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**Features**

Crop-pollinating native bees add value to the farm, IPM experts look for ways to keep honey bee colonies healthy, and American Gothic revised: positive perceptions from a young American farmer.

**Industry News**

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**Company Strategies**

Agronomic practices following a flood.

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Forty years of drip irrigation: Reviewing the past, prospects for the future.
Farmers need insect pollinators to produce many different types of marketable fruits and vegetables. These include apples, almonds, berries, cherries, cucumbers, melons, squash, sunflowers, and watermelon, to name just a few. In fact, worldwide, animal pollinators are required for more than 70% of crop species. In the United States, this produce and indirect products, such as milk derived from dairy cows fed on alfalfa, represents about 30% of the foods and beverages we consume. Even self-pollinating crops such as tomatoes, peppers, and eggplants often produce more, larger, or higher-quality fruit when cross-pollinated by insects.

Today, the European honey bee usually gets credit for providing this service; however, recent research is demonstrating that our native bees also are important pollinators, responsible for an estimated $3 billion in produce each year in the U.S.

Honey bees form the cornerstone of agricultural pollination in the U.S. and will continue to do so for many years to come. Due to declines in the beekeeping industry however, honey bee colonies can be in short supply or expensive when most needed. For example, during California’s almond bloom in spring 2007, growers rented honey bee hives for up to $150 a piece, almost three times the average price of just two years before. Various problems, especially parasites, diseases, and the recent Colony Collapse Disorder (see sidebar), are likely to further discourage bee keeping and continue this rising trend in prices.

Native bees may be able to take some of the burden off honey bees and, in a few cases, replace honey bees altogether. Wild-living native bees already occur on most farms, contribute to current crop yields, and can provide an insurance policy for farmers’ pollination needs. Their value is clearly illustrated by Claire Kremen, a professor at the University of California–Berkeley, and her research team in California’s Central Valley, who have found more than 50 species of native, unmanaged bees providing pollination services to three different crops. In fact, when there is enough habitat on or near a farm, native bees provided all of the pollination needed by certain crops, even those with heavy pollination demands such as watermelon. On the East Coast, more than 80 different species of native bees have been documented to pollinate berry crops, and new research demonstrates that native bees adequately pollinate 90% of the watermelon farms studied in New Jersey and Pennsylvania.

In addition, native bees do some things that honey bees...
bees cannot accomplish. For example, native bees can significantly increase cherry tomato production. It is well known that tomatoes receive enough self-pollination just by wind to produce satisfactory yields. It also is known that tomato flowers do not attract honey bees because no nectar is produced and the pollen is hidden deep inside pores in the anthers. Many native bees, however, are able to vibrate the tomato anthers in just the right way to dislodge this pollen. In so doing, they significantly increase cross-pollination between plants. The result is that fruit set can go up by almost 50% and fruit weight is nearly doubled when these flowers are visited by native bees compared with wind alone.

In another example, Dr. Sarah Greenleaf, from the University of California–Davis, demonstrated that native bees cause honey bees to move more often between male and female rows of sunflowers in hybrid seed operations. The result is an increase in cross-pollination and a doubling of sunflower seed yields.

Establishing a healthy population of native bees

The abundance of native bees depends upon both suitable habitat near a field and careful farm management. Farms close to natural or wild habitat already may be visited by significant populations of native bees. If growers want to increase populations of these wild bees on their land, three resources must be in place:

- nesting sites,
- a variety of flowering plants that provide pollen and nectar, and
- a refuge from insecticides.

All of these resources can occur in small patches or in marginal areas across a farm, such as around farm ponds, fence rows, or field margins.

Ensuring adequate nest sites is an easy thing to do. Be on the lookout and try to protect native bee nests already established on your property. Ground-nesting bees (these are different from yellow jacket wasps) often occur in well-drained, somewhat bare, sandy loam soils that are not tilled year after year. Tunnel-nesting bees use holes in old snags or the center of pithy twigs. You can also make artificial nest sites for native bees by boring holes in lumber or creating patches of bare soil with sparse vegetation.

Providing forage areas may be as simple as leaving weedy borders or allowing cover crops to bloom. Growing patches of native flowers also helps to attract valuable pollinators. Ideally, a farm should always have something in bloom, from early in the spring until the fall. These flowers can include the crops themselves or adjacent plants. If nothing else, forage patches should include flowers that bloom before and after the crop for which you most need pollination. Many of our native bees are active as adults for only about five weeks, longer than the typical bloom period for the varieties of crops in the field. Because of this, the bees on a piece of land will only reproduce successfully, and be there when your crop requires them, if they can find flowers before and after a crop blooms.
Finally, if pesticides—even those approved for organic operations—must be used, growers can still reduce their impacts on pollinators in simple ways. For example, apply pesticides just after dark when bees are no longer visiting the field (pest insects often remain on the crop during the night), and never apply insecticides to plants in bloom, even weeds that grow around field margins. Switch to pesticides that are less toxic to bees and adopt appropriate integrated pest management practices for selected crops. (For more information on reducing bee poisoning, see http://extension.oregonstate.edu/catalog/pdf/pnw/pnw591.pdf.)

We all desire the most efficient, cost-effective, and reliable pollination strategy. Our native bees can be an important part of this strategy and, with a small effort on the part of growers, may improve the reliability and effectiveness of pollination for a variety of crops. Farmers can provide a haven for native bees that will result in greater crop yields and lower costs for renting pollinators and will provide an insurance policy when honey bees are scarce. These same habitat enhancements can also support honey bees and other beneficial insects, shade irrigation ditches and streams, conserve water and reduce erosion, buffer winds, and beautify your farm. By “growing” these wild bees in addition to your crops, you will support sustainable agriculture and help native bee populations as well as the native and crop plants they service.

The honey bee puzzle
IPM experts look for ways to keep colonies healthy

In 2006, managed honey bee colonies began to disappear in large numbers without known reason. Scientists suspect this problem may be caused by a complex combination of factors, including disease, parasites, pesticides, and other environmental stresses. Research is ongoing around the country, and this article describes some of the latest findings from the northeastern United States.

Since the 1980s, bee colonies have been extensively damaged by a pest called the varroa mite. Dennis vanEngelsdorp, from the Pennsylvania Department of Agriculture, tested the effectiveness of two biopesticides, formic and oxalic acids, which are used to control varroa in Canada and Europe but have not been approved for use in the United States. In the U.S., beekeepers use conventional pesticides to control mites, but the pests show increasing resistance to these materials. Moreover, beekeepers are concerned about impacts of pesticides on bees and bee products.

Results of vanEngelsdorp’s study showed that certain uses of organic acids can effectively suppress mite populations below the economic threshold. If organic acids were developed into registered products for American beekeepers, they might provide more economical mite management, reduce pesticide residues in bee products, and slow the development of mite resistance to conventional pesticides.

Penn State’s Nancy Ostiguy has explored interruption of bee reproduction as a way of reducing levels of varroa mites, which require bee broods to reproduce. Ostiguy temporarily removed or isolated queens from the rest of the colony to prevent reproduction. Early results showed only minor differences in mite populations when brood production was interrupted, but Ostiguy also noticed very high levels of queen replacement by the colonies.

A closer look revealed a significant relationship between viral infection and queen replacement. In fact, colonies with the highest virus levels requeened themselves most frequently. Varroa, a vector of bee viruses, may be a factor in this equation, too. Ostiguy was able to show, for the first time, the transmission of a virus to honey bee larvae via honey and pollen. Some viruses may contaminate pollen even before honey bee contact.

“These data are extremely important,” Ostiguy explains, “because they may provide clues as to why queen quality has declined since the introduction of the varroa mite.”

John Burand, from the University of Massachusetts, is leading a multi-state team to develop diagnostic tools for assessing bee colony health. By examining pathogens at the molecular level, Burand seeks a better understanding of microflora that enhance bee health. He hopes to translate this new knowledge into IPM recommendations that will help to maintain the microbes which are beneficial to bees.

—Source: Integrated Pest Management Insights, Northeastern IPM Center; see http://northeastipm.org/newsandreports/2008jul/Jul08_index.html

For more information
The Xerces Society for Invertebrate Conservation publishes Farming for Bees: Guidelines for Providing Native Bee Habitat on Farms. See www.xerces.org.
In my opinion, Grant Wood's *American Gothic* has stood as the stereotypical representation of the American farmer for decades. This painting did represent farmers in the early 1900s, but agriculture has changed so much in the last century, and yet the outdated stereotype prevails. The attitude of many current-day farmers and the general public still reflects the attitude portrayed in *American Gothic*: somber and disheartened, while the truth is, agriculture these days is something to be excited about.

No one experiences the implications of this mindset more than young people who are considering farming as a profession. Personally, I have been told countless times that I am crazy for turning down “paying” job offers a college education creates for a chance to return home to the family farm. Therefore, I feel compelled to stand up and say that I am one of many college-educated rural youth who are passionate and excited about redefining agriculture and ensuring that being a farmer is something we can be proud of well into the future.

### The name game

Consider one alarming result of this stereotype: it seems the word “farmer” itself is growing less and less popular with time. As Gail Keck, who writes for *Prairie Farmer*, points out, farmers are now called “producers” who participate in “production agriculture,” run large “operations,” and grow “commodities.” What is wrong with saying that I am a farmer who runs a farm and grows crops? It seems that there is something embarrassing about defining oneself as a farmer, so the industry has come up with newer, trendier words to make the occupation sound more professional.

This trend does not simply stop with definitions at the farm gate; it extends all the way to our own universities. As Keck asks, how many land grant colleges have a college of agriculture? Of course, every land grant college has one though you will probably find it disguised under some other title on most campuses. Even at my beloved University of Illinois, we do not have a college of agriculture, we have a “College of Agriculture, Consumer, and Environmental Sciences,” cleverly known as ACES. Don’t get me wrong, I would love my college under any name, but are we so ashamed of agriculture that we have to dress it up with other limiting titles to make it more attractive? All this, not to mention the fact that I have yet to find a school that will offer me a degree in farming! It seems that instead of redefining the stereotype, farmers are letting the stereotype define them.

Maybe this change in title is necessary to keep agriculture popular in the current times. It is no secret that the average age of the American farmer continues to increase. Therefore, it is vital that young farmers are attracted to farming as an occupation and step in to carry agriculture into the future. Many farmers, young and old alike, cite the huge investment, risks, and uncertainty of a farming occupation as barriers to starting out in the trade. While these are legitimate issues faced by...
beginning farmers, I would argue that such concerns, in one form or another, are a part of just about any occupation a college graduate may encounter. We live in a time of consolidation of companies and outsourcing of jobs where no job is guaranteed; still American food production stays very domestically based. This fact in itself, combined with surging commodity prices and new markets created by biofuels and growing exports, suggests a very positive future in farming. As with any occupation, where there is risk, there is opportunity.

**Decision to farm draws criticism**

Why then, is there such a negative response to the decision to return home to the family farm? I am routinely told that I am crazy for turning down job offers for the chance to farm in a family partnership. Ironically, I feel this response is a direct result of the success that the industry is experiencing. Based on the prosperity of the industry, the study of agriculture is more popular than it has ever been. Moreover, this prosperity has created more job openings than there are graduates. In an effort to fill these positions, employers offer much higher salaries and more glamorous jobs than those that may be waiting back on the farm. When young farmers opt to turn down these offers in order to farm, they are often viewed as being irrational and experience a negative response from many of those active in both agriculture and academia.

The factor that these critics often overlook is the passion and optimism many young farmers have about the occupation. I share this enthusiasm. It drove me to be successful in college, not to land a job that offered a guaranteed salary, but to make a living off the land that I have grown up being passionate about. Actually, all criticisms aside, I’m not sure that any amount of money would impede the desire to farm that runs deep in my blood.

This negative stereotype may have a greater effect on young farmers than the actual business environment itself as they decide to choose farming as an occupation. The mindset that this stereotype creates often influences a young farmer’s decision more than the facts themselves. I have had to deal with these emotions on a regular basis from various influential people telling me that I will not be successful at farming. I often feel that I am settling for less than my full potential by returning home to farm although my gut feeling tells me the farm is where I belong. I am so grateful to have a father, and also a mentor, who knows the challenges but will do everything he can to give me the opportunity to follow my dreams. Current problems in agriculture that critics use as the basis of their arguments pale in comparison to the struggles my mom and dad faced as beginning farmers in the early 1980s. If my parents could built a successful farm in that business environment, I have no excuse not to follow and exceed the example they have set.

Reassuringly, I am not the only young college graduate who disagrees with the stereotype that young people should not farm. During the years I was in college, I watched fellow upper-classmen graduate to begin productive farming careers. I could not have been more proud to graduate with honors and follow in their footsteps. I only hope that my success as a farmer will influence another college graduate to challenge the stereotype just as these people did for me.

I am proud to share the passion of farming with numerous college graduates who will return to the family farm. While the majority of the population maintains a negative, outdated perception of farming, we will be successfully working the land to prove them otherwise. Anyone who questions the future of American agriculture or believes a modern day farmer is defined by *American Gothic* needs only to look into the eager eyes of a young farmer to have their attitude changed.

