

Letter

Biologically based control tactic makes mating a losing game for European corn borers

Elizabeth Weber
Editor

As summer follows spring, it's a fact: if European corn borer moths don't mate, they can't procreate. And if they don't lay eggs on corn plants, the corn fields they frequent won't need insecticide treatments.

Those "ifs" could soon become "whens," thanks to Iowa State University entomologist Tom Baker. Because European corn borers cost Iowa producers an average 15 bushels per acre annually in crop damage, Baker's refinement of a highly effective, environmentally safe way to protect Iowa corn crops may signify a breakthrough in biological control technology.

Here's how it works: Dispensers placed in the grassy areas adjacent to corn fields are rigged to release a synthetic version of the females' pheromone, or sexual attractant. (Work by the U.S. Department of Agriculture's Corn Insect Research Lab in Ames had shown that the corn borer moths prefer to mate in dense, moist bromegrass, then fly each night into adjacent corn fields to lay eggs.)

Thus this synthetic pheromone "mate bait" is really a bait and switch tactic that confuses male moths, rendering them insensitive—and unresponsive—to the relatively minute amounts of pheromones produced by the female moths.

Putting science to work

When Baker arrived from the University of California–Riverside to chair ISU's entomology department in

1992, he was struck by how much scientific knowledge had been amassed about European corn borer pheromones—and how little had been done to apply the information toward controlling this Midwest crop pest.

Encouraged by results of similar work on pests of stored grain and fruit crops grown on smaller land areas, Baker began this study using pheromone "ropes": flexible, plastic tubes containing the synthetic pheromone. Although they were effective to varying degrees depending on their distribution density in the grassy field margin areas, they couldn't be fine-tuned to dispense optimal amounts of pheromone at specified times.



Equipping the dispensing mechanism with a pump provides greater control over frequency and timing of the synthetic pheromone. The wind then carries the synthetic pheromone scent to male moths.

But Baker had another dispensing mechanism up his sleeve. Called MSTRS® (metered semiochemical timed release system), this technology is a device consisting of a circular piece of polyester batting (see photo) mounted on a wooden embroidery hoop and equipped with an aerosol spray canister. This system is very similar to those used for dispensing air fresheners in public buildings or pest control chemicals in grain bins.

However, applying MSTRS in an outdoor setting, with a synthetic pheromone directed at an untried target (the male corn borer moth), was hardly simple. For starters, because European corn borer moths typically are active at night, Baker equipped the apparatus with a timer rigged to a light sensor. He also experimented with number of disbursements, amount of

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Seminar to offer special topics in cattle grazing

The 1998 sustainable agriculture seminar series, sponsored by the Leopold Center, will feature "Technologies to Advance the Sustainability of Iowa's Grasslands: Special Topics for Advanced Graziers," according to Iowa State University animal scientist Dan Morrical.

This will be the second year that the series is conducted in cooperation with Professional Agriculture Off-campus Programs in ISU's College of Agriculture and the fourth consecutive year the series has been offered for graduate credit through the ISU Department of Animal Science.

Morrical, who is assisting ISU animal scientist Jim Russell in coordinating the series this year, says, "We're trying to focus on new technologies and the big picture that will be of benefit to established graziers or people with more experience. This seminar is intended to complement symposiums, pasture walks, and other events that are geared toward beginning graziers."

As in 1997, the series will be aired from the college's Brenton Center in Curtiss Hall. Harold Crawford, ISU agricultural education professor, is working with ISU Extension's Iowa Communications Network coordinator Brian Menz to select ten to 12 viewing sites statewide.

Because of the production-oriented nature of this year's series, both producers and students may subscribe to the course. Producers wishing to participate on a pay per view basis should contact their area Extension livestock field specialists for information about specific sites.

Individuals wishing to attend the live presentations at the Brenton Center in Curtiss Hall at ISU may do so free of charge.

All sessions will be held on Thursday evenings from 7:00-8:30 p.m. For more information, call 1-800-747-4478.

Technologies to advance the sustainability of Iowa's grasslands: special topics for advanced graziers

Jan. 22: *Introduction to the series—Use of Year-round Grazing to Promote Forage-Based Livestock Production in Iowa*, Jim Russell, ISU; and *Unlocking the Economic Potential of Iowa's Grasslands*, Kern Hendrix, Purdue University

Jan. 29: *Integrated Use of the Feed Resource Base to Maximize Profit to Farm Enterprises*, Larry Corah, National Cattlemen's Beef Association

Feb. 5: *Productivity and Economics of Management Intensive Grazing*, Kevin Moore, University of Missouri

Feb. 12: *Forage Budgeting in Grazing Systems by Integrating Plant and Animal Management*, Dan Morrical, ISU

Feb. 19: *Forage Species Selection for Increasing Uniformity of the Year-round Forage Supply*, Bruce Anderson, University of Nebraska

Feb. 26: *Optimizing Use of Corn Crop Residues in Grazing Systems: Adding Value to the Corn Crop*, Terry Klopfenstein, University of Nebraska

March 5: *Current Experiences in Using Stockpiled Forages for Winter Grazing*, Jim Russell and Matt Hersom, ISU

March 7 (Field lab, 10 AM to 3 PM Sat.): *Making Winter Grazing Work* (McNay Outlying Research Farm, Chariton), Jim Russell, Dan Morrical, and Denny Maxwell, ISU

March 12: *Grazing System Effects on Nutrient Balance of Pasture Soils*, Antonio Mallarino, ISU

March 26: *Methods for Measuring Improvements in Productivity and Profitability from Improved Grazing Management*, Daryl Strohbehn and Steve Barnhart, ISU

March 28 (Field lab 10 AM - 3 PM; Sat.): *Fitting a Management Intensive Grazing System into Farm Enterprises in Rural/Urban Landscapes* (ISU Beef Nutrition Research Center) Dan Morrical; (Feed and Pasture Budgeting and Paddock Layout), Steve Barnhart; (Pasture Plant Identification), Jeff Lorimor; (Waste Handling and Distribution), Jim Russell and Rod Berryman



The Leopold Letter is also available via World Wide Web:
URL: <http://www.ag.iastate.edu/centers/leopold/leopold.html>

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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: Elizabeth Weber



Learning from our heritage: the Leopold Center's first ten years

Ten years ago the Iowa General Assembly passed the landmark Iowa Groundwater Protection Act, legislation that has since been critically acclaimed. The Leopold Center for Sustainable Agriculture was the most controversial portion of the legislation.

