bt corn averaged \$39.62 per acre, compared to \$29.96 per acre for non-Bt corn. Bt fields had slightly higher weed control costs, averaging \$2.82 per acre. Fertilizer costs were \$5.02 per acre higher than non-Bt corn.

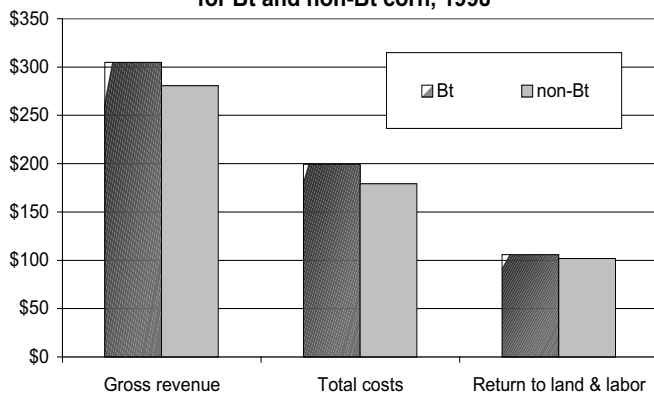
Figure 3 shows the comparison between gross revenue, total costs, and the return to land and labor between Bt and non-Bt corn. Corn was valued at the 1998 average price of \$1.90 per bushel. The total difference in return to land and labor was only \$3.97 per acre.

Conclusions

Based on a cross-sectional examination of Iowa cropping practices in 1998, genetically-modified crops provided farmers with no significant difference in returns. Remember, this is not a comparison of genetically-modified crops with their conventional counterparts, but a look at the bottom line last year for Iowa farmers—both those who raised GMO crops and those who did not.

Some producers said they used GMO soybeans to

Figure 3. Comparison of costs and returns (\$/acre) for Bt and non-Bt corn, 1998



increase their flexibility during planting season. The value of this feature when evaluating use of GMO and non-GMO crops cannot be determined from the data available. It is interesting to note, however, that increasing crop yields was cited by over half the farmers as the reason for planting GMO soybeans, yet yields were actually lower.

Use of genetically-modified seed didn't appear to impact a farmer's bottom line for either corn or soybean production, but the reasons were different. In soybeans, GMO yields were lower but so were costs. In corn, yields and costs were higher when GMO seed was used.

Genetic modification, and the controversy surrounding it, will likely continue for many years to come. Based on what happened in 1998, Iowa farmers will find returns per acre relatively unaffected whether or not they plant the GMO corn and soybeans currently available. Marketing may be more of a problem with GMO crops, but using GMO crops has not affected profitability. Farmers will choose to use or not use GMO corn or soybeans based on their own situation and view of the issues, but profitability does not appear to be a decisive factor.

Public acceptance of GMOs

Agri Marketing magazine reports in its July/August issue the results of a survey of consumers in the United States about genetically-modified foods or GMOs. Relatively unknown five years ago, GMOs now have a spot on the public agenda.

The survey found:

- One in five respondents saw genetically-engineered food as "something artificial, fake or unnatural." This is understandable, noted the magazine, given the media's tendency to portray GMOs as " Frankenfoods."
- Slightly more than a third (37 percent) of consumers saw themselves as "supporters" of this technology, 47 percent were "opponents," and 16 percent were "fence-sitters." (In Canada, where the survey also was conducted, there were fewer "supporters" and "opponents" but more "fence-sitters.")
- "Supporters" were most likely to be men, who thought the benefits outweigh the risks.
- "Opponents" saw the technology as a moral issue, and had less trust in the technology, government and food companies.

NEWS & NOTES

One of the Center advisory board's newest members, **Connie Greig**, and associate director **Mike Duffy** are part of the search committee for the ISU College of Agriculture dean. The 19-member group began work in May to identify a successor for Dean David Topel, who has served since 1988.

* * *

Aldo Leopold and the Leopold Center were featured in the May 1999 issue of *Agri Marketing*. The magazine, written for agribusiness professionals who are members of the National Agri-Marketing Association, focused on sustainable agriculture as a business strategy by large corporations as well as small companies. The article quoted one Monsanto representative as saying that "what's good for the environment is generally also good for business." The problem, Center director **Dennis Keeney** related in the story, is that not everyone agrees on what policies and practices contribute to sustainability.