We are driven by an unexplainable force that has been instilled in us from a young age by those who are young farmers at heart. The tradition, pride, and passion for making a living off the land is a dream that no amount of criticism can take away. You can call my college what you want, you can picture me in overalls holding a pitchfork, you can even call me crazy for wanting to farm, but I know what defines a farmer, and I am proud to say I am, always have been, and always will be a farmer!
Despite June’s severe flooding in the Midwest, U.S. farmers are on pace to produce the second largest corn crop and fourth largest soybean crop in history, according to the Crop Production report released in August by the USDA’s National Agricultural Statistics Service (NASS).

Corn production is forecast at 12.3 billion bu, down 6% from last year’s record, but up 17% from 2006. Based on conditions as of August 1, corn yields are expected to average 155 bu/acre, up 3.9 bushels from last year. If realized, this would be the second highest corn yield on record, behind 2004. Growers are expected to harvest 79.3 million acres of corn for grain, down 8% from last year.

Soybean production is forecast at 2.97 billion bu, up 15% from last year but down 7% from the 2006 record. Yields are expected to average 40.5 bu/acre, down 0.7 bu from 2007, while harvested area is expected to be 17% higher than in 2007.

All cotton production is forecast at 13.8 million bales, down 28% from last year. Yield is expected to average 842 lb/acre, down 37 lb from last year’s record. Producers expect to harvest 7.85 million acres of all cotton, the lowest harvested area since 1983, and 25% less than last year.

The August Crop Production report contains NASS’s first estimates of yield and production for corn, soybeans, and other spring-planted row crops. To help ensure that these estimates were based on the best information available, NASS supplemented its standard data collection activities in order to account for the impact of the June flooding in the Midwest. NASS personnel re-interviewed approximately 9,000 farmers in flood-affected areas who had previously reported their planted acreage to the agency in early June. Additionally, NASS increased the number of corn and soybean fields selected for objective field measurements in the flood-affected areas and also increased the sample size for the Agricultural Yield Survey, through which farmers report expected crop yields.


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In June 2008, floodwaters again swamped the Midwestern United States, afflicting Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, and Wisconsin. Flooding in the U.S. can affect large regions of cropland, and areas of the Midwest and Great Plains were inundated with floodwater in 1993, 1996, and then again this year. Although most growers were able to respond well, still managing to produce what early USDA estimates indicate will be the second largest corn crop ever at 12.3 billion bu by the end of the season, proper cleanup and field management after a flood is critical to ensure production in following years.

Flooding brings more to crop fields than just water. Farmers should be aware of and consider the following:

Cleanup, soil testing, and cover crops

If sediment came from fertile fields of upstream farms, the fertility status of the field will probably be unchanged or higher than before the flood. If heavy sedimentation occurs, these soils should be tested to determine nutrient status. Take soil samples at a 6- to 8-inch depth in at least 15 locations per field. Each soil sample should represent 20 acres or less. Areas with significant differences in textures should be sampled separately.

Sand deposits may have to be removed or spread over other areas and mixed with the more productive soil beneath. Sand deposits on top of silty or clay-type soils deeper than 4 inches may decrease potential crop yields. Determine the location, depth, and amount of coverage of sand. Where coarse sand or gravel is deposited deeper than 4 to 6 inches, the materials often are removed to restore soil productivity.

“Considerable expense can be involved in situations where flooded fields are covered with sand,” says James Fawcett, agronomist and extension agent in the Iowa City area. “Bulldozers may have to be used to remove large sand deposits.”

Fawcett has been with the Iowa University Extension Service since 1988, so he has experience from the 1993 flood in Iowa as well as the extensive flooding that occurred in the Cedar Rapids area this year.

During the year, farmers should have opened all drainage ditches and removed debris from fields and pastures. Check hedge and fence rows carefully and look for partially hidden objects that could injure livestock or damage machinery. To prevent severe soil compacting, avoid running trucks and heavy farm equipment over wet soils. Most soils are not dry enough for traffic or cultivation until the top 5 or 6 inches crumble, rather than slick over or pack.

Encourage the growth of cover crops such as rye or wheat. Any type of plant growth is effective in drying waterlogged soils.

It is usually not necessary to remove silt deposits. After soils are dry enough to work, level and mix silt deposits into original topsoil, if practical. Apply animal manure and incorporate it into the soil.

The fertility level of flooded soils will probably change over a period of time. Extension agents recommend taking soil samples to determine new fertility levels rather than guessing at requirements. They also recommend, when sampling silted fields, to make...
Agronomic practices following flood

Weed management

Floods can affect weeds both the year they occur and in subsequent years. The biggest impact in the flood year will be the reduced competitive ability of the crop. Weeds will take advantage of the stunted or killed crops and grow to maturity.

In the year after a flood, new weed problems will be likely. Some of the weeds carried into the field by floodwaters may not have germinated in time to be noticed during the previous growing season. Mechanical and chemical methods need to be considered in both the flood year and subsequent years to manage weeds. A bioassay test—in which seeds are planted in flooded and nonflooded soil samples—can be helpful to determine if soils are safe for intended crops.

If the crop recovers after the flood, make an effort to reduce the impact of weed competition. This may not be practical if fields are too wet to enter for mechanical or chemical weeding. Check fields regularly to monitor crop and weed development. Take note of weed species, particularly new ones. Weed seeds may be carried into the field by floodwater.

“As after the flooding of 1993 in Iowa, water hemp was much more of a problem. I have again seen it this year and expect it to be a problem during 2009,” Fawcett says.

Make a field map of these weed locations and use it to plan next year’s weed management program. Consider whether herbicides can be safely applied. Most labels clearly specify the maximum growth stage of the crop at which the product can be used. Applications following a midseason flood are very likely beyond this “window” of application timing. Most labels also caution against using herbicides if the crop is under any stress. Thus, the feasibility of herbicide use the same year as a flood occurs is limited. If herbicide use is feasible but conditions are extremely wet, consider using a commercial sprayer equipped with flotation tires.

Flooding usually kills the crop or at least injures it so severely that it will not be worth harvesting. If this was the case, farmers should try to prevent weeds from going to seed through the use of mowing, tillage, or chemical application. Mowing will allow some weeds to survive but may hasten drying of the soil more than using herbicides. Mowing is also an option if the soil is too wet to be tilled.

Mechanically tilling the soil, if it is dry enough, will destroy weeds. It will also aerate the soil more than either mowing or spraying. Applying non-selective, nonresidual herbicides may be a good option if the soil is too wet to work mechanically. Repeat either mowing, tillage, or chemical application if another generation of weeds emerges that will produce seed.

The year after the flood

Be alert for new weed problems the year after the flood. Some weeds may have germinated after the assessment of weeds during the flood year. Others may have remained dormant until this season. The flood may also have deposited soil that is different in texture, pH, and organic matter content. These factors may influence herbicide performance and crop safety. Take soil samples and base herbicide selection and rates on current soil characteristics.

The “new soil” may have herbicide residues from the previous season’s application. These levels are unlikely to affect this year’s crop, but it would be wise to do a simple bioassay test to determine if planned crops are feasible in the flood-deposited soil. To carry out a bioassay test:

- Take several soil samples from the flooded field (1 qt per sample) and plant three or four seeds of the planned crop in each one.
- Collect soil samples from a known herbicide-free site to use as a standard and likewise plant three or four seeds of the planned crop.
- Grow the seedlings for two to four weeks.

If plants in the flooded soil are normal and appear to grow as well as those in the herbicide-free soil, indications are strong that it is safe to plant a crop. If crop growth in the flooded soil is abnormal, certified crop advisers can help determine if the symptoms are related to possible herbicide residues in the soil or to other causes, such as nutrient deficiencies or diseases.

Herbicides decompose in the soil by microbial action. This breakdown is slowed under flooded (anaerobic) conditions. Soil temperatures are also cooler under flooded and wet soil conditions, slowing both microbial and chemical degradation. Thus, the potential for herbicide carryover that would injure the subsequent crop may increase after flooding. A summary of possible effects of flooding on herbicide breakdown is shown in Table 1 (next page).

Should you allow even more time than product labels specify before planting rotation crops? Probably not if you have used dinitroaniline.
(DNA) herbicides (as noted in Table 1), but it’s difficult to say for other chemicals. Consider whether floodwaters brought in untreated soil from other fields. Also consider whether runoff removed a significant part of the applied product. When in doubt, growers should use a bioassay test or send a soil sample to a commercial lab for chemical analysis. In some cases, it may be appropriate to allow an extra week or two beyond the normal plant-back interval and deep-till the field to dilute any remaining residues.

Once the field has been planted, monitor it carefully for possible weed problems. If weed densities approach the economic threshold, use the appropriate mechanical or chemical measures to control them.

**Post-flood syndrome**

“A problem for farmers to be aware of during a year following a flood is post-flood syndrome or fallow-field syndrome,” Fawcett says.

In fields left fallow due to flooding or ponding, plant growth the following year has sometimes displayed symptoms of phosphorus (P) deficiency. These deficiencies occur even though soil testing may indicate more available P after flooding than in nonflooded fields.

Post-flood syndrome and fallow-field syndrome refer to the same experience—crops grown in fields flooded or fallow the previous year that show symptoms of P and zinc (Zn) deficiency, severe stunting, purple or light-green color, and poorly developed roots. In addition to early-season growth symptoms, yield losses can be dramatic in some instances, especially in corn. Grain yields can be reduced about 15% for corn following fallow compared with corn after cover crops.

This syndrome, according to researchers, occurs because the relationship between beneficial soil fungi and crops is reduced. These fungi, which help crops take up essential nutrients, need host plants to complete their life cycle and are reduced if the crops are not there.

Farmers facing the potential of post-flood or fallow syndrome can attempt a few practices to overcome the effect.

In the flood year, establish a cover crop in portions of fields that were not planted or were drowned out due to excessive water. This may have been difficult because persistent rains may not have allowed enough soil drying to permit planting. The choice of cover crop species depends on what herbicides had been applied to the field and the length of the remaining season.

Weed growth will support fungal populations but may provide less consistent ground cover, more erosion risk, and increased future weed pressure than cover crops.

Growers can use high-analysis P fertilizer with corn in a starter band in fields with potential for fallow syndrome problems. Research indicates that broadcast applications of P fertilizer have not been effective in preventing fallow syndrome, particularly in soils with high soil test P. High soil test P will lessen the fallow syndrome problem but not eliminate it. Ellis (1998) recommends the use of 60 to 80 lb P/acre of starter fertilizer applied the year after flood and fallow to help offset the beneficial fungi loss.

In high-input crops, using a fungal inoculant as a way of restoring these beneficial organisms is not readily available and would be too expensive.

Soybeans may also be affected by fallow syndrome, but they have generally experienced less growth retardation than corn.

**References**


This article was adapted from material provided by the North Dakota State University Extension Service (www.ag.ndsu.edu/disaster/flood.html), Iowa State University Extension Service (www.extension.iastate.edu/DisasterRecovery/cropconcerns.htm), and Pioneer’s GrowingPoint website (www.pioneer.com/growingpoint/agronomy/crop_insight/0820.jsp).
Helping growers balance economics and environmental benefits

Growing crops using sustainable farming practices requires care and awareness of the shifting pluses and minuses in both systems and the area between. While environmental benefits accrue from reducing tillage and increasing crop diversity, the economic factors may encourage the continued use of intensive tillage and specialized crop production, especially when weather is uncooperative.

A study published in the November–December 2007 issue of *Agronomy Journal*, titled “Crop Productivity and Economics During the Transition to Alternative Cropping Systems,” examined crop yields, input costs, and economic returns during the transition to a range of cropping system alternatives in the Northern Corn Belt region. These systems included organic vs. conventional, conventional vs. strip tillage, rotation between corn–soybean vs. corn–soybean–wheat/alfalfa–alfalfa, and fertility regimens such as no fertilizer/manure vs. fertilizer/manure applied at recommended rates. This study was completed for publication in late 2006, and as we all know, prices have increased in an uneven fashion since that time. Understanding how the recent run-up of prices and costs will shift this paradigm will require additional number crunching.

Farmers on the way to organic

Organic crop production depends on crop rotations to maintain productivity. Organic production may be both environmentally sound and economically viable and has historically represented a small portion of the total cropland in Minnesota where the study was done. In recent years, it has more than doubled from 56,275 acres in 1997 to 115,470 acres in 2003, according to USDA's 2006 figures. Organic production systems are at least partially driven by the potential for increasing farm profitability due to the price premiums offered for certified organic crops. A drawback to organic systems is their reliance on tillage for weed control. Farmers in the Northern Corn Belt have been slow to adopt less intensive tillage systems during the last decade, but recently the use of no-till or reduced till has increased as energy costs have risen. One result is reduced erosion and loss of soil organic matter.

As producers learn how to manage new systems during the transition period, biological changes and management adjustments may increase input costs or depress yields, inhibiting adoption of these systems in the short term. A few studies have examined short-term effects on crop yields and input costs during the transition period to organic systems. This study examined the transition effects over a wider range of alternative production systems.

Crop diversity has declined in the Northern Corn Belt region. Corn and soybean production in Minnesota increased steadily since the early 1900s, reaching 73% of the harvested area in 2005, with resulting reductions in hay and small grains. This study was designed to investigate the agronomic, environmental, and economic performance of a wide range of cropping systems. The original hypothesis was that systems that reduce tillage, increase crop diversity, and reduce use of purchased inputs can improve overall sustainability by increasing economic returns, reducing greenhouse gas emissions, and enhancing soil quality, while maintaining adequate weed control, soil fertility, and crop productivity. The objective of the study was to determine the effects of adopting alternative production systems on input costs, crop yields, and economic returns during the transition period, a short-term focus.