The Center's heritage can be attributed in large part to the visionary architects of that legislation. It also derives from the Leopold Center's namesake, Burlington, Iowa, native and renowned conservationist Aldo Leopold, and his enduring book, *A Sand County Almanac*—especially its capstone chapter, "A Land Ethic."

Paul Johnson, former Chief of the Natural Resources Conservation Service and a state representative in 1988, was one of the Center's originators. At the Center's first conference in 1990, he said, "Today people ask who Aldo Leopold was and why a center at Iowa State was named after him. Those questions and the answers are an important and intentional part of the process." Earlier, in a June 1988 *Des Moines Register* editorial, Johnson pointed out that the legislature structured the Center as it did to "... make people feel uncomfortable. We wanted the center to stir our consciences."

It has been the Center's momentous challenge during the past decade to serve as a collective conscience in Iowa, maintaining scientific credibility while defining a sustainable agriculture. Its guiding principle is this: if it is true to Leopold's teachings and the visions of its founders, it will be true to its mission.

I would like to probe those core values Leopold gave to the Center.

Although he based his views on sound science, Aldo Leopold openly

criticized the rigidity of the university system and other bureaucracies. He emphasized acting on principle and with integrity, and he had little time for those who criticized him. He thought holistically, kept abreast of agricultural and environmental concerns, and predicted that the environment, specifically development versus nature, would be a major issue in the future. He emphasized that the human race was an a priori part of the food web, and must be part of the landscape without dominating it. He strongly believed that the



Conservationist, ecologist, and educator Aldo Leopold (1887–1948).

private landowner was key to conservation, and he did not advocate large public holdings of productive land.

"The land ethic simply enlarges the boundaries of the community to include soils, waters, plants and animals, or collectively: the land," Leopold wrote in "A Land Ethic." This statement, read by millions, sends a strong signal to the Center 50 years later. It tells us what our "audience" is (the land) and that we are part of that land community.

Leopold also wrote, "In short, a land ethic changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it Obligations have no meaning without conscience, and the problem we face is the extension of the social conscience from people to land."

By these powerful words the Center is charged with developing ways for people to live with the land while maintaining its social and biotic fiber.

Leopold also spoke with foresight about the industrialization of agriculture, the concentration of nutrients by confined feeding of animals, and the use of pesticides such as DDT. He railed against preconceived notions of pests in his article, "What is a Weed?" He knew that "sustainable" (the word had not yet been coined) landscapes required a mix of flora and fauna, and that monoculture cropping was bad for biodiversity and for the land.

In his 1945 address, "The Outlook for Farm Wildlife," he discussed two opposing views of farm life. One saw the farm as a food factory whose success was judged by salable products but which had no place for wildlife except as accidental relics of pioneer life.

The other philosophy—the farm as a place to live—included a harmonious balance between plants, animals and people, between domestic and wild, and between utility and beauty. Leopold noted that while it was inevitable and in some ways desirable that industrialization would spread to farm life, it had overshot its mark. He predicted the negative consequences of industrial agriculture, including economic, social and ecological insecurities.

Leopold wrote, "A land ethic, then, reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land. Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity."

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Coordinator reflects on Year of Water program

Eldon Weber Year of Water coordinator

We asked Eldon Weber, an instructor in Iowa State University's Agricultural Education and Studies Department, to reflect on his experiences as Year of Water coordinator, including any surprises he encountered. He responded with the same positive energy that exemplified his work on the program. The Center is grateful to Weber for his work in making the Year of Water a success. —ed.

In April 1996, I was pleased when Dennis Keeney asked me to coordinate the Year of Water and maintain an information-sharing "clearing-house." Shortly thereafter, representatives from interested organizations met to set the program in motion.

There were definitely some pleasant surprises:

- The extent of interest in the program: 71 affiliated organizations became involved in the Year of Water! Another surprise was the number of events and news articles, generated within and among the organizations, that were linked to the Year of Water theme.
- Some 40 representatives of the affiliated organizations were on hand for Governor Branstad's signing of the proclamation. (In order to get everyone in the picture, the group was divided and two different pictures were taken.)
- After researching possibilities for a gift to give to those attending the Kick-off Meeting at the Des Moines Historical Building, we chose to distribute bottled Colfax



Eldon Weber

Mineral Water with labels bearing the Year of Water logo. I was surprised to find this was the only bottled water company selling water that originated in Iowa.

The coordinator role allowed me to integrate some of my other sustainable agriculture educational projects with the Year of Water. There has been a good connection between the Year of Water and educational initiatives with K-12 teachers and students. Working with more than 50 fifth, seventh, and ninth grade teachers and 700 of their students, I was able to devise



hands-on activities that incorporated Year of Water themes with the "Earthworm Empire/Living Soil" lessons: Surfing the Web for Willie the Worm and A Worm's Eye View of the World of Water.

I was most impressed with the Children's Water Festival at Des Moines Area Community College, where these activities were used with some of the 1,500 fifth graders in attendance. Angie Mann, of the Des Moines Water Works, and Julie Work, co-chair of the event—and many volunteers—did a superb job of organizing and implementing that event!