* * *

Renewed interest in better monitoring Iowa's water quality is the topic for a new statewide task force for the Iowa Department of Natural Resources. Center director **Dennis Keeney** chairs the Water Monitoring Advisory Task Force with L.D. McMullen, general manager of Des Moines Water Works. Former Leopold Center Advisory Board member **Cheryl Contant** (now at Georgia Tech University) will facilitate the group's activities.

* * *

Conference goes at Iowa State University's Scheman Continuing Education Building now have a locally-grown food option. The Iowa's Choice Menu features seasonal fruits and vegetables available locally, and Iowa meat entrees available year-round. The

Expo '99 opens new world of agriculture

Learning what others are doing in sustainable and value-added agriculture projects was a highlight for more than 200 people who attended Expo '99 in June. At right, **Cathy McGregor** (left) of Charles City and **Beth Henning** of Des Moines address questions to a speaker during one of the sessions. The event brought producers, marketing and business venture specialists and community leaders together to talk about each others' successes and failures. Sponsors included the Vision 2020 Project, the Leopold Center, ISU Extension, and Sustainable Agriculture Research and Education (SARE).



Project helps find common ground

This past winter and spring, the Leopold Center helped sponsor a series of discussions using a "Common Ground" study circle approach developed and coordinated by the Wallace House Foundation. This pilot effort, also funded by the Vision 2020 Project, engaged agricultural producers, urban consumers and rural and urban community leaders to address issues in community food systems and production agriculture.

Groups developed action steps to connect producers with consumers that included recommendations to

- increase institutional buying efforts,
- encourage more "all-Iowa" meals for groups,

- provide more start-up assistance to new farmers,
- implement a rating system for state-funded projects that invest in Iowa, and
- make changes in the food system infrastructure to make it easier to purchase locally-grown foods.

One participant noted, "The process should be replicated in other parts of the state using partner organizations."

Project findings and action plans will be submitted to ISU administrators this fall. For more information about this project or the "Common Ground" study circle process, contact Kent Newman of the Wallace House Foundation, (515) 243-7063.

menu was developed by the Practical Farmers of Iowa Field to Family Project with support from the Vision 2020 project at ISU. At Scheman and elsewhere, Center education coordinator **Rich Pirog** has encouraged groups to consider local foods for their menus.

* * *

An environmental science film series, *Journey to Planet Earth*, continues to receive praise and rave reviews. Center

director **Dennis Keeney** was an advisor for the agricultural portion of the program. Narrated by Kelly McGillis, the three-part series focuses on Farming: Land of Plenty, Land of Want, the Urban Explosion, and Rivers of Destiny, including the Mississippi. It won top prize at one major film festival and will be reviewed in the August edition of the *School Library Journal*. Funding came from the Kellogg Foundation, World Bank and Rockefeller Foundation, among others.

FROM THE FIELD: Steve Williams



Photo courtesy Practical Farmers of Iowa

Steve Williams and his wife Wendi face a labor shortage.

When a labor of love doesn't stretch

Steve Williams would rather take care of his livestock than sit in front of a computer screen any day. But sometimes, he admits, it would be nice to have help, namely, a full-time employee.

Williams, a member of Practical Farmers of Iowa, is sole operator of Valley View Farm near Villisca in southwestern Iowa. He owns 300 acres—half pasture, half row crops, and all certified organic. He cash rents from his father another 150 acres for row crops and 300 acres of pasture to support 100 beef cows and a 200-sow farrow-to-finish hog operation.

He and other farmers have found themselves in a bind: their operations are too small to support more than one family, but they have more than enough work for one person. A tight labor market puts farmers in competition with Wal-Mart and McDonald's for workers, and Williams often wonders how he'll manage.

"How do you find a good half-time person?" is a perpetual question. "You almost have to grow by one person's labor because it's so hard to find quality help at a reasonable rate."

Currently, he hires someone four to five hours twice a week to do routine jobs like mowing ditches and cutting weeds. Planting is done by his father, Dave (a member of the Leopold Center Advisory Board). Wendi, Steve's wife, helps with accounting, and also keeps track of their two preschoolers, ages 2 and 4.