Study conditions

A long-term cropping systems field study was established in 2002 at the Swan Lake Research Farm located near Morris, MN. Annual precipitation in this region averages 25.8 inches, and average monthly temperatures range from below 8.4°F in January to 71.6°F in July. Average growing degree days at the site during the corn growing season is 2,199. Five soil series were identified within the experimental site; these are soil types that are normal for Minnesota farmland.

Seeding rates were comparable between systems. ‘Wrangler’ alfalfa was grown all years, ‘Alsen’ wheat was grown in 2002–2004, and ‘Oklee’ wheat was grown in 2005. Corn and soybean varieties changed from year to year as newer varieties became available. Soybean relative maturities ranged from 0.7 to 1.3 in the conventional system and 0.9 to 1.1 in the organic system. Corn relative maturity ratings ranged from 93 to 94 days in the conventional system and 94 to 95 in the organic system. In the conventional system, glyphosate-resistant soybean varieties were used each year; a Bt (*Bacillus thuringiensis*) corn variety was grown in 2002, and corn varieties with both glyphosate-resistance and Bt traits were planted in 2003–2005.

In the organic system, nongenetically modified, non-treated seeds were used for all crops, with clear-hilum soybean varieties planted each year. Certified organic seed was used for the organic treatments in 2004–2005. Both system treatments were planted at the same time, with the exception of alfalfa, which was planted simultaneously with the wheat in the conventional treatments or with a
broadcast spreader just before the second harrow operation after wheat emergence in the organic treatments. A rye cover crop was seeded into corn in the organic treatments using a broadcast spreader before the second inter-row cultivation operation to meet nominally the minimum rotation requirements for organic certification. Fertilizer or manure was applied according to best practices.

Yield samples for corn, soybean, and wheat grain were measured from a central strip within each plot, using identical size plots and methods. The organic and conventional prices used in the analysis are shown in Table 1. To isolate production-related effects from market effects, average prices for the period 1995 to 2003 were used in calculating crop revenues. Market year average prices for Minnesota were used for conventional crops, and organic prices for the upper Midwest were used for organic crops. The effect of government loan deficiency payments was included in the values shown in Table 1, using 2005 commodity loan rates for Stevens County, MN. Loan deficiency payments for 1995 to 2003 were calculated as the difference between the loan rate and the market year average price for each year. If the loan rate was less than the market year average price, the loan deficiency payment was zero. The average loan deficiency payment for the period 1995 to 2003 was added to both the conventional and organic average crop prices. Despite demand for organic dairy products, a market for organic alfalfa has not yet been established, and an organic price premium was not available for alfalfa.

A variety of production cost factors were noted (Table 2). Some included machinery ownership costs, changes in fuel costs, herbicide costs, and in some cases, increased crop drying costs, even though planting dates were the same for strip tillage and conventional tillage treatments. There were a variety of offsets, such as primary tillage costs, offset by increased use of secondary tillage and mowing for weed control. Seed, fertilizer, and chemical costs were somewhat lower for the organic treatments than for their conventional counterparts; however, this cost reduction was offset by the cost of manure handling and loading and added diesel fuel and labor costs for field operations, resulting in higher overall operating costs for the organic treatments.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Conventional price</th>
<th>Organic price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>95.05</td>
<td>177.52</td>
</tr>
<tr>
<td>Soybean</td>
<td>232.12</td>
<td>575.65</td>
</tr>
<tr>
<td>Spring wheat</td>
<td>143.81</td>
<td>245.89</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>93.18</td>
<td>93.18</td>
</tr>
</tbody>
</table>


Yields

Corn yields during the four-year transition period were affected by system, fertility, tillage, and five interactions: system by fertility, fertility by rotation, system by tillage, tillage by rotation, and system by tillage by rotation. Average corn yield over the four-year transition period was slightly higher for the treatment of conventional system, conventional tillage, corn–soy rotation, and fertilizer added at recommended rates than for other treatments but not significantly higher than yields obtained under four other conventional system treatments. This system represents the most common cropping system in the region. Average corn yield for this treatment was significantly greater than yields obtained under any of the organic treatments, with the best organic treatments showing a 34% reduction in average corn yield in comparison.

This yield reduction was greater than that reported by researchers for a comparable study in southwestern Minnesota and contrary to the findings of another study that showed no yield reduction for organic vs. conventional corn production during the transition years in Iowa. The low nutrient content and/or availability of the applied manure may have contributed to the yield reduction in the organic treatments relative to those in the conventional treatments of this study and the organic treatments of the other Minnesota study.

Soybean yields were affected by system, fertility, tillage, system by rotation interaction, and system by tillage interaction but were not significantly different among the following treatments: conventional; organic, conventionally tilled, corn–soy rotation with added manure; or the organic, conventionally tilled, corn–soy–wheat/alfalfa–alfalfa rotation with added manure.

Bean leaf beetles were observed in 2002, approaching threshold levels for insecticide applications, but no insecticide was used. Soybean aphid (Aphis glycines Matsumura) populations exceeded threshold levels in 2003 and 2005 and were sprayed in the conventional treatments only. This may have lead to relative reductions in soybean yield of organic treatments in those years.

Wheat yields were affected by system, fertility, and tillage. Average wheat yield for the treatment of conventional system, conventional till, corn–soy–wheat/alfalfa–alfalfa rotation with recommended levels of fertilizer was higher than the wheat yields obtained under any other system except the conventional strip tillage system using recommended levels of fertilizer.

Alfalfa yields were affected by system, fertility, and system by fertility interaction. In the conventional system, average alfalfa yield for the system with added fertilizer treatments was somewhat higher than for the no-fertilizer treatments.

Significant yield trend by treatment interactions were observed for each of the crops during the four-year transition period. For corn, the trend was affected by systems with a significant downward trend in organic corn yields. Soybean
yield trend was affected by a system by rotation interaction, with a significant upward trend in conventional treatment soybean yields grown in a corn–soybean–wheat/alfalfa–alfalfa rotation. The conventional treatments provided significantly higher yields than organic treatments in soybean, so even though average soybean yields for conventional treatments were not significantly different from the top two organic treatments, they were diverging over the transition period. Wheat yield trend was affected by a system by tillage interaction. None of the systems rated by tillage trends were significantly different from zero; however, the organic strip-tilled yield trend was significantly lower than the trends for the other system by tillage interactions. Similarly, for alfalfa, trends were affected by fertility, with the alfalfa yield trend for no fertilizer treatments significantly lower than the trend for added fertilizer treatments.

Total weed seed production in 2002 was relatively low, with no difference between conventional and organic treatments. However, as years progressed, total weed seed production increased considerably in the organic plots. No obvious effects occurred due to fertility management. The higher weed pressures that emerged in organic treatments compared with the conventional treatments likely contributed to the observed reductions in corn and wheat yields and also to the significant diverging yield trends that occurred for organic vs. conventional corn and soybean yields.

**Net present values**

Net present value analysis was chosen for this project because it incorporates both the timing and magnitude of net returns. This may be important in transitioning to new systems where returns may be changing over time, and particularly for organic systems where net returns may dramatically increase after certification. While this approach is suitable for analyzing the short-term performance of these systems, it is important to recognize that the ultimate economic viability of these systems also depends on long-term performance and that uncertainty about future returns can also act as an economic barrier to adoption. Net present values for the complete rotations without organic price premiums were affected by system, tillage, rotation, and tillage by system interaction. Without organic price premiums, the best conventional treatment, conventionally tilled in a corn–soy rotation with fertilizer applied, had a net

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**Table 2. Average production costs for treatments averaged over years 2002 to 2005.†**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>C-S</td>
<td>C-S-W/A-A</td>
<td>C-S</td>
<td>C-S-W/A-A</td>
<td>C-S</td>
<td>C-S-W/A-A</td>
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<tr>
<td></td>
<td>YF NF</td>
<td>YF NF</td>
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<td>119 91</td>
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<td>84 64</td>
<td>57 49</td>
<td>89 67</td>
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<tr>
<td>Diesel</td>
<td>62 62</td>
<td>64 64</td>
<td>49 49</td>
<td>52 52</td>
<td>86 84</td>
<td>79 77</td>
<td>89 84</td>
<td>79 77</td>
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<td>Labor</td>
<td>35 32</td>
<td>54 54</td>
<td>32 30</td>
<td>52 49</td>
<td>69 67</td>
<td>72 72</td>
<td>74 72</td>
<td>84 82</td>
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<td>Seed, fert., chem.</td>
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<td>338 237</td>
<td>479 333</td>
<td>358 262</td>
<td>296 296</td>
<td>203 203</td>
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<td>198 207</td>
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<tr>
<td>Manure haul &amp; load</td>
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<td>— —</td>
<td>— —</td>
<td>— —</td>
<td>143 —</td>
<td>101 —</td>
<td>143 —</td>
<td>101 —</td>
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<tr>
<td>Other operating‡</td>
<td>94 89</td>
<td>96 91</td>
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<td>106 101</td>
<td>119 109</td>
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<tr>
<td>Total operating cost</td>
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<td>795 620</td>
<td>618 501</td>
<td>810 630</td>
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<td>Machinery ownership</td>
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<tr>
<td>Total cost</td>
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<td>1,275 1,089</td>
<td>1,134 1,010</td>
<td>1,235 1,045</td>
<td>1,195 1,082</td>
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</tbody>
</table>

† C-S, corn–soybean rotation; C-S-W/A-A, corn–soybean–wheat/alfalfa–alfalfa rotation; YF, fertilizer or manure applied at recommended rates; NF, no added fertilizer or manure.
‡ Includes machinery repairs and maintenance, insurance, and interest on operating capital.
present value more than $280/acre higher than any of the organic treatments. Although net present values ranged from $136/acre to $319/acre among the conventional treatments, no significant differences due to tillage, rotation, or fertility were detected.

**Organic premiums change the picture**

When organic price premiums were included for the organic treatments in 2004 and 2005, the net present values for 2002 to 2005 were affected by tillage, fertility, rotation, and tillage by system, and rotation by system interactions. The best organic treatment (organic, corn–soy rotation, conventional tillage, and manure addition) produced net present values that were comparable to or exceeding those from any of the conventional treatments.

Particularly with organic systems, where substantial price premiums may be received beginning in the third year of transition from conventional systems, the entry point into the system can have a significant effect on net present values. For this analysis, entry point refers to the crop grown in the first year of the study, which was the first transition year. Looking at the fertilizer-added treatments only, net present values for each rotation entry point were affected by system, tillage, rotation, entry point, and interactions of tillage by system, rotation by system, entry point by tillage, entry point by rotation, entry point by tillage by system, and entry point by rotation by system. The organic, conventionally tilled corn–soy treatment, starting with soybean in 2002, provided the highest net present value over the four-year transition period at $507/acre, which was $217/acre higher than for that treatment with a corn entry point. Note that these results are somewhat sensitive to the length of time over which the comparisons are made, and over a longer time period, these differences should diminish. However, these short-term differences may be critical in determining economic survival during the transition years.

Treatments that included alfalfa in the rotation with the alfalfa entry point generally provided the lowest net present value, since no alfalfa was harvested in 2002, providing no income for that year. This entry point was not expected to be one that most producers would consider. However, in the organic treatments, the alfalfa entry point was comparable to both the corn and soybean entry points, likely due to the benefit of alfalfa in providing nitrogen for the succeeding corn crop in organic systems. The extremely poor performance of the alfalfa entry point in the strip tillage organic treatments may be caused by the detrimental effect that volunteer alfalfa had on succeeding crops under limited tillage, thus making this option agronomically and economically unfavorable.

**Sensitive points regarding organic conversion**

This study showed that, with typical organic price premiums, net present values for several organic cropping system alternatives during transition from a conventional system were competitive with conventional systems. However, without organic price premiums, there were significant reductions in short-term profitability for the organic systems that could act as a barrier to their adoption if organic price premiums were to decline. Although organic systems required less expenditures on purchased inputs, they required more fuel and labor and higher investments in machinery ownership, which resulted in higher total production costs compared with conventional production systems. Organic production costs were sensitive to manure costs and could substantially increase or decrease depending on the cost of obtaining and handling manure. Organic systems had lower corn yields and generally lower wheat and alfalfa yields compared with the highest-yielding conventional systems; however, soybean yields for the highest-yielding organic systems were not significantly different from the highest-yielding conventional systems. This study also illustrated the importance of timing transition decisions to the appropriate entry point when short-term profitability is critical.

Within conventional systems, no significant differences in net present values were detected for tillage and rotation alternatives, suggesting no economic barriers to adoption of greater crop diversity and less tillage in the short term. Within organic systems, net present values were reduced for the combination of reduced tillage and increased crop diversity compared with other combinations, and this was directly related to reductions in crop yields for this treatment. With the exception of this treatment, production costs were generally lower for systems with reduced tillage and for systems that increased crop diversity. Within conventional systems, no significant difference in corn and soybean yields were detected for tillage and rotation alternatives, and the cost savings associated with these treatments did not lead to significant differences in profitability. Although crop yields were expected to be lower without the use of fertilizer or manure inputs, significant reductions generally were detected only for wheat and alfalfa over the four-year period, and this, combined with cost savings realized from fertilizer and manure inputs, resulted in no significant difference in profitability for the two fertility treatments during the transition from conventional high-input production.