In classes that used these hands-on activities, students were attentive and cooperative—with one memorable exception. In a ninth grade science class, one student confronted me with the question, "Why protect our water resources? We have all the water we want, and the soil and wetlands purify the water that we pollute."

As I tried to explain the impor-

tance of each of us doing our share to help assure water quality, this student continued to bombard me with "whys" until the teacher took him aside. (My thought at that moment: teachers are not paid enough!)

I have received excellent assistance from individuals too numerous to mention, but I will cite a few here: Dennis Keeney and the Leopold Center staff, and Anne Larson in particular, have been a great sounding board to help me chart my course. The ISU College of Agriculture Information Office, under the leadership of Karen Bolluyt, and Susan Anderson in particular, provided me with outstanding media and information technical support. Dave Pavlik of the ISU Media Resources Center refined the Year of Water logo concept, which has received many compliments.

Ross Harrison of the Iowa Department of Natural Resources published the Year of Water educational supplement in the January issue of *The Conservationist*.

Finally, I could not have managed the program without having a home page on the Internet. Thanks are due Sean Marht, the ISU student who assisted in developing the Year of Water World Wide Web home page.

That Web site is one of several Year of Water outcomes that may be continued as a collaborative effort among the 71 participating organizations. In late October, Weber and Center director Keeney invited the affiliated organizations to contribute nominal funding for maintaining the information clearing-house function of this program as well as supporting children's educational activities and providing a planning base for future initiatives. —ed.

"WE ARE EMBARKED on two large-scale experiments. One is premised on the notion that conservation is something a nation buys. The other is premised on the notion that conservation is something a nation learns."

—A. Leopold

Leopold Center information finds numerous outlets

Along with seven annual conferences held in Ames since 1990, regional co-sponsored conferences have been invaluable in connecting the Center and its research findings with Iowa farmers and community leaders. The number of regionally sponsored events has increased annually since the Center began a quarterly conference/workshop support program in 1994. From January 1993 through December 1997, the Leopold Center has cosponsored 70 regional conferences and workshops attended by more than 7,500 farmers, educators, ag business representatives, youth, and community leaders in 37 different Iowa towns and cities (see map).

Topics have included water quality, manure and nutrient management, pest management and biological control, alternative swine production systems, intensive grazing management, and organic farming. ISU Extension has been a primary partner for a majority of these events, although many other groups and organizations have been involved, including Practical Farmers of Iowa, county soil and water districts, Iowa community colleges, the Iowa Fruit and Vegetable Growers Association, Trees Forever, and Limestone Bluffs RC&D.

In Creston, where Leopold-sponsored grazing workshops were held for three consecutive years (1995–97), workshop attendance increased each year and a local grazing group formed. Brian Peterson, NRCS grasslands conservationist, says, “These three workshops clearly increased the knowledge of grazing systems for area producers. A group of producers using many of these grazing practices is excited about the upcoming advanced grazing seminar series offered over the Iowa Communications Network and co-sponsored by the Center.” (see p. 2)

The Leopold Center also cosponsored three organic farming conferences with Limestone Bluffs RC&D (1995–97); these meetings were attended by more than 475 eastern Iowa farmers and community leaders. Warren Johnson, Limestone Bluffs RC&D coordinator, says, “The three conferences and follow-up seminars have provided the impetus for organic producers to develop a

The Leopold Center has cosponsored conferences and workshops in over a third of Iowa’s 99 counties. Johnson, Jones, Pottawattamie, and Winneshek counties hosted workshops in more than one town or city.

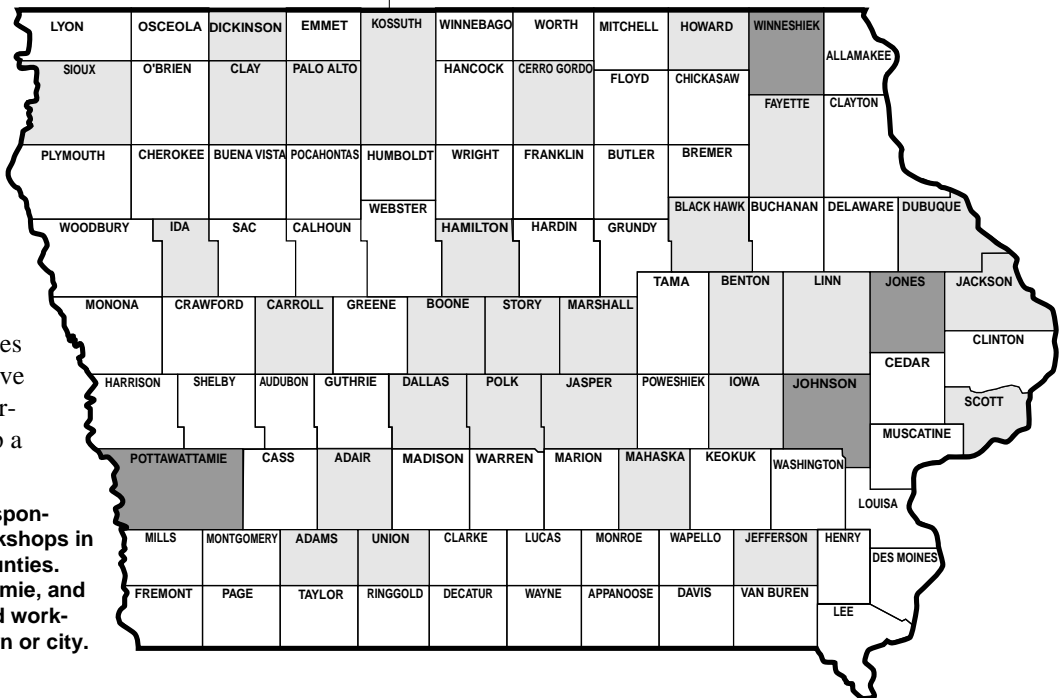
network to produce and market their organic products.”