Another wrinkle is that Steve is switching to organic production on the land he rents, which requires considerably more labor than conventional methods. "It used to be the only time I went across my field after I planted it was to bring in the crops," he explained. "With organic, you're going over that same field at least six times for tillage, cultivation and other care."

Williams, 32, is only in his third year of raising crops, his eighth as his own boss. He returned to Page County in 1990, after a year in Chicago working with computers and information management. He jumped at the opportunity to return to Iowa as his father phased into retirement.

"I probably left the hottest field there is to come back to a field that seems like it's just about dead," the younger Williams said. "But it's been with few regrets."



Steve Williams

Ag teachers test curriculum on sustainability

It was bugs and more bugs for Iowa high school agriculture teachers who participated in a two-day in-service training in June. Nearly 40 instructors got their first peek at the new sustainable Horticulture and Biological Control curriculum, which they will test with their classes this year. They also got a close-up look at two beneficial insects—the aphid-eating larvae of the lacewing moth, and beetles that chow down on prolific purple loosestrife.

Two years in the making, the new curriculum is supported by a competitive grant from the Leopold Center. The notebook was developed by teachers as well as faculty from the ISU horticulture, entomology and agricultural education and studies departments. Rich Pirog, who coordinates the Center's educational programs, wrote the module about food systems.

The supporting web site is at <http://www.hort.iastate.edu/sustain/>. Teachers are asked to use the material this coming school year and make suggestions for improvement.

Journalists learn about ag issues

Two dozen writers and media representatives will greet the harvest season knowing more about agricultural issues than they did when crops were planted last spring. The journalists attended day-long workshops organized by the Iowa Newspaper Foundation with the help of a Leopold Center conference/workshop grant. Wrote one reporter, who grew up on a farm: "Ag 101 for Journalists offered me technical aspects I never knew were taking place on my own farm. It is essential that we, as journalists, shine the spotlight on agriculture. Farmers deserve attention."

Other sponsors of the workshop, offered twice in June, included the Iowa Farm Bureau Federation, the Natural Resources Conservation Service, and a private agricultural consulting group, Agren, Inc.



LEOPOLD CENTER

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Letter

CALENDAR OF EVENTS

● Events marked with this logo are cosponsored by the Leopold Center.

June–September—Practical Farmers of Iowa field days. For a complete listing, contact Rick Exner, PFI, (515) 294-5486. ●

June–September—Master Conservationist program, an eight-session course offered at three Iowa locations. Contact: LeAnne Rohrberg, ISU Extension, (515) 294-7222. ●

September 10—Iowa Environmental Council (IEC) annual conference, Scheman Continuing Education Building, Ames. Contact: Linda Appelgate, IEC, (515) 244-1194. ●

September 28-30—Farm Progress Show, Amana. Contact: Matt Jungmann, (319) 622-6090, or go to <www.farmprogress.com> for maps and ticket information. (Four exhibits feature Leopold Center projects.) ●

October 5-7—Building on Leopold's Legacy: Conservation for a New Century, Madison, Wis. Contact: Michael Strigel, Wisconsin Academy of Sciences, Arts and Letters, (608) 263-1692.

October 16—International Rural Women's Day conference, Newton. Contact: Denise O'Brien, (712) 243-5752. ●

October 27—On-farm Composting Workshop, Cedar Rapids. Contact: Garth Frable, Iowa Recycling Association, (515) 265-1596. ●

November 4-5—Trees Forever annual meeting and seminar, Amana Holiday Inn (I-80). Nina Leopold Bradley is featured speaker. Contact: Debbie Longseth, (515) 331-7940. ●

November 16—"Empowering local, specialized producers to meet local needs," a small and non-traditional farmer conference, Johnston. Contact: Tanya Meyer, Natural Resources Conservation Service, (319) 668-8110.

November 22-23—Iowa Forage Conference, Vermeer Conference Center, Pella. Contact: Joe Sellers, ISU Extension, (515) 774-2106. ●

January 29, 2000—Fifth Anniversary Iowa Local Food Systems and Community Agriculture conference, Des Moines. Contact: Robert Karp, Field to Family Project for Practical Farmers of Iowa, (515) 232-5649. ●