An important determining factor for long-term economic viability is long-term productivity. In particular, weeds were increasing rapidly in organic compared with conventional systems over four years, which almost certainly impacted crop yields. The diverging trends in corn and soybean yields, with conventional systems showing higher yield trends compared with organic systems, raises concern about the long-term viability of the organic systems; however, this can only be determined by additional years of study.

*This article was adapted from “Crop Productivity and Economics during the Transition to Alternative Cropping Systems,” published in Crops & Soils, Fall 2008, American Society of Agronomy.*
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References


Fall 2008 Self-Study Quiz

Helping growers balance economics and environmental benefits (no. SS 03824)

1. Prior to 2006, what has been a major price driver to the increased production of organic crops?
   - a. Reduced costs of fuel.
   - b. Reduced emissions of greenhouse gases.
   - c. Ease of marketing these crops.
   - d. Increasing price premiums for certified organic crops.

2. Corn and soybean production in Minnesota increased steadily since the early 1900s, reaching
   - a. 53% of harvested area in 2005.
   - b. 42% of harvested area in 2005.
   - c. 99% of harvested area in 2005.
   - d. 73% of the harvested area in 2005.

3. Total weed seed production in 2002 was relatively low, with no difference between conventional or organic treatments. However, as years progressed, total weed seed production increased considerably in the organic plots. What did NOT cause the increase in weed pressure?
   - a. Fertility management.
   - b. Tillage practices.
   - c. Seeding rates.
   - d. Temperature differences.

4. Organic crop production has historically represented a small portion of the total cropland in Minnesota, where this study was done. In recent years, acreage has more than
   - a. quadrupled.
   - b. halved.
   - c. doubled.
   - d. increased tenfold.

5. Why was net present value analysis used to compare values of organic vs. conventional treatments?
   - a. Net present value takes out long-term uncertainty
   - b. Net present value is easy to calculate.
   - c. Net present value can take multiple years and different earnings into consideration.
   - d. Is more likely to be accepted by the Internal Revenue Service.

6. Organic systems required less expenditures for
   - a. purchased inputs.
   - b. fuel and labor.
   - c. machinery ownership.
   - d. marketing costs.

This quiz is worth 1 CEU in Crop Management. A score of 70% or higher will earn CEU credit. The International CCA program has approved self-study CEUs for 20 of the 40 CEUs required in the two-year cycle. An electronic version of this test is also available at www.certifiedcropadviser.org. Click on “Continuing Education” and then “Self-Study CEUs.”

Directions

1. After carefully reading the article, answer each question by clearly marking an “X” in the box next to the best answer.
2. Complete the self-study quiz registration form and evaluation form on the back of this page.
3. Clip out this page, place in envelope with a $20 check made payable to the American Society of Agronomy (or provide your credit card information on the form), and mail to: ASA c/o CCA Self-Study Quiz, 677 S. Segoe Road, Madison, WI 53711. You can also complete the quiz and pay online at www.certifiedcropadviser.org ($15 charge).

Quiz Continues

Next Page
7. Organic production costs were sensitive to
   a. seed types.
   b. manure costs.
   c. tillage techniques.
   d. planting times.

8. Significant yield trend by treatment interactions were observed for each of the crops during the four-year transition period. Which is true?
   a. Organic corn was reduced by virtue of being in an organic treatment.
   b. Soybean yielded downward by interaction with fertilizer addition.
   c. Corn yield was affected upward for the organic treatment.
   d. Soybean yield was significantly higher for organic systems.

9. Entry point (the first crop in a four-year cycle toward organic certification) makes a major difference in the four-year return on investment. What caused alfalfa entry points to be poor performers in organic strip tillage treatments?
   a. Prices for alfalfa were low.
   b. Alfalfa didn’t keep out weeds effectively.
   c. Alfalfa behaved like a weed, volunteering in corn and soy fields and causing crowding in subsequent years.
   d. Alfalfa reduced fertility in subsequent years.

10. An important determining factor for long-term economic viability is long-term productivity. Which aspect of productivity is at risk using organic production systems?
    a. Decreased fertility.
    b. Loss of tilth.
    c. Increasing weed pressure.
    d. Increasing insect pressure.

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SELF-STUDY QUIZ REGISTRATION FORM

Name: ____________________________

Address: ____________________________

City: ____________________________

State/province: __________ Zip: __________

CCA certification no.: ____________________________

$20 check payable to the American Society of Agronomy enclosed.

Please charge my credit card (see below)

Credit card no.: ____________________________

Name on card: ____________________________

Type of card: [ ] Mastercard [ ] Visa [ ] Discover [ ] Am. Express

Expiration date: ____________________________

Signature as it appears on the Code of Ethics: ____________________________

I certify that I alone completed this CEU quiz and recognize that an ethics violation may revoke my CCA status.

This quiz issued September 2008 expires September 2011

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SELF-STUDY QUIZ EVALUATION FORM

Rating Scale: 1 = Poor    5 = Excellent

Information presented will be useful in my daily crop-advising activities: 1 2 3 4 5

Information was organized and logical: 1 2 3 4 5

Graphics/tables (if applicable) were appropriate and enhanced my learning: 1 2 3 4 5

I was stimulated to think how to use and apply the information presented: 1 2 3 4 5

This article addressed the stated competency area and performance objective(s): 1 2 3 4 5

Briefly explain any “1” ratings: ___________________________________________________________

Topics you would like to see addressed in future self-study materials: ______________________
Agronomic and economic performance characteristics of conventional and low-external-input cropping systems in the Central Corn Belt

One of the key questions facing agriculturalists in the 21st century is how to produce adequate amounts of food, feed, and farm income while protecting and improving environmental quality. The need to answer this question is particularly acute in the Midwestern United States, a region in which crop production currently relies heavily on synthetic N fertilizer and herbicides to manage soil fertility and weeds, and where these materials are detected regularly in ground and surface waters. This area has also been a major recipient of government subsidy payments, and there are persistent questions concerning farm economic viability if these subsidies were removed due to global trade agreements or changes in domestic farm policy.

Alternative systems that use diverse sequences of crops, mixed crop/livestock production, and integrated pest management strategies may reduce adverse environmental and health effects without decreasing—and in some cases increasing—per acre crop yields and the productivity of livestock management systems. To date, evidence for the ability of farming systems to produce high yields and sufficient income with reduced levels of chemical inputs has been inconsistent. These divergent results emphasize the need to better understand the performance characteristics of contrasting cropping systems. Consequently, a multiyear, 22-acre field experiment was conducted to test the hypothesis that low-external-input systems can provide yields and net returns that match or exceed those obtained from conventional systems.

Experimental site, rotation systems, and crop management

The experiment was conducted in central Iowa on Clarion/Nicollet/Webster soils, very common in that area. Before the initiation of the experiment, the site had been managed for at least 20 years with a corn–soybean rotation receiving conventional fertilizer and herbicide inputs. The entire site was planted with oats in 2001, and the cropping systems experiment was established in 2002. The experiment was arranged as a randomized complete block design with each crop phase of each rotation system present every year in four replicate blocks. Plot size was 60 by 280 ft.

Three crop rotations were included in the study. The two-year (corn–soybean) rotation was managed with conventional fertilizer and herbicide inputs. The three-year (corn–soybean–small grain + red clover green manure) and four-year (corn–soybean–small grain + alfalfa–alfalfa hay) rotations are representative of diversified farming systems in the region, which often include livestock. Compared with the two-year rotation, the three- and four-year rotations received lower synthetic N fertilizer and herbicide inputs. Spring triticale was used as the small grain in 2003–2005, and oats were used in 2006.

A nongenetically engineered soybean variety was used in all systems in 2003 to 2005. In 2006, a glyphosate-tolerant soybean variety was used in the two-year system, whereas a nongenetically engineered variety was used in the three- and four-year systems. Red clover and alfalfa were planted with triticale or oat. First-year alfalfa was not harvested in 2003 but was harvested once in 2004 to 2006. Established second-year alfalfa was harvested three times in 2003 and four times in 2004 to 2006. Red clover was used solely as a green manure and was not harvested for forage in any year. Soybean, red clover, and alfalfa seeds were treated with appropriate inoculants before planting. Triticale and oat straw was baled and removed after grain harvest. Corn and soybeans were planted in 30-inch rows, and all other crops were drilled in 8-inch rows or broadcast.

Tillage

Tillage regimes differed among rotation systems. In the two-year system, a combination of fall chisel plowing and spring field cultivation was used between corn harvest and soybean planting, and spring field cultivation was used between soybean harvest and corn planting. In the three-year system, a combination of fall chisel plowing and spring field cultivation was used between corn harvest and soybean planting; zero tillage or spring disking was used between soybean harvest and small-grain and red clover planting; and fall moldboard plowing, followed by spring disking and field cultivation, were used to incorporate clover sod and prepare a seedbed for corn. Tillage practices in the four-year system were the same as in the three-year system, except for a longer period without soil disturbance from small-grain and alfalfa establishment until alfalfa sod was moldboard-plowed in the fall.

Plant nutrient sources

Synthetic fertilizers were applied in the two-year rotation at conventional rates based on soil tests, whereas...
Composted cattle manure and reduced rates of synthetic fertilizers were applied in the three- and four-year rotations. Manure was applied in October of each year at a rate of 7 tons/acre (fresh-weight basis) to plots of red clover in the three-year rotation and to plots of established alfalfa in the four-year rotation. The late-spring nitrate test was used for corn in all rotation systems to determine rates for postemergence sidedress N applications.

Use of the late-spring soil nitrate test to guide postemergence N fertilizer rates for corn led to variation among years and cropping systems in synthetic N use. This variation reflected differences in weather conditions, quantities and qualities of previous crop residues, and manure amendments. Synthetic N inputs for corn were, however, consistently higher in the two-year system than in the three- and four-year systems. Across years, the mean synthetic N use for corn was 119 lb/acre/year in the two-year system, 49 lb/acre/year in the three-year system, and 32 lb/acre/year in the four-year system.

The authors of this study estimate that the quantities of N applied in manure were about 70% of what could be produced on a mixed crop–livestock farm where cattle were fed with the amounts of corn and forage produced in the experimental plots. Manuring has been shown to increase corn and soybean yields, even when the nutrient requirements of those crops are met with other fertility sources, and has been attributed to changes in soil biological, physical, and chemical properties.

Weed manipulation, sampling, and analysis

Weed responses to the three rotation systems were studied in two ways—by allowing the natural populations of weeds to be affected by the practices associated with each rotation system and by adding weed seeds to certain plots and measuring the subsequent changes in soil density. Weed biomass was determined by clipping, drying, and weighing aboveground weed parts collected from each plot. Natural weed biomass in corn and soybeans did not differ among management systems and was low in all years—common waterhemp and woolly cupgrass were the dominant species. Populations of two normally troublesome weeds, velvetleaf and giant foxtail, were found to be relatively low, but were monitored and manipulated to determine effects from the various rotations. The numbers of giant foxtail and velvetleaf seeds added to manipulated subplots in 2002 were within the range of seed shed rates observed by other investigators in corn and soybean fields.

Giant foxtail seed population density in the surface soil in subplot areas with experimentally supplemented seed banks declined significantly between fall 2002 and spring 2006 in all of the rotation systems. The decline was greatest in the two-year system, least in the three-year system, and intermediate in the four-year system. Velvetleaf seed population density in subplots with supplemented seed banks declined significantly in the two- and four-year systems but remained unchanged in the three-year system. Reductions in velvetleaf seed density did not differ between the two- and four-year systems.

Herbicide use was consistently lower for corn and soybeans in the three- and four-year systems than in the two-year system, due to the use of banded postemergence materials rather than broadcast applications of pre- and postemergence materials. Averaged across years and the different phases of each rotation system, mean herbicide inputs (by weight of active ingredient) were 76% lower in the three-year system and 82% lower in the four-year system than in the two-year system.

Weed management in the two-year rotation was based largely on herbicides applied at conventional rates. In the three- and four-year systems, herbicides were applied in 15-inch-wide bands in corn and soybean, greater reliance was placed on cultivation, and no herbicides were applied in small-grain and forage legume crops. Choices of postemergence herbicides used in each of the systems were made based on the identities, densities, and sizes of weed species observed in the plots.

Although weed suppression was largely effective in all of the systems included in this study, certain aspects of the lower-input systems require more attention. Weed growth in the stubble of small grains intercropped with alfalfa in the four-year system was problematic in 2003, when dry conditions in August precluded a fall alfalfa harvest, but not in other years when weeds were removed with hay harvested in September. In contrast, weeds were more frequently a problem in the stubble of small grains intercropped with red clover in the three-year system, which was not removed as hay in late summer. Improvements in weed suppression in small-grain stubble might be accomplished by timely late-summer mowing.

Crop yields

Corn and soybean yields in the three- and four-year systems matched or exceeded levels obtained from the conventionally managed two-year system (Table 1). Small-grain yields did not differ between the three- and four-year systems but were markedly lower in 2004 than in other years, due to higher disease incidence and severity. Alfalfa hay yields in the four-year system rose steadily between 2003 and 2006, perhaps reflecting a negative effect of the short establishment period during 2002 for the 2003 hay crop and a beneficial effect of composted manure and synthetic P and K fertilizers preceding the 2006 hay crop.