Educational workshops are one important vehicle the Leopold Center uses to share research findings with the public. Information delivered via news media and the Internet is another.

As a result of a form available on the Center’s World Wide Web page (<http://www.ag.iastate.edu/centers/leopold/leopold.html>), requests for information flood in from around the state, country, and world. In a recent one-month period, the Center filled requests for sustainable agriculture publications from more than 20 states and from Japan, Central and South America, New Zealand, South Africa, and Australia. The demand for information through this medium continues to grow.

News media offer another valuable means of relaying information both within and outside Iowa. In recent weeks, Center director Dennis Keeney’s comments have appeared in local, regional, and national media (both print and electronic). Examples include a reprint of last issue’s “Science with Stewardship” column on the editorial pages of *The Des Moines Register*, a profile of the Center’s work in the Nov. 2 *Sunday Register*, a National Public Radio interview on concerns about the “dead zone” in the Gulf of Mexico, and a half-hour segment on water quality on “Iowa News and Views,” a public affairs program appearing on cable public access channels in Iowa.

Center advertisements via billboards, print, and radio have also raised awareness of sustainable agriculture issues and announced Center programs available to Iowa citizens.



MATING GAME

(continued from page 1)

pheromone released each time, and spacing between dispensers (five per acre appear optimal).

His next innovation was a pump mechanism to replace the aerosol. This provided more control over frequency and timing of pheromone dispensing and addressed environmental concerns about the aerosol canisters.

Using several types of traps, Baker also monitored numbers of moths in treatment plots versus plots where no synthetic pheromone had been released either by MSTRS or by ropes. Subsequent dissection of females in the laboratory by Baker's research associate Dr. Henry Fadamiro revealed whether and how recently the females had

mated. Walking through fields to flush moths at key times also provided estimates of population densities and proportion of males to females.

Egg-laying plummeted

The MSTRS technology proved superior to the ropes. It disrupted male moths' ability to locate the sex pheromone source during the moths' first and second flights at levels greater than 98% and 99%, respectively. Females were placed in cages to "challenge" the synthetic pheromone, Baker explains. "But female moths can't possibly compete with the amplitude of pheromones that we are putting out."

He adds that laboratory studies have shown that the male European corn borer moths are very loyal to a

specific pheromone blend and will not stray from it—making it quite unlikely that they will become resistant to it.

While the MSTRS method did not provide 100% mating suppression in European corn borers, it reduced mating by 30% to 40% on average—an effect that Baker thinks could be synergistic for reducing crop damage over several moth generations.

"It's not that the moths aren't mating. But for the most part, they're only mating once, not two or three times. We believe that could reduce egg-laying capacity to levels that are much less likely to result in damage to crops."

Even when the MSTRS devices were used in grassy field margins contiguous with those where no pheromone had been dispensed, mating by

Placing new tools in farmers' hands: when science gets down to business



Once pheromone technology is accepted as an effective tool, applying it will demand vigilance and strategy. "With insecticides, you can take a wait-and-see approach, but with the pheromone strategy, there is no 'rescue treatment'; farmers must commit early in the season and follow through," Baker says. (photo courtesy ISU Photo Service/ISU Office of Agriculture Information)

Respected researchers like ISU entomologist Tom Baker can quickly come under scrutiny by their peers if they get involved in commercializing the innovations resulting from their research. Their scientific colleagues may question how they can be both scientifically objective and entrepreneurial.

That is why, in his efforts to place MSTRS technology into farmers' hands, Baker must consider how to protect his scientific credibility among his academic

peers—which in turn can affect his ability to attract ongoing support for more basic portions of his research.

"A time comes in the careers of many scientists who have done curiosity-driven, 'basic' research when the applied aspects grow more satisfying. Such individuals need to be able to direct their efforts to technology transfer," Baker says. "But for the past three decades, the system has rewarded scientists for doing federally funded basic research. Now, scientists who link their efforts with private companies to make their discoveries available to the public may appear to have lost their objectivity."

According to Lynne Mumm, disclosure and database manager at the Iowa State University Research Foundation, "One function of our office is to find companies to disseminate

new technologies. We encourage faculty to participate in this technology dissemination process as well as publish papers or work with ISU Extension."

In an era of accountability and shrinking federal research budgets, academic research institutions nationwide are beefing up the support systems that guide faculty scientists through the sticky legal and technical wickets of patents, copyrights, trademarks, and other intellectual property issues.

"The land grant system has a strong tradition of applied research that encourages solution-oriented investigations and lends stature to practically applicable discoveries and inventions," Baker adds.

Because shepherding a product or process through commercialization hurdles (e.g., Environmental Protection Agency approval) takes significant time, effort, and expertise that many researchers are not inclined or able to devote, potential new technologies sometimes languish on the laboratory bench once research funding expires.

Even when a company picks up a new technology for manufacture and distribution, there's still the issue of adoption. Whose role is it to convince crop producers that the technology will work? It's a rare researcher who can nurture a product through research, development, and marketing without making what amounts to a career change.

But Baker is optimistic: "The academic environment at ISU has traditionally encouraged and assisted faculty who want to help transfer technology to the public."

Baker views crop producers as a part of the technology transfer process. "In my experience, most farmers want the competitive edge that new tools provide. The farmers who cooperated on this project were glad to help with an emerging technology. They like having more options, whether they use them all or not."

Fortunately, the business sector knows that too.

—E.W.

females was suppressed. That suggested that mating suppression should be even greater on larger treated areas, as females would have to travel long distances from untreated areas to lay eggs on fields adjacent to grassy areas equipped with dispensers.