Economic analyses

Economic performance of the different crops and rotation systems was assessed using:

- data from the experimental plots concerning machinery operations, inputs, and yields
- costs of seeds, fertilizers, and herbicides at local agricultural dealers
Manure was assumed to be free (i.e., generated by on-farm livestock), but labor and machinery costs were assigned to spreading it. All crop expenses and incomes were accounted for in the year the crop was produced. Consequently, seed costs for alfalfa and income from hay produced during the alfalfa seeding year were assigned to the small-grain phase of the four-year system. Crop prices used in the calculations were $2.43/bu for corn, $6.20/bu for soybeans, $1.97/bu for triticale (56 lb/bu), $1.60/bu for oats, $60/ton for oat and triticale straw, and $85/ton for alfalfa hay. Crop subsidies included loan deficiency, counter cyclical, and direct payments.

Averaged over the period 2003 to 2006, gross revenue was greatest in the two-year system, least in the three-year system, and intermediate in the four-year system. Lower overall gross revenue from the lower external input systems reflected low revenue from triticale and oats. Gross revenue from established alfalfa was intermediate between revenue from corn and soybean.

Total production costs, excluding labor, were lowest for the four-year system, highest for the two-year system, and intermediate for the three-year system. Cost savings for the lower-input systems relative to the conventional system were most marked for herbicides and synthetic N fertilizer. In contrast, labor requirements and associated labor costs were highest in the four-year system, least in the two-year system, and intermediate in the three-year system. In particular, corn in the lower-input systems had higher labor requirements than corn in the conventional system, due to added work for spreading composted manure, plowing legume sod, and cultivations. Alfalfa hay production in the four-year system also had a large labor requirement relative to corn and soybean production in the conventional two-year system.

Despite lower gross revenue and higher labor requirements, returns to land and management without subsidies were higher for the four-year system than for the conventional two-year system, due to the large reduction in overall production costs. The addition of subsidy payments

### Table 1. Yields of corn, soybean, triticale, and oat grain and alfalfa hay from experimental plots from 2003 to 2006. Straw yields from triticale and oats are not shown.

<table>
<thead>
<tr>
<th>Year</th>
<th>Crop</th>
<th>Two-year rotation</th>
<th>Three-year rotation</th>
<th>Four-year rotation</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>Corn</td>
<td>191</td>
<td>187</td>
<td>183</td>
<td>5</td>
</tr>
<tr>
<td>2004</td>
<td>Corn</td>
<td>204</td>
<td>205</td>
<td>210</td>
<td>8</td>
</tr>
<tr>
<td>2005</td>
<td>Corn</td>
<td>198</td>
<td>227</td>
<td>225</td>
<td>6</td>
</tr>
<tr>
<td>2006</td>
<td>Corn</td>
<td>203</td>
<td>207</td>
<td>213</td>
<td>2</td>
</tr>
<tr>
<td>2003</td>
<td>Soybeans</td>
<td>44</td>
<td>43</td>
<td>44</td>
<td>2</td>
</tr>
<tr>
<td>2004</td>
<td>Soybeans</td>
<td>54</td>
<td>60</td>
<td>59</td>
<td>2</td>
</tr>
<tr>
<td>2005</td>
<td>Soybeans</td>
<td>59</td>
<td>64</td>
<td>64</td>
<td>1</td>
</tr>
<tr>
<td>2006</td>
<td>Soybeans</td>
<td>44</td>
<td>50</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>2003</td>
<td>Triticale</td>
<td>82</td>
<td>80</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2004</td>
<td>Triticale</td>
<td>41</td>
<td>42</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2005</td>
<td>Triticale</td>
<td>65</td>
<td>70</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>2006</td>
<td>Oats</td>
<td>133</td>
<td>132</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>2003</td>
<td>Alfalfa, second year</td>
<td></td>
<td>3.8</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>Alfalfa, second year</td>
<td></td>
<td>4.0</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>Alfalfa, second year</td>
<td></td>
<td>4.5</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Alfalfa, second year</td>
<td></td>
<td>4.9</td>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>
changed the magnitude of differences among the cropping systems in returns to land and management, although it did not change the rank order of the systems.

Summary

The results of this study show that corn and soybean yields in low-external-input systems can be sustained at levels that match or exceed levels obtained from conventional systems during the initial years following conversion from conventional management practices, despite large reductions in agrichemical use. The frequency of corn and soybean phases within the diversified low-external-input systems examined in this study was lower than in the conventional two-year rotation system, so total corn and soybean production over time would be lower in these systems. Nonetheless, the additional crops used within these systems can have substantial value in the marketplace or play key roles in the nutrition of livestock in mixed farming operations.

The rotation systems and management practices used in the present study were well suited to investigations of crop performance and weed dynamics but should not be construed to represent economically optimum systems. For example, longer rotations with additional years of hay might be more profitable; for conventional systems, different herbicide products might be more cost effective. This study also did not consider the economic impacts of integrating crop and livestock enterprises. Despite these shortcomings, the systems evaluated in this study indicate the types of outcomes that might be achieved with conventional and diversified low-external-input systems.

One of the key points to emerge from the present study is that productive and profitable cropping systems are based on optimizing overall system performance by fitting together individual crop components. For example, though triticale and oat added relatively little revenue themselves to the four-year rotation system, they served as effective nurse crops for establishing alfalfa, thereby minimizing erosion, suppressing velvetleaf growth without herbicides, and providing habitat for seed predators attacking velvetleaf and giant foxtail seeds. Alfalfa was less profitable than corn, but its inclusion within the rotation system allowed significant reductions in N use for corn, while also suppressing velvetleaf seed production and fostering weed seed predators.

### Table 2. Gross revenues, production costs, labor requirements, and returns to land and management for contrasting rotation systems, 2003 to 2006.

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Gross revenue</th>
<th>Production cost</th>
<th>Labor hours/acre</th>
<th>Returns without subsidies</th>
<th>Returns with subsidies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$/acre/year</td>
<td>$/acre/year</td>
<td></td>
<td>$/acre/year</td>
<td></td>
</tr>
<tr>
<td>Two-year rotation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>487</td>
<td>236</td>
<td>0.7</td>
<td>244</td>
<td>321</td>
</tr>
<tr>
<td>Soybean</td>
<td>307</td>
<td>134</td>
<td>0.8</td>
<td>164</td>
<td>198</td>
</tr>
<tr>
<td>Rotation average</td>
<td>397</td>
<td>185</td>
<td>0.7</td>
<td>204</td>
<td>260</td>
</tr>
<tr>
<td>Three-year rotation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>501</td>
<td>203</td>
<td>1.7</td>
<td>282</td>
<td>363</td>
</tr>
<tr>
<td>Soybean</td>
<td>331</td>
<td>118</td>
<td>1.0</td>
<td>202</td>
<td>237</td>
</tr>
<tr>
<td>Small grain/clover</td>
<td>202</td>
<td>102</td>
<td>0.8</td>
<td>92</td>
<td>123</td>
</tr>
<tr>
<td>Rotation average</td>
<td>345</td>
<td>141</td>
<td>1.2</td>
<td>192</td>
<td>241</td>
</tr>
<tr>
<td>Four-year rotation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>506</td>
<td>196</td>
<td>1.7</td>
<td>293</td>
<td>374</td>
</tr>
<tr>
<td>Soybean</td>
<td>334</td>
<td>118</td>
<td>1.0</td>
<td>205</td>
<td>240</td>
</tr>
<tr>
<td>Small grain/alfalfa</td>
<td>249</td>
<td>142</td>
<td>1.1</td>
<td>96</td>
<td>126</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>376</td>
<td>79</td>
<td>1.7</td>
<td>281</td>
<td>311</td>
</tr>
<tr>
<td>Rotation average</td>
<td>366</td>
<td>134</td>
<td>1.4</td>
<td>219</td>
<td>263</td>
</tr>
</tbody>
</table>
Fall 2008 Self-Study Quiz

Agronomic and economic performance characteristics of conventional and low-external-input cropping systems in the Central Corn Belt (no. SS 03825)

1. Farming systems that can reduce the adverse environmental effects of crop production while maintaining yields usually rely less on
   a. synthetic fertilizers and pesticides.
   b. integrating crop and livestock production.
   c. using IPM.
   d. diverse crop sequences.

2. Characteristics of the research for this study included
   a. four crop rotation systems tested.
   b. spring triticale and oats for small grains.
   c. drilled soybeans.
   d. corn after corn.

3. Weed management for the low-external-input systems in this study involved
   a. adding waterhemp and woolly cupgrass seeds to simulate exceptionally heavy weed pressure.
   b. hand weeding.
   c. banding herbicides over corn and soybean rows.
   d. using fungi as a natural bioherbicide.

4. A reason for lower gross revenue from the three-year system as compared with the others included
   a. lower revenue from triticale and oats.
   b. higher production costs associated with forage establishment.
   c. lower corn and soybean yields in that rotation sequence.
   d. costs assigned to the value of manure.

5. Comparing the three- and four-year systems with the two-year system, herbicide use was
   a. reduced 18 to 24%.
   b. reduced by well over half.
   c. higher.
   d. roughly the same.

6. A characteristic of plant nutrient management in this study was that
   a. manure was the primary source of nitrogen in the two-year rotation.
   b. uniform rates of nitrogen were used to minimize plot-to-plot variability.
   c. no phosphorus or potassium were applied.
   d. the late-spring nitrate test was used for corn in all rotations.

7. Considerations when evaluating the results of this study include all of the following EXCEPT
   a. the benefits for livestock operations integrated into a cropping operation.
   b. other rotation systems that could be more suitable or profitable.
   c. new nitrogen-fixing corn that will eliminate the advantages of clover or alfalfa in the rotation.
   d. balancing the low production value of crops such as oats and triticale with their other benefits of crop establishment and weed control.
8. The average return to land and equity without subsidies in any of the rotation systems was about
   □ a. $150/acre.                □ c. $250/acre.
   □ b. $200/acre.                □ d. $300/acre.

9. Crop yields in the various rotation systems reflect
   □ a. yield penalties for corn after corn.
   □ b. the high yield variability among plots as shown by standard errors.
   □ c. penalties of poor weed control where herbicides were banded.
   □ d. similar or better corn and soybean yields in the three- and four-year rotations as compared with the two-year rotation.

10. Consequences of using a three- or four-year rotation instead of a two-year rotation on a regional basis include
    □ a. lower overall production of corn and soybeans.
    □ b. a lack of knowledge about forage production practices.
    □ c. the increasing resistance of weeds to certain herbicides in a diverse crop mix.
    □ d. the decline in soil organic matter that comes from small grains in the rotation.
Check out the new Career Placement Center

Careerplacement.org

Job seekers, are you ready to find your next career opportunity? Employers, are you looking for the next addition to your team? Then check out the new and improved ASA–CSSA–SSSA Career Placement Center on the web at www.careerplacement.org and at the Joint Annual Meeting in Houston this October in George Bush Ballroom AB of the George R. Brown Convention Center.

Job seekers

Job seekers can post resumes, free of charge for certified professionals (CCA, CPAg, CPSS, and CPSC) and ASA–CSSA–SSSA members through our easy-access submission site. They can also create more than one resume to target different job opportunities and select categories for employers to conduct resume searches. These categories include the certifications you hold, your education and job level, the type of employment you desire, and relocation preference. But that’s not all—resumes can be searched based on any criteria in your resume.

You can search job openings by title and content, allowing you to target specific job criteria and the positions you’re interested in. Jobs are posted online immediately after submission, so you can learn about these opportunities very quickly. There will be additional job listings posted at the Career Placement Center in Houston this October at the Joint Annual Meeting (www.acsmeetings.org). Employers will conduct interviews for these positions, and you can learn more about these opportunities first hand. The Annual Meeting Career Placement Center is also an excellent way to meet many employers—all in one convenient location during a three-day period.

To post your resume and search jobs, visit www.careerplacement.org. For more information, call 608-268-4949 or email lmalison@agronomy.org.

Employers

Ready to find the perfect employee, the one with skills, education, and experience you need? Search our resume database and find that qualified practitioner and agronomic, crop, soil, or environmental professional. Resumes can be searched using a wide range of criteria, so you can find the right individual to match your position. You can also browse all the resumes posted by the date submitted.

You may also post job openings online and through our monthly CSA News magazine. It’s more cost effective than the big, national job sites and focused exclusively on ag-related, experienced professionals. For rates and more information, contact Melissa Fall at mfall@agronomy.org or 608-268-4972. Have a variety of job openings? Consider a new display ad here in the Career Center page of Crops & Soils magazine. Contact Alexander Barton at abarton@2bartons.com or 847-698-5069.

The Joint Annual Meeting in Houston offers a range of services to employers. If you are attending, take advantage of renting an interview table or private booth, schedule interviews with job seekers, and post your position(s) for many to see. Other services include the use of a photocopier machine, staff assistance with scheduling interviews, and if you need a break, an employer lounge with refreshments is available in the Career Placement Center.

To search resumes and post job openings, visit www.careerplacement.org. For more information, call 608-268-4949 or email lmalison@agronomy.org.

Position announcement

Research agronomist—Kentucky

Our Research Agronomists own their jobs. Do your job your way. Work for a company with an impeccable reputation in the Ag industry. Stay on the forefront of agricultural technology. Be part of a close-knit successful team of highly-expert Research Agronomists and Crop Consultants. Good performance is rewarded financially. Receive extensive orientation, training, and ongoing support from the organization. This is a full-time salary job with a significant bonus program and with generous benefits. Call Randstad at 270-746-6454, or email resume to Kimberly.Hoffman@us.Randstad.com.

Table 1. Career Placement Center hours in Houston.

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday, October 5</td>
<td>10:00 am–5:00 pm</td>
</tr>
<tr>
<td>Monday, October 6</td>
<td>8:00 am–5:00 pm</td>
</tr>
<tr>
<td>Tuesday, October 7</td>
<td>8:00 am–5:00 pm</td>
</tr>
</tbody>
</table>
Barometric pressure sensor

A new barometric pressure sensor is being offered for use with the Onset Computer Corporation’s remote monitoring system and weather station products. The sensor measures barometric pressure over a range of 660 to 1,070 mb.

The new product provides several features including weatherproof housing, enabling the sensor to be mounted outside of the weather station enclosure. This means that the station can maintain its weatherproof seal without having to be vented to the atmosphere. According to Onset, the Smart Sensor design enables the sensor to be plugged into HOBO U30 Remote Monitoring System and weather station products and be automatically recognized without complicated wiring, programming, or calibration requirements.

The new Barometric Pressure Smart Sensor works with Onset’s weather station products. These systems can be configured to measure the user’s choice of a wide range of parameters including, temperature, relative humidity, rainfall, soil moisture, wind speed and direction, leaf wetness, photosynthetically active radiation (PAR), and solar radiation.

For more information, see www.onsetcomp.com.

Guidance system for corn harvesting

John Deere has introduced a new sensing system on corn heads, AutoTrac RowSense, allowing precision guidance to be used on combines that are harvesting corn. Laura Robson, senior marketing representative for John Deere Ag Management Solutions, says the new system works by integrating GPS data from the StarFire Receiver with mechanical feeler data from new row sensors located on the corn head.

According to the company, the system guides the combine down the row at optimal harvesting speeds and helps maneuver around curves, through waterways, or in weedy areas. Steering is handled by Deere’s assisted steering system while the corn head makes small adjustments to keep the machine on the row to maximize harvest, even in down corn.

“This system also helps reduce operator fatigue,” Robson explains. “The operator does not have to make constant steering adjustments and can focus on header and separator performance, obstacles in the field, and make adjustments for varying crop conditions. The overall result is a more productive harvest with less stress and fatigue for the operator.”

With down corn, weedy conditions, or reduced visibility on the rows, the corn head sensing system feels the base of the corn stalk and ensures that the operator stays on the row without having to manually steer the machine.

Waterways are also handled because the combine is able to navigate across the grassy waterway strips, in a straight line, and move smoothly back into the row without any operator adjustment, according to the company.

For more information, visit www.JohnDeere.com/Ag.

Nitrate ion meters

A new sensor technology to support the agricultural industry is being offered by Horiba Instruments Inc. The B-340 Series Compact Nitrate Ion Meters may be used to measure nitrate ion (NO\textsubscript{3}) or nitrate as nitrogen (NO\textsubscript{3}–N) measurement in soils or crops.

Horiba Instruments claims a cost savings can be achieved using the nitrate ion electrode method to improve crop yields and reduce fertilizer costs. The company also says that the sensor’s small sample size need, selectable analysis, and selectable unit features contribute to the simplicity and ease of use.

For more information, call 949-250-4811 ext. 1216 or email Pamela.millett@horiba.com.

Tracking of harvesting operations in real time

Intelleflex Corporation and Minds Inc. are offering a system for the automated tracking of crop harvesting. The system combines GPS, RFID, and wireless communications technologies to provide real-time tracking of field-harvesting activities. It may also be used to track the exact location, timing, and efficiency of each harvester, as well as the arrival, loading, and departure time of crop transport vehicles. According to the company, this will allow better coordination among growers, harvesters, and transportation vehicle operators.

The system requires that GPS units and RFID readers are mounted on harvesters to track their whereabouts in the field as well as the arrival, loading, and departure times of transport vehicles. The information is then transmitted wirelessly for immediate access via electronic devices.

For more, see www.intelleflex.com/Solutions.harvest.asp.
Canada East

Row width effects on winter wheat

By Peter Johnson, Cereals Specialist, Ontario Ministry of Agriculture, Food, and Rural Affairs; peter.johnson@ontario.ca or 519-271-8180

In Ontario, there is interest in planting soybeans and winter wheat with a planter unit, improving seeding rate accuracy and seed depth placement, and eliminating the costs of drill ownership. The wider row spacing in wheat may also allow for modified relay intercropping (MRI), a system where soybeans are seeded into standing wheat three to four weeks prior to harvest, using wider wheat row spacing to facilitate the soybean planting. Seeding wheat in wider rows may also improve establishment of red clover underseedings. Most planters can only plant as narrow as 15-inch rows, although certain makes can drop to 10-inch rows.

A three-year (2005–2008) on-farm strip trial was conducted to evaluate four different row width configurations in winter wheat. Results are presented from the first two years of the study.

Methods

Trials were conducted at eight locations in 2005–2006 and six locations in 2006–2007 as two replicate randomized field length trials of four different row width configurations were established. Row width configurations included 7.5 inches, “1 in 4” (one row blocked, three rows on), or 75% of the rows on), “1 in 3” (one row blocked, two rows on, or 67% of the rows on), and 15 inches (50% of the rows turned on). With the exception of two sites (Shady and Thorndale in 2006), all sites were planted using a John Deere 1560 drill. In 2006 at the Shady and Thorndale locations, the 7.5-inch rows were planted with a drill, while the 15-inch rows were planted with a planter. Populations were kept as equal as possible, using a population monitor to count seed drop, regardless of row width configuration. Fields were monitored for disease, weed pressure, and head counts throughout the growing season. Yields, moisture, test weight, thousand-kernel weight, and protein measurements were taken from the wheat at harvest.

Results

Table 1 provides a summary of results from eight sites over two years comparing all treatments, and Table 2 provides a summary of results from 13 sites comparing 7.5- vs. 15-inch row spacing. Wheat yields declined as row configurations become wider, moving away from the standard 7.5-inch row width. It is interesting to note that two of the latest planted sites (Woodstock in 2006 and Oxford in 2007), which had very little fall growth and no fall tillering, showed the least effect of row widths. Whether this is an impact of spring tillering, less plant-to-plant competition, low yield potential, or just a random effect, is unclear. Protein increased slightly, with thousand-kernel weight and test weight unaffected. Disease pressure decreased marginally, but weed pressure increased, showing that weed control would be an integral part of any wider-row system.

Summary

Widening row widths reduced wheat yields by 5 to 8% on average. The impact of these results all but eliminate the potential for wider row widths to aid in clover establishment and add to the soybean yield that would be required to justify any modified relay intercropping system. The exception to these conclusions may be in late-planted or low yield situations. There may be some opportunity for further investigation under specific conditions.

Table 1. Two-year data summary of all row widths.

<table>
<thead>
<tr>
<th></th>
<th>7.5 inches</th>
<th>1 in 4</th>
<th>1 in 3</th>
<th>15 inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006 four plots</td>
<td>84.5</td>
<td>80.5</td>
<td>78.8</td>
<td>74.9</td>
</tr>
<tr>
<td>2007 four plots</td>
<td>80.4</td>
<td>75.3</td>
<td>73.9</td>
<td>70.9</td>
</tr>
<tr>
<td>Avg. eight plots</td>
<td>82.4</td>
<td>77.9</td>
<td>76.4</td>
<td>72.9</td>
</tr>
</tbody>
</table>

Table 2. Two-year data in 7.5- vs. 15-inch rows.

<table>
<thead>
<tr>
<th></th>
<th>7.5 inches</th>
<th>15 inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006 seven plots</td>
<td>93.2</td>
<td>86.8</td>
</tr>
<tr>
<td>2007 six plots</td>
<td>84.4</td>
<td>75.9</td>
</tr>
<tr>
<td>Avg. 13 plots</td>
<td>88.8</td>
<td>81.4</td>
</tr>
</tbody>
</table>
Ontario CCA Conference

With summer drawing to a close so quickly, the Ontario CCA office has spun into high gear, getting ready for the 6th CCA Conference and Annual Meeting on January 14 and 15 at the Holiday Inn in Cambridge, ON. Every January, between 200 and 250 CCAs come out of hibernation to attend this event. They gain new knowledge, hook up with industry associates, and share their valuable insights, experiences, and stories.

This year will prove to be no different as we have a great array of speakers lined up. Topics include the impact of a booming ethanol industry, biology and management of leaf hoppers, disease resistance in edible beans, improving competitiveness and profitability in farming, identifying new and emerging pests, tillage erosion, source water protection, and much more. This is also a great opportunity to earn some continuing education units (CEUs) when life isn’t so hectic.

The conference is also a perfect time to salute those CCAs who have gone above and beyond their duty with the CCA Award of Excellence. It is designed to recognize a crop adviser who delivers exceptional customer service, is highly innovative, has shown that he/she is a leader in the field, and has contributed substantially to the exchange of ideas and the transfer of agronomic knowledge with the agricultural industry. A candidate may be nominated by a customer, employer, peer, or other associate. For their hard work and dedication, the winner receives a cash award of $1,000 and will have another $1,000 donated on their behalf to an agriculture-related charity of their choice. Nominations are due by October 31, so why not nominate a CCA today? Nomination forms can be obtained by visiting the website: www.ccaontario.com.

So, mark your calendars now—you don’t want to miss out on this exciting event! A copy of the agenda and registration form can also be found at the website above under the News and Information tab or by contacting the Ontario CCA office at 519-669-3350.

Canada West

Agronomy in the Peace region of Alberta, Canada

By Jason Casselman, CCA
Peace FSG Agronomy Manager for Cargill, Alberta, Canada

Helping farmers prosper is the goal that drives the Cargill CropSense program in the Peace region of Alberta, Canada. As the agronomy manager for Cargill in the Peace region, I truly believe that growers who have a certified crop adviser on their team to help manage the farm have an advantage in this unique area of the country.

I take great pride in the growth and success of our agronomic services with an ever-increasing group of farmers. When I came up to the Peace from eastern Ontario in 2006, there were five customers and about 12,000 acres on the program. We are now working with 25 customers on approximately 75,000 acres with expectations to be over 100,000 acres next year.

The Peace region covers approximately 5 million acres of land. The two main crops are spring wheat and canola with growers also including barley, oats, peas, and grass for seed production in the rotation. During the growing season, we can have sunshine for about 18 hours a day, and the maximum daily temperature will not go over 86°F, which is ideal for the crops that are grown. Most of the grain is shipped to the West Coast for export overseas.

We work with a wide range of growers including Hutterite colonies and those who farm in the Peace and in southern Alberta, which is about 600 miles away.

The main strategy implemented with growers is being proactive rather than reactive to optimize yields and profit. Important parts of the program include crop rotation planning; fertility, weed, insect, and disease management plans; in-field scouting; harvest management; and record keeping.

Fertility plans have to be designed for the grower’s operation. Many growers have on-farm fertilizer storage and will buy and store fertilizer in the fall for spring application. The number of fertilizer blends depends on the number of storage bins on farm. Growers who are closer to the fertilizer plants and pick up in the spring will have more blends based on field requirements. Growers will also fall apply anhydrous ammonia to spread the workload and try to increase spring planting efficiency, but with larger air carts on the market and product availability, some growers are switching to all dry fertilizer application in the spring.

We developed an important strategy of being weed free at seeding to allow the crop to start off without weed competition and in our reduced tillage systems a pre-seed burn off is a must. Our growers see the advantages to starting with a clean field at seeding and then maintaining those clean fields with in-crop herbicides at the optimum stage for greatest economic benefit.

Our agronomy assistants are integral in delivering the in-season services including field scouting, crop staging, weed identification, insect threshold monitoring, and disease risk assessments. We hire students who are planning for a career in and are passionate about agriculture. Students who want to get into this business need to get as much real-world experience as possible and being an agronomy assistant gives them that opportunity to work with the farmers on a day-to-day basis. It is an ideal environment where they are learning first hand with the farmer on the farm.
North Central

On-farm research conference for CCAs

Certified crop advisers (CCAs) who are involved in both conducting on-farm agronomic research and making effective and informed conclusions from collected data have the opportunity to hone their skills at a special two-day conference on December 18–19, 2008 in Ames, IA.

Iowa State University’s Corn and Soybean Initiative received a one-year grant from the USDA North Central Region Integrated Pest Management Center to develop training resources to help extension, agribusinesses, and growers conduct scientifically valid crop production research. As part of this grant, Iowa State University will host a two-day conference to teach the basics of conducting simple, statistically valid crop production on-farm research.

The Iowa CCA board is a sponsoring partner in this program, and agronomists in Iowa and beyond can participate. CCA continuing education units (CEUs) will be assigned for the program based on the performance objectives covered by the final agenda.

The conference will focus on four key areas, namely:

- Design of on-farm research trials, including site selection and layout, research inputs, and other techniques to generate valid data
- Collecting appropriate data to help explain on-farm research
- Analyzing and understanding data for fair, statistically sound interpretations
- Effectively presenting the results to producer and non-producer audiences

Topic leaders for the conference include applied research specialists from Iowa and neighboring states. For more information and online registration, please visit www.aep.iastate.edu/onfarm. Attendance will be limited, and early registrants will have precedence in participation.