What's next

Baker credits ISU extension entomologist Marlin Rice with providing a broad understanding of how numerous, complex agricultural factors—microclimate, corn variety, and field size—play a role in this research. Earlier research by Rice on the extent of crop damage caused by the European corn borer, and his ability to enlist farmers' help with the project, "have been critical contributions to this work," Baker says.

"Small-plot experiments have demonstrated that we can reduce the ability of males to find females," Baker notes. Preliminary calculations indicate that this method could be significantly more cost-effective than insecticide use, even taking into account labor costs to set up and monitor the dispensers—but this depends on determining the amount of egg-laying (and damage) reduction that the MSTRS can achieve across a broader area. The next step in the research is scaling up to determine the efficacy of the approach for larger areas—such as 250-acre corn fields.

Baker hopes to conduct additional investigations over larger areas, fine-tune the MSTRS system for outdoor durability, and enhance the intensity of the synthetic pheromone. Relating reduction in mating frequency to reductions in egg-laying is another key question yet to be addressed.

Center report available



The Leopold Center's annual report for July 1996 through June 1997 has been sent to individuals and organizations on the Center's mailing list. The publication, marking the Center's first ten years of existence, is dedicated to the 33 persons who have served on the Leopold Center's Advisory Board since the Center's inception. The report, which

honors their contributions, also describes the Iowa Year of Water events (a major Leopold Center initiative in 1997) and the Center's anniversary conference held in late July 1997.

The year's education and outreach activities are also featured, and brief descriptions are provided for competitive grant research and education projects currently underway. Staff activities, ranging from the director's travels to new duties and projects, round out the year's summary.

The annual report was written and edited by Mary Adams, Center editor, with assistance from other staff members. Jüls Design of Ankeny provided design and production for the 32-page publication.

Copies of the 1996-97 annual report are available free from the Center. Call (515) 294-3711 or e-mail leocenter@iastate.edu to receive a copy.

Board post transferred

Jerry Stockdale, a professor of sociology at the University of Northern Iowa, has resigned from the Center's Advisory Board after eight years of service.

"I hadn't realized it was that long until I saw a plaque that showed each member's tenure," Stockdale jokes.

Stockdale notes that the board's function has evolved over time as the Center has hired staff and developed its programs. "Originally, the board was very active in making a wide variety of decisions. Now the board serves more to assist with major policy decisions and in particular with the review of proposals."

As a sociologist, Stockdale says he considered it his role as a board member to help the Center tap into research not just about agriculture, but about changes in Iowa's rural communities. In fact, he says, his appointment to the board was an outgrowth of a long-standing professional concern with such issues, "before the term 'sustainable agriculture' was used."

Center director Dennis Keeney says, "Jerry has been associated with the Center nearly as long as I have. He has been a mainstay, serving as Board Chair and in several other roles. I have relied on Jerry for wisdom sprinkled with humor, sage advice, and a hearty skepticism of the system. We will miss him, but we're grateful that he has given so freely of his time and energy to assist Iowa in this important role."

Stockdale will continue his academic and research career in general sociology as well as in the sociological aspects of sustainable agriculture.

"I leave the board with positive feelings about the organization and the staff. I am amazed at what's happened at the Leopold Center during the years I served. It certainly has exceeded my expectations about what it would accomplish, particularly with respect to sharing research results with farmers and the public."

Replacing Stockdale as UNI representative is Thomas Fogarty, an associate professor of geography and public policy. Though new to the Advisory Board, Fogarty is familiar with the Center from his membership on its human systems issue team from 1990-1994. His areas of expertise include conflict management and peace issues. An active researcher and lecturer and a former Fulbright Fellow, Fogarty has served as editor of several professional journals and authored numerous scholarly articles. He teaches various geography and public policy courses, including "Environment, Technology, and Society."

Fogarty, a native of Rhode Island, has served on the UNI faculty since 1989.



Dr. Thomas Fogarty

Testimony illuminates issues of farm size, structure



Michael Duffy is professor of economics and an extension economist at Iowa State University. He is also an associate director at the Leopold Center and professor-in-

charge of ISU's Beginning Farmer Center. In August he was asked to testify before U.S. Secretary of Agriculture Dan Glickman's Commission on Small Farms, a 27-member panel that conducted five hearings nationwide. A portion of that testimony follows. —ed.

In speaking of our "small farm heritage," Secretary Glickman defined the question for this Commission as, "How can small farms compete in a big economy?"

Having examined questions of farm size and efficiency, as well as the structure of agriculture in Iowa, I have come to believe that such choices involve trade-offs. When a policy favors one type of production system over another, we bear the consequences.

All farms, large or small, combine a set of resources to achieve goals. Substitutions are made among the resources based on their relative values. For example, for many decades agriculture and the rest of the economy have been substituting capital for labor.

Think of the farm as having three broad categories of resources. Land can be defined to include soil, plants, and animals. Capital exists as money and liquid assets, and machinery, equipment, and the technologies they embody. Labor consists of hard physical labor, hand labor, and head labor, or management. On small, or "family" farms today (I use the terms interchangeably), owner-operators or family members provide the majority of labor.

Farm resources can be further categorized as internal or external. In recent decades, there has been a shift to a capital-intensive agriculture, and from

internal to external inputs. In the 1950s, net Iowa farm income averaged 35 percent of gross (see Figure 1). Over the past decade net averaged 18 percent. If government payments are subtracted from both net and gross incomes, net as a percentage of gross drops to 9 percent. In other words, in the 1950s, for every \$100 of gross farm income, net income was \$35. Now, for every \$100 of income, net income is between \$18 and \$9.