Northeast

Mid-Atlantic Certified Crop Adviser Program gives scholarships to FFA students

The Mid-Atlantic Certified Crop Adviser (MACCA) Program presented $500 scholarships to two Delaware FFA students at the annual State Fair FFA Awards Breakfast on July 25. The recipients were:

- Daniel A. Reynolds, from the Smyrna High School FFA Program, who will be attending Virginia Tech and majoring in agriculture.
- Jessica L. Heinz, from the Christiana FFA Program, who will be attending the University of Maryland and majoring in agriculture.

“The MACCA board of directors wanted to invest in agriculture, and we could think of no better way than higher education for our future farmers and agricultural professions,” said Bill Rohrer, MACCA vice chair, in his remarks at the presentation.

The MACCA Program is part of ASA’s International Certified Crop Adviser Program. It includes more than 250 CCAs in the five Mid-Atlantic states. Membership is open to anyone who makes nutrient, pesticide, crop, or environmental recommendations to producers, including dealers, distributors, applicators, consultants, manufacturers, allied industries, and state and federal agency personnel. Participants in the program undertake six hours of exams in the categories of Integrated Pest Management, Nutrient Management, Soil and Water Management, and Crop Management. To retain certification, 40 hours of continuing education credits are required every two years.

Left to right: Daniel Reynolds (scholarship recipient), Bill Rohrer (MACCA vice chair), and Justin Conrad (FFA reporter).
Western

Variable-rate fertilization of crops in the Pacific Northwest

By Jason W. Ellsworth, CPAg, Regional Technology Specialist, Wilbur-Ellis Company; Bryan G. Hopkins, CPSS, Associate Professor, Brigham Young University

Interest in variable-rate fertilization has intensified as recent fertilizer prices have doubled and, in some cases, more than tripled. Increased input costs have made the agriculture industry more cognizant of fertilizer efficiencies and/or inefficiencies. Variable-rate fertilization, when combined with soil mapping, soil sampling, and accurate estimates of yield potential, is a tool that will improve fertilizer efficiency.

Variable-rate application of fertilizers is not new, yet the adoption rate in many parts of the country is still relatively low. In the Pacific Northwest, where crops include potatoes, onions, grass seed, wheat, corn, alfalfa and other forages, and a host of seed crops, variable-rate fertilization is being adopted at an increasing rate. However, there is still some skepticism over its value.

Much of the variable-rate fertilization research has been done in crops such as cotton, corn, and wheat. Each of these crops has a high fertility requirement with little detriment to yield from over-application of fertilizers. The controlling factor for how much a grower will risk on an “insurance rate” of fertilizer is determined by the ratio of crop value to fertilizer cost. The higher the value, the more likely a grower is to make the decision to risk fertilizer over-application to ensure the crop is not deficient and maximum yield is obtained.

The risk of over-applying fertilizer, particularly nitrogen, in potatoes, sugar beets, and malt barley—all crops commonly grown in the Pacific Northwest—is greater than merely the value of the crop and cost of fertilizer. These crops differ due to the specificity of the N requirement among varieties, particularly potatoes. Excessive nitrogen promotes and prolongs a crop’s vegetative stage, decreasing yield, tuber size, and quality in potatoes; reducing sugar in sugar beets; and resulting in excessive protein in malt barley.

Uniform application of fertilizer makes little sense where substantial variability exists. A common saying is “basing a fertilization recommendation off of a single soil sample results in half the field being under-fertilized and half being over-fertilized.” Small crop yield and quality losses can add up quickly across a field (Table 1). The example in Table 1 uses a 125-acre field of potatoes that yielded 27.5 tons and sold for $100/ton. A 5% yield loss over this field results in a $17,000 loss, which more than pays for the cost of intensive soil mapping and subsequent variable-rate application of fertilizer.

Results from our three-year study indicated that in 42 plots, only 12 had a negative yield response comparing variable-rate to a uniform application. This study compared a uniform application of nitrogen determined by a soil sample and yield goal to a variable-rate application based on zones created from bare soil imagery, soil sampling, and zone yield potential. Lower N rates were applied to those areas that had low yield potential, and higher rates were applied to areas with high yield potential.

Of those 42 plots, 12 received 35 to 50 lb more N than the uniform rate, and 19 received 35 to 70 lb less than the uniform rate. The average yield increase in the plots fertilized based on a variable-rate map was >1.5 tons over the uniform rate. Using the values in Table 1, 1.5 tons represents that 5% increase in yield, demonstrating that variable-rate application can be “inexpensive.”

Yield maps are critical to understanding the magnitude to which variable-rate fertilization can positively influence yield. A yield map enables a grower to visualize the impact fertilizing has on a site-specific basis. Examining the yields in the 42 plots, the range of yield differences between the uniform- and variable-rate application was –35 to 50% with an average increase of 10% (13 vs. 14.5 tons). While reviewing the yields with growers at the study’s conclusion, it was appa-

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Table 1. Value of a percentage loss or gain in yield for a portion of the field. This example was made using a 125-acre field that yielded 27.5 tons and sold for $100/ton.
ent where and by how much to adjust the variable-rate maps to compensate for the negative yield response. Thus, a yield map is beneficial in not only determining the cost of fertilization but increasing the efficiency of the next application.

Examining the yield data and rates applied on each plot suggests that one-third of the field was adequately fertilized, one-third under-fertilized, and one-third over-fertilized with a uniform application, instead of one-half over and under.

In conclusion, variable-rate fertilization is requisite for high-input crops, particularly those with very specific nutrient needs. Variability in yield potential and residual N in the soil changes the N application requirement for the crop. Little fertilizer savings will be realized in most fields; however, the fertilizer will be redistributed, increasing fertilizer efficiency. Knowing the loss in crop value by assuming a uniform rate of fertilizer helps you understand the importance of applying fertilizer at optimum rate for each acre in a field.

This article was prepared by a member of the Western Extension and Research Activities (WERA 103) Committee on Nutrient Management and Water Quality. For more information about WERA 103 including upcoming meeting dates see: http://cropandsoil. oregonstate.edu/wera103/.

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November conference to provide ‘fresh approaches to fertilizing techniques’

Once again, the California Department of Food and Agriculture’s Fertilizer Research and Education Program (FREP) and the Western Plant Health Association (WPHA) will be teaming up to present “Fresh Approaches to Fertilizing Techniques,” a conference to be held November 12–13, 2008 at the Doubletree Hotel Modesto in Modesto, CA. The event combines the 16th Annual FREP Conference with the WPHA Central Valley Regional Nutrient Seminar for a jointly formed agenda spanning two full days.

The conference program is geared toward a wide range of agriculturalists, including agricultural supply and service consultants, growers, university extension, and local, state, and national governmental agency personnel. A panel of speakers will show how groundbreaking fertilizer research can be integrated into agricultural practices. Presenters will provide general and technical information, current research data, and practical applications for each of four key agricultural topics:

- Managing micro- and macro-nutrients (timing, sources, and cost-effectiveness)
- Keeping nutrients in their place (deficiency to excessiveness)
- Understanding organic fertilizer (basics, organic science, and optimal use)
- Managing nutrients of regional crops (cherry, citrus, winegrapes, almond, pistachio, rice, and alfalfa)

Continuing education units (CEUs) for certified crop advisers and pest control advisers are expected to be available.

Early conference registration, post-marked by October 31, 2008, is $75 per day or $135 for both days; fees are waived for currently enrolled students. After October 31, registration fees are $85 per day or $160 for both days; students’ fees are $10 per day.

Conference registration and additional information is available by visiting www.cdfa.ca.gov/is/folders/frep.html, emailing frep@cdfa.ca.gov, or calling 916-445-0444.

The California Department of Food and Agriculture’s FREP coordinates and funds research and projects that advance the environmentally safe and agronomically sound use and handling of fertilizer materials. FREP serves growers, agricultural supply and service consultants, university extension personnel, and local, state, and national governmental agencies and organizations.

WPHA represents the interests of fertilizer and crop protection manufacturers and retailers, as well as biotechnology providers in California, Arizona, and Hawaii. WPHA promotes environmental stewardship and sound agronomic practices, effectively communicates industry issues, engages in legislative and regulatory affairs, and facilitates member and industry relations.

Northwest update

Attention CCAs, CPAg’s, and CPSSs/C’s who do soil sampling in Idaho: the Idaho State Department of Agriculture (IDA) enacted a new law stating that “anyone taking a soil sample for dairy operations or beef CAFOs (concentrated animal feeding operations) need to be a state certified soil sampler,” according to Hilary Simpson, nutrient management program specialist for IDA. The Northwest CCA and ICCA program offices have been in contact with Ms. Simpson as well as others in the department to develop a procedure that would exempt CCAs, CPAg’s, and CPSSs/C’s from this process due to the extensive testing and training they already have through their professional certifications.

We agree that the technical/science side of soil sampling is covered through the certification exams but not the new state law specifics. The IDA is very willing to evaluate those certified in one of the ASA or SSSA programs on a case-by-case basis. It will require that you contact Ms. Simpson, hsimson@agri.state.id or 208-332-8571, to discuss what is needed and submit details on your experience, educational degrees, and certifications. Ms. Simpson will be conducting hour-long training sessions on the law specifics and is very willing to do this at production agriculture conferences being held in the state and region. As a reminder, this is only for dairy or beef CAFO operations.

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Research-based manure management web resource proves popular in U.S. and beyond

At the Livestock and Poultry Environmental Learning Center, the topic is always the science of manure management. The center connects experts from land grant universities and federal agencies with animal producers and their advisers.

The primary way to make this connection is to visit www.extension.org and then click on “Animal Manure Management.” This is the web-based collaborative environment where research experts share knowledge to help producers and their advisers solve challenges. Launched in March 2008, this website gets more than 12,000 hits per month. Its objective is to be your first stop for science-based information on animal manure issues. More than 150 representatives of land grant institutions, USDA, USEPA, and other partners are contributing to the site’s content.

“The most popular resources are the live and archived webcasts,” says Jill Heemstra, manure management extension educator in Nebraska and the national coordinator for the center. “When we have a live webcast, people from about 100 sites log on, but each recorded webcast receives more than 70 views every month.”

Live webcast presentations occur at 1:30 pm CST on the third Friday of each month. Twenty archived webcasts are currently accessible.

Approximately 20 hours of continuing education credits are currently available in nutrient management and water quality by attending archived webcasts. CEUs can be earned by attending one-hour workshops and taking 10-question multiple-choice quizzes managed by ASA’s Certified Crop Adviser Program. Archived topics include emerging contaminants such as pathogens and antibiotics, manure treatment technology options, options for increasing the value of manure, and critical considerations for nutrient planning.

In addition, the website offers some additional critical resources including:

- A newsletter promoting upcoming webcasts and summarizing research projects and new resources on animal manure issues.
- 100+ web pages on manure treatment technologies, storage and handling, environmental planning, regulations, small farms, nutrient management plans, and more. There is a database of frequently asked questions, and web pages summarize critical issues associated with the above topics and connect the reader to recommended resources for those needing more in-depth information.
- “Ask the Expert.” If the database doesn’t have a ready answer for your individual questions, the question will be answered by university experts.
- New resources planned for the next year. These include research-based information on antibiotics and hormones, air quality, and grazing system water quality. The center is also developing online learning lessons that can be used to meet continuing education requirements.

Mark Risse, a professor at the University of Georgia and one of three co-leaders for the project, says the website has a wider audience than anticipated.

“Beyond people that advise producers, county extension agents, Natural Resources Conservation Service (NRCS) staff and consultants, we are finding policy makers, producers, the general public, and even other scientists are using the website,” Risse says. “It is the best science-based information on manure compiled from around the country to a single site. Users are coming to it to answer specific questions, for general education and for continuing education.”

The center is part of the national eXtension interactive web resource customized with links to local Cooperative Extension websites. It is funded by a grant through the USDA Cooperative State Research, Extension, and Education Service (CSREES) with additional support from eXtension. Land grant colleges were founded on the ideals that higher education should be accessible to all and that colleges should teach liberal and practical subjects and share knowledge with people throughout their states.
CCA program eyes international expansion

By Luther Smith, Director of Certification Programs; lsmith@agronomy.org

The Certified Crop Adviser (CCA) Program started out in the early 1990s in a handful of U.S. states. It has grown from that point to include all 50 states and provinces in Canada, hence changing the scope from a national program to an international one. “International” was soon added to the name of the program and board although some argue that covering two countries doesn’t make it “truly international.”

Fast forward to today. Since the late 1990s, the program has added additional states and provinces, but no other countries have joined. The international board has always been open to having discussions with any country that was interested in joining the program. There have been many inquiries but no substantive actions to expand outside the U.S. and Canada, until now.

India shows interest

About a year ago, I was contacted by Rajiv Sinha, director of agronomic support for DSCL, an India-based company with a strong focus in agriculture retail. DSCL was following an aggressive agenda to develop agriculture retail locations throughout India similar to the structure in the United States. An agriculture retail location in India under the DSCL model includes both agricultural and household supplies—one-stop shopping for the farmer and family members. It also includes support staff who advise farmers on agronomic practices and inputs.