What do we really mean by the question, "How can small farms compete in a big economy?" Small and big are relative terms. The size of a farm can be measured by number of acres, number of livestock, gross farm income, amount of capital, and amount of labor employed. But the key to its survival is the amount of profit or net

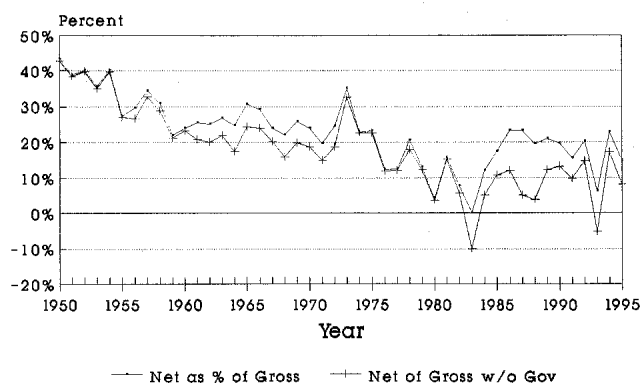
Size and efficiency

One frequent observation is that small farms cannot compete because they aren't "efficient"; but efficiency in this context is usually measured solely in terms of cost of production. As specialization and size are promoted as the path to efficiency, too often "big" is automatically equated with efficient and "small" with inefficient.

To examine the link between size and efficiency, I have been working with the Iowa Farm Business Association, which has approximately 3,000 members—mostly commercial family farms in which farming is the primary occupation.

One FBA measure of efficiency is total direct cost per bushel: all expenses that can be directly attributed to production of that crop. Another efficiency measure is total economic cost per bushel. This includes not only all direct costs, but also a return on assets owned as well as a return for unpaid family labor. In general, while there were some initial economies of size, the low

Figure 1: Iowa Net Farm Income as a Percent of Gross Farm Income



Source: Iowa Ag Statistics

income generated. Efficiency is generally the measure of a firm or farm's ability to compete, but too often, it is considered only in terms of cost per unit of output. Other measures of efficiency can include the pollution generated, number and quality of jobs available, fossil fuel used, and impact on the environment.

Ultimately, a small farm must sustain its net income to survive. Some small farms are trying to compete by imitating large farms, but small farms must capitalize on their unique flexibility if they are to succeed.

point on the average cost curve is somewhere between 300 and 500 acres. Results from FBA data from other years were similar to 1996.

Figure 2 shows the economic cost per hundredweight of swine produced based on the number of pigs marketed in 1996. Cost per hundredweight based on the number of sows was also analyzed. Again, the economies of size disappear after relatively small size increases.

These results are consistent not only with other years but with other studies. Not all agricultural enterprises

exhibit this type of cost curve, but for many enterprises the economies of size are attained rather quickly.

The FBA swine cost data have been criticized because they don't include any very large units. While this is true, similar data from the ISU Enterprise Records also support the fact that low production costs can be achieved without large numbers of sows.

In 1996, of the 98 farms in the enterprise records, the top 10 percent based on cost of production averaged only 164 sows; the top third averaged only 161 sows. One-third of the farms with the highest production costs actually had more sows than the average cost-of-production group.

Most swine record analysis shows greater variation within size groups than between them. Low production costs can be achieved in many ways. The FBA data showed that the average cost curve for the predominant enterprises in Iowa is L-shaped. The costs remain flat over a wide range of output. Farms are getting bigger, not because it lowers their production costs to do so, but because they need more volume to generate income given the tight income margins shown in Figure 1.

Agriculture's changing structure

The concern over small farms originates from uneasiness about changes in the *structure* of agriculture (defined for our purposes here as organizations and their ownership, including control of assets). Change is inevitable; we can only hope to influence its direction.

The U.S. Census of Agriculture provides the most detailed data available to examine the structure of agriculture. Agribusiness, researchers, policymakers and others use the Census information to examine the impact of changes and formulate projections. Unfortunately, Census information is inadequate to inform the debate. The Census was not designed or intended to capture the true nature and complexity of agriculture. While it gives a count of the number and types of farms, it does

not look at underlying industry structure. Since 1974, it has defined a farm as "any place from which \$1,000 or more of agricultural products were produced and sold, or normally would have been sold."

Census data also includes part-time and retired farmers as well as very small acreage and livestock units. The Census does ask farmers if they consider farming their principal occupation. Data are categorized based on whether or not farming is the principal occupation, which attempts to overcome some of the limitations imposed by a census. However, it is unclear how a retired, semi-retired, or part-time farmer who wants to be full-time might answer the question regarding principal occupation. Farming may be the principal occupation only because there is no other occupation. Nor does the

occupation, are under 55 years old, and have sales (not income) greater than \$100,000. (Net income would be approximately \$10,000.)

The survey also asked operators whether they were involved in any manner with another operation (19 percent) and how many families were involved in the decision making on their farms (17 percent). When the duplicates are eliminated, 31 percent of Iowa farms surveyed are multi-family or multi-operation. An additional 14 percent had someone helping them on a regular basis. The majority of people (86 percent) identified as regular helpers were family members.

Iowa farm structure is changing drastically. The statistics regarding age, number of farmers, and the percent of sales from such a small percentage of farmers do not recognize that

many farms are multi-family or multi-operation farms—which tend to be family operations. In many circumstances, the offspring have some sales on their own but work mostly with the large home farm. The survey results suggest that between 30 and 45 percent of farm operations involve more than one family member.

Survey respondents were also asked to name the top three income-generating commodities on their farms. Fourteen percent could only list one commodity.

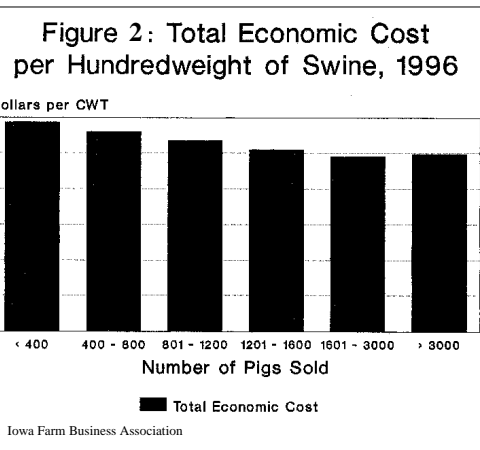
Another 39 percent could only list

two. This means that over half of Iowa farms may have only two income-generating commodities. Such a narrow production base has troubling implications for Iowa agriculture and the structure that exists.

Suggestions

I offer Secretary Glickman the following suggestions:

- All current and future USDA-funded studies should be reviewed for size bias. Studies must be size-neutral.
- Public research should look beyond today's agriculture. Let private industry do the "money-making" research. The government should conduct research that helps achieve



Census recognize multi-family operations.

To compensate for these limitations, we conducted a 1997 phone survey that attempted to examine the structure of agriculture in Iowa. Of 1,134 usable responses, less than two-thirds (63 percent) said farming was their principal occupation; 44 percent of those who considered farming their principal occupation were over 55 years old.

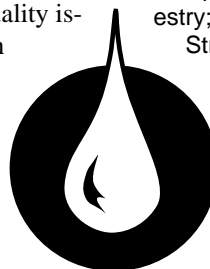
Farming was the principal occupation for only 25 percent of the farms that had sales of \$100,000 or more; this represented only 15 percent of the entire sample. In other words, in Iowa, where 98,000 farms are reported, only 14,700 consider farming their principal

societal goals *and* looks for new technologies.

- Consider an array of options and alternatives. Every farm is unique. The more options and alternatives that are available, the more likely it is that an individual farm will find its survival niche. This includes agriculturally related activities: packaging, slaughter, marketing.
- Play on the small farmer's strengths. Support management-intensive strategies as opposed to capital-intensive technologies.
- Do not confuse wanting to feed the world with wanting the world to be fed. Too often we hear that small farms can't feed the world. Hunger is as much a distributional and income problem as a production problem. Before we try to feed the world we must feed ourselves.
- Realize that agricultural policy is about more than just increasing production. How a society feeds itself and utilizes its natural resources determines how long it will last. Emphasize the culture part of agriculture. The quality of rural life and the existence of many rural communities depend on a mix of different-sized farms.
- Get better information and data on the structure of the industry. We cannot continue to count the wrong kinds of numbers and rely on anecdotal evidence. We must understand what is really happening and why changes are occurring.
- Farmers and society want viable options. Farmers don't want to be considered oddballs. But they must also realize that they have to utilize their own resources, not just mimic what the neighbors are doing. Too often, discussion of small farms focuses on how to keep a few in business, as if they are some type of relic with curiosity value. *Give them options; do not put them in theme parks.*
- Small farms can compete—but not by trying to farm the same way large farms do. Nor can they compete or survive if the majority of the research that is done continues to look at ways to put them out of business.

Water Quality videos available for loan

A series of eight videos featuring regional experts on key water quality issues are now available for loan through the State Library of Iowa's State Documents Depository Program. The presentations were taped as part of a seminar series entitled "Water Quality as an Environmental Issue for Iowa Agriculture in the 21st Century," sponsored at Iowa State University last spring.



Featured speakers and topics include:

- Tape #1—Jeff Zinn, Congressional Research Service, "Current and Future Issues Affecting U.S. Agricultural Environmental Policy"
- Tape #2—Darrell McAllister, Iowa Department of Natural Resources, "Current and Future Quality of Iowa's Water Resources"
- Tape #3—Stu Melvin and Jeff Lorimor, ISU Agricultural and Biosystems Engineering; "Minimizing Environmental Effects of Animal Production on Water Quality"
- (no tape #4—technical difficulties)
- Tape #5—Jim Baker, ISU Agand Biosystems Engineering; "Protecting Surface Water Quality through Management of Agricultural Practices"

- Tape #6—Richard Schultz, ISU Forestry; "Improving Iowa's Water Quality: Streamside Management Systems"

- Tape #7—Rameshwar Kanwar, ISU Agricultural and Biosystems Engineering; "Protecting Groundwater Quality through Management of Agricultural Practices"

- Tape #8—Roger Becker, University of Minnesota; "Weed Management Systems: High-Tech Solutions or Education to Protect Water Resources?"

- Tape #9—Bruce Babcock, Center for Agricultural and Rural Development, ISU; "Farm Programs and Environmental Policy in the 21st Century"; Linda Appelgate, Iowa Environmental Council; "Concerns and Support of the Public Regarding Surface and Groundwater Quality in Iowa"

As part of the 1997 Year of Water observance, the Leopold Center funded duplication of the videos. Tapes may be borrowed from the State Library of Iowa or the University of Iowa Libraries via the Iowa interlibrary loan program.

Contact the State Library of Iowa, Information Services Bureau (515) 281-4102; the University of Iowa Libraries Government Publications Dept. (319) 335-5927; or your local library.

LEOPOLD CENTER'S HERITAGE

(continued from page 3)



In this statement, Leopold asserted that land and soil health are key concepts, universally understood subjectively if not absolutely. He also moved conservation far beyond merely reducing soil erosion or water pollution by placing healthy land at the center of his conservation philosophy.

Leopold's most famous statement may be, "A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise." This is a core value of the Leopold Center,

that we keep the rights of the biotic community foremost in our decision-making process. It requires that we have the utmost integrity.

In choosing Aldo Leopold as a namesake, Paul Johnson and his colleagues placed an immense responsibility on the Leopold Center. In striving to remain true to Leopold's philosophy, we have a tremendous opportunity to shape the future. A ten-year anniversary has been a fine time to be reminded of this fact.

Dennis R. Keeney

Leopold Center joins with Iowa State University to establish Henry A. Wallace Endowed Chair for Sustainable Agriculture

A \$1 million grant from the W. K. Kellogg Foundation and a \$500,000 gift from the Wallace Genetic Foundation will establish the Henry A. Wallace Endowed Chair for Sustainable Agriculture at Iowa State University. These grants will be supplemented with funds from ISU's College of Agriculture and the Leopold Center for Sustainable Agriculture.

The endowment will provide perpetual funds for the faculty chair, for research programs, and for other sustainable agriculture education efforts.

Wallace, an Iowa State alumnus, was vice president of the United States during Franklin D. Roosevelt's third term, 1941–1945. Historically he is considered one of Iowa's most influential citizens.

"This endowment is of singular importance to the Leopold Center, Iowa State University and Iowa agriculture," said Dennis Keeney, director of the Leopold Center. "It will allow ISU to serve Henry A. Wallace's legacy of keeping farm families working productively on the land. The Leopold Center will work closely with the chairholder to assure that sustainable agriculture is well served."

According to ISU President Martin



Jischke, "This endowed faculty chair was established to recognize Henry A. Wallace's long association with Iowa State University and to promote his philosophical and practical ideas. Mr. Wallace's broad vision was years ahead of his time. He advocated the use of sound science and public policy for the conservation of farmland and natural resources and the alleviation of worldwide poverty and hunger."

"The Wallace Genetic Foundation is enormously pleased and honored to

be part of this important project," says Jean Wallace Douglas, director of the Wallace Genetic Foundation. "Sustainable agriculture is not only important to Iowa, but the nation and the world.

"We're honored and very pleased to be a partner with the Wallace Genetic Foundation and help establish this chair," says Oran Hesterman, program director for the W. K. Kellogg Foundation. "This chair will position Iowa State University to serve tomorrow's agriculture and take leadership for timely and appropriate changes towards more sustainable agriculture."

The Wallace chair will be a rotating position within ISU's College of Agriculture. The term of appointment will range from three to five years. Candidates will possess a demonstrated record of achievement as researchers, scientists, and/or educators in sustainable agriculture; have national or international stature; and possess vision, strong communication skills, and an ability to work productively with constituencies of diverse viewpoints. The search will begin immediately.

The chair holder, who will work closely with Leopold Center staff, will also have an Extension appointment.

News and notes

Leopold Center Advisory Board member **David Williams** of Villisca recently received an award of merit from the Soil and Water Conservation Society. One of seven individuals nationwide selected to receive the award at the Society's national convention in Toronto, Williams was cited for "significant individual achievement in advocating the conservation of water, soil and related natural resources."

Williams was also the winner of the 1996 National Cattlemen's Beef Association's Region 3 Environmental Stewardship Award (which includes Iowa, Minnesota, Missouri, Illinois, and Wisconsin); that award for 1997 has

been presented to **Dave Lubben**, former Leopold Center Advisory Board member and 1996 president of Practical Farmers of Iowa.

Lubben, who operates a 280-head feedlot and 130-head cowherd, uses rotational grazing, minimizes fossil fuel consumption, maintains fish and wildlife habitat, and employs other practices to safeguard land and water.

The **Magic Beanstalk Community Supported Agriculture** group has been chosen by the Stanley Foundation to receive one of its Iowa's Best Practices award for 1997. The Foundation selected the CSA because it "demonstrates broad-based community support

and a positive, sustainable impact on the human living environment." Magic Beanstalk CSA was instrumental in developing the Field to Family Community project funded through the Center's competitive grants program.

Center director **Dennis Keeney** spoke Oct. 23 at the Iowa Talented and Gifted Young Scholars' program at Grinnell about careers in environmental science.

"THE 4-H BOY WHO BECOMES CURIOUS about why red pines need more acid than white is closer to conservation than he who writes a prized essay on the dangers of timber famine."

—A. Leopold

"A HARMONIOUS RELATION TO LAND is more intricate, and of more consequence to civilization, than the historians of its progress seem to realize. Civilization is not, as they often assume, the enslavement of a stable and constant earth. It is a state of mutual and interdependent cooperation between human animals, other animals, plants, and soils, which may be disrupted at any moment by the failure of any of them."

—A. Leopold in

"The Conservation Ethic"

Calendar of Events

Jan. 6—Iowa's Pork Industry —Dollars and Scents, transmitted via ICN to 27 sites. Contact ISU Extension county offices or call (888) 478-0088.

Jan. 10—Practical Farmers of Iowa Winter Workshops, Des Moines. Contact Rick Exner (515) 294-1923.

Jan. 15—Neely-Kinyon Research Farm Annual Meeting, Greenfield. Contact Kathy Rohrig (515) 743-8412.

Jan. 29—High-Density Apple Management Workshop, Des Moines. Contact Mark Gleason (515) 294-0579.

Feb. 3-5—Alternative Streambank Stabilization Workshop (for NRCS and other engineering specialists), Ames. Contact Jeff Tisl (319) 245-1048 or Tom Isenhart (515) 294-8056 (isenhart@iastate.edu).

Feb. 20—Crop and Pest Management Conference, Davenport. Contact Virgil Schmitt (319) 652-4923.

Feb. 20 & 21—9th annual Upper Midwest Organic Farming Conference, Sinsinawa Mound Center, Wisconsin. Contact Faye Jones (715) 772-3153; (fjoc@win.bright.net).

DATES TO BE ANNOUNCED:

Jan.-March—(three) Grassroots of Grazing Producer Meetings, Adair, Madison and Warren Counties, Contact Brian Petersen (515) 782-4218.

Feb.—Holistic Resource Management Course (three days), northeast Iowa. Contact Gary Huber (515) 294-1854 or Margaret Smith (515) 648-4850.



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