Rajiv had contacted me to discuss how his company could be involved or start the CCA program in India for their employees. He believed the certification process to qualify people who could do the work and the continuing education process to continually improve the knowledge and skill base was just what they needed to support their efforts in modernizing production agriculture in India.

Then earlier this year, I was contacted by J.K. Ladha, an ASA board member who works for the International Rice Research Institute (IRRI). He wanted to discuss the South Asia Cereals Initiative (SACI), a project that IRRI is developing to combat the food crisis in South Asia. There are seven objectives within SACI with the primary focus being doubling average rice and wheat yields to better feed the growing populations in this part of the world. Another objective addresses improving the human capital and information delivery system by developing the CCA program. IRRI is seeking funding for SACI through the Gates Foundation.

DSCL’s and IRRI’s inquires were independent of each other but were and are on a similar mission: to develop the CCA program in India. The SACI project will start in India and will expand over time to include Pakistan, Bangladesh, and Nepal. We will know if the funding for the project is approved sometime this month.

The ICCA and ASA executive committees have discussed the ramifications of expanding into India and other countries. They decided if the ICCA program was going to expand into other countries, the goal should be that a CCA in India would be similar to a CCA in the United States or Canada. In other words, the requirements and standards would be the same with the understanding that there would be cultural and agricultural differences.

The initial discussions culminated with a proposal paper on how to expand and implement the program into India and a meeting with interested parties in early June in Delhi, India. I had the opportunity to participate in those meetings and discuss with many stakeholders the benefits of starting the CCA program. These meetings included representatives from government agencies, universities, and private companies involved with production agriculture in the country. The ICCA program was started with and continues to follow the model of involving the three primary segments that make up the agricultural industry—academia, government (public sector), and industry (private sector)—and India is no different. That model adds strength to the program and is a primary reason why it is successful.

Shared view of the CCA program

My visit to India included stops at ag retail locations in the state of Haryana, Haryana Agricultural University, and a farmer meeting of about 100 growers.

I mentioned that differences in culture and agriculture are expected, but what I learned is that the people—whether farmers, university educators, or ag retail agronomists—shared similar concerns, questions, and optimism as their counterparts in the U.S. or Canada.

For example, I was talking with a group of farmers, and their concern was whether the information they receive from an ag retail agronomist (insert CCA here) would be in the best interest of their farming operation or in the best interest of the ag retail agronomist in terms of providing information on products he/she had to sell. I later was talking with a group of ag retail agronomists and managers, and they asked if being a CCA would help differentiate between full agricultural service providers and price sellers who undercut them in the marketplace. It sounded like the similar challenge between price selling/order takers and full service ag retail businesses in the U.S. and Canada.

The group of university faculty and extension educators I met with felt the program would need to be mandatory.
and potentially separate the selling of products and providing advice. Private sector representatives expressed to me that they thought the involvement of government would slow the process down while public sector representatives felt they needed to protect the public from private sector profit motives. These examples were very similar to those in the U.S. and Canada when the program started here. They viewed the CCA program as raising the overall professionalism of ag input providers and meeting the continuing education needs. Bottom line—they liked the concept and were optimistic about its success.

To place some perspective on agriculture in India, the average size farm in northern India is about 2.5 to 5 acres with millions of farms and farmers. Sixty percent of the population is on the farm (in the U.S., it’s less than 2%), but that is declining as people move to the cities. The population of India is about 1.1 billion people and is estimated to surpass China by 2012 with less land area than the U.S. (population in the U.S. is about 300 million). A typical farm may have one small tractor, but farmers use modern inputs—seed, fertilizers, and crop protection—and water quality and quantity are growing issues in both rural and urban areas. The three private companies (ag retail businesses) that we met with employed 1,200 field agronomists (potential CCAs), with plans to grow to more than 5,000 within the next five years.

Enormous opportunities, potential challenges

So what does this all mean to the existing CCA program and the other certification programs of ASA and SSSA? The leadership, as I mentioned earlier, very much wants to maintain the same standards regardless of the country. They are very supportive of further international expansion. India alone projects an additional 5,000 CCAs over the next three to five years. If the Gates Foundation funds the grant proposal submitted by IRRI, the development of exams and infrastructure in India would begin in March 2009 with the first training sessions. Obviously, preparations have already begun. India states would join the existing North American ICCA program with a central office in India to minimize international transactions.

U.S.-based agricultural input manufacturers and suppliers who have been very supportive of the CCA program in North America are also in India and are encouraging the expansion for their employees based there. It would open up opportunities in educational programs, cultural and agricultural exchanges between South Asia and North America, and broaden the base of the certification programs as well as ASA activities. We are very aware of potential challenges and recognize that there is a learning curve in this undertaking, so we are taking a systematic approach in an attempt to avoid any pitfalls. The leadership also set a goal that any international expansion would not diminish the existing program or CCAs in North America.

The opportunities are enormous as you can imagine, but the expansion is not limited to India. Kim Polizotto, chair of the ICCA board, has had discussions with representatives from Argentina and Brazil. Those discussions will continue in October at the ASA Annual Meetings in Houston. These countries are also very interested in developing the CCA program with the idea that the same model used in India would be used there. If the international expansion comes to fruition, the CCA program would become “truly international” with global brand recognition.

The opportunities are enormous as you can imagine.... If the international expansion comes to fruition, the CCA program would become ‘truly international’ with global brand recognition.”
NAPT—working for you

The agricultural laboratory connection

Did you know there is a program to help soil, plant, and water-testing laboratories ensure that their testing methods meet quality control standards? The North American Proficiency Testing (NAPT) program does this through exchanges and a statistical evaluation of the analytical data. The program guidelines have been developed for the agricultural laboratory industry by representatives from groups familiar with and involved in standardizing methods and developing nutrient recommendations for soil and plant analysis methods within the U.S. and Canada.

Quarterly soil, plant, and water samples are shipped to participating laboratories and analyzed. Results are then sent to the coordinator, who statistically evaluates the data and provides each laboratory with a scorecard of its performance relative to other laboratories performing the same analyses. The resultant information supplies an instructional base for improving performance not only in each laboratory, but for the entire soil- and plant-testing community.

The NAPT program collaborates with multiple state agency programs, namely Iowa, Minnesota, Missouri, Nebraska, and Ontario in their laboratory certification process. The March 2008 newsletter posted on the NAPT website (www.naptprogram.org) contains contact information for each state or province. The Proficiency Assessment Program (PAP) is an additional service offered to laboratories reporting quarterly soil results to the coordinator. PAP is the soil test assurance program required by Natural Resources Conservation Service (NRCS) of laboratories involved with federal government nutrient management plans in several western U.S. states. The NRCS has acknowledged NAPT-PAP as a fundamental block in Nutrient Management Conservation Practice Standards, S590. A listing of certified PAP laboratories is available on the website.

Oversight of the program

SSSA representatives, an oversight committee, and the NAPT coordinator jointly govern the NAPT program. Janice Kotuby-Amacher, the coordinator, manages its daily operations and preparation of the proficiency samples. The oversight committee sets program policy, establishes technical guidelines, and assists SSSA in the selection and evaluation of the coordinator. The 20 members on the committee represent both private and public sectors committed to ensuring the quality of soil and plant analysis. SSSA staff administer the program, manage collection and disbursement of funds, and provide web assistance.

The group invites crop advisers to take advantage of the resources the NAPT program offers. Subsequent articles in Crops & Soils will enhance understanding of soil reports and laboratory methods utilized in various regions. Requests from crop advisers are welcomed. Visit the NAPT website at www.naptprogram.org for more information and to view a list of participating laboratories.

For more information, contact Dr. Don Horneck, NAPT Chairman, at 541-561-4376; Dr. Janice Kotuby-Amacher, NAPT Coordinator, at 435-764-7643; or Melissa Fall, SSSA-NAPT Service Representative, at 608-268-4972.

Alabama CCAs gain recognition

Alabama CCAs just gained more value and recognition for being certified through the hard work of their certifying board and chairman, Joe Touchton. Earlier this summer, the Alabama CCA program entered into a cooperative agreement with the Alabama Department of Agriculture to recognize Alabama CCAs as being qualified for commercial pesticide applicator permits. The Alabama commercial applicators’ examination is waived for current Alabama CCAs.

“The new arrangement will simplify the record keeping for those who have both a CCA certification and commercial pesticide applicator permit,” Touchton explains. “A CCA will still need to apply for the permit; it is not automatic, but if their CCA [status] is current, then the pesticide applicators’ exam is waived.”

The agreement covers three categories of commercial pesticide applicator permits: agricultural plant pest control, demonstration and research pest control, and ornamental and turf pest control. Forms for permits and additional information can be obtained by contacting Debbie McClain at Debbie.McClain@agi.alabama.gov or 334-420-7240.

Although Alabama CCAs will get the commercial pesticide applicators’ examination waived, they will still be required to apply for the permit and pay the associated fees and renewals. Continuing education units (CEUs) earned in the CCA Integrated Pest Management category will be honored by the Department as meeting the CEU requirements for the pesticide applicator permit.

“Each January, [the Alabama CCA program] will report to the Department those CCAs with active status and have their pesticide applicator permit through their association with the CCA program,” Touchton says. “An active [CCA] status will substi-

[continued on page 42]
Newly Certified

The following list includes newly certified individuals and those that have added additional certifications since the last issue of Crops & Soils. The list is alphabetized by state/province and by surname within each state/province.

Canada

Anderson, Ashley, Minburn, AB (CCA)
Armitage, Garett, Vulcan, AB (CCA)
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40 years of drip irrigation
reviewing the past, prospects for the future
About 40 years ago, a revolutionary change occurred in the science and art of irrigation, and it now seems appropriate to review its origin and current status and to consider its future prospects. Fittingly, this revolution took place in the Middle East, the region where irrigation first began. However, the initiators were themselves newcomers to the practice who were able to turn the disadvantage of their inexperience to the advantage of a fresh approach. The new mode of irrigation started in Israel within two decades of its birth in the middle of the 20th century, as the nascent state needed to develop its agriculture under extreme conditions of water scarcity and capital constraints.

Having participated in that seminal development, I can describe it directly. It was a rare and heady experience for a young scientist to be present and active at the birth of an innovation that had both fundamental and practical importance and has since proven to be globally applicable. I refer to the advent and evolution of high-frequency, low-volume, partial-area irrigation techniques, including drip/trickle and microspray irrigation. What began as a re-examination of the guiding principles of irrigation management (Hillel, 1971, 1972; Rawlins and Raats, 1975; Bresler, 1977) eventually led to a complete change of paradigm, an inversion of traditional premises, and the elaboration and widespread adoption of an entirely new set of technologies (Hillel, 1982, 1987, 1990, 1997; Dasberg and Bresler, 1985; Bucks and Nakayama, 1986).

Conventional approach based on ‘equal availability’

The conventional approach to irrigation management, presumably bolstered by research done in the early decades of the 20th century, was based on the hypothesis that soil moisture remains equally available to crops until plant roots deplete it to some residual low value called...
“the permanent wilting point” (Veihmeyer and Hendrickson, 1950). In practice, this hypothesis justified a regimen of infrequent irrigation designed to wet the soil periodically to its maximal “field capacity” and then to let crop roots deplete soil moisture almost to the “wilting point” of the plants before irrigating again to replenish the “soil moisture reservoir.” The conventional irrigation scheme thus consisted of repeated short episodes of watering, followed by extended periods of soil moisture extraction by the crop.

Accordingly, the rooting zone was periodically wetted to saturation, a maximal content that deprived the roots of aeration, leached nutrients, and raised the water table. Then the soil was allowed to dry gradually to a minimal water content that subjected the plants to increasing stress. Practical limitations on the frequency of irrigation by the conventional methods of surface-flooding, furrow, and sprinkler irrigation made it difficult to test alternative strategies to avoid such wide fluctuations by maintaining an intermediate (optimal) level of soil moisture and aeration continuously.

The low-frequency mode of irrigation seemed to make economic sense because most of the conventional systems were more expensive to run at a higher frequency, lower delivery rate, and longer duration. For example, where the cost of portable tubes was a major consideration, it was economical to make the least amount of tubing serve the greatest area by shifting available tubes successively to as many tracts of land as possible before returning to the same tract for the repeat irrigation. The question was, therefore, how dry can the soil become before crops experience a “significant” reduction in yield?

The hypothesis of undiminished soil moisture availability to crops until they come close to wilting is an example of the human tendency to contrive theoretical justification for what may seem convenient in given circumstances. To be sure, the “equal availability” principle was questioned by some leading scientists (Richards and Wadleigh, 1952), but at the time, they had no way of disproving it conclusively. There was simply no practical or economical way to establish and maintain a nearly constant soil moisture regime in the root zone of a field throughout the growing season so as to show that plants growing in a continuously moist soil outperform plants growing in a soil that is periodically near the lower end of the so-called “availability range.”

A new paradigm emerges

Gradually, the contradictions of the old theory became too obvious to ignore. Evidence accumulated that soil moisture is not equally available but rather less and less readily available to crops as it is progressively depleted. Therefore, it occurred to some of us that we ought to try the opposite approach: to irrigate as frequently as possible but with very small volumes of water (Hillel and Guron, 1973). For the traditionalists, our unorthodox approach seemed foolish. Irrigate more often in an arid environment? That, they said, would increase water use per unit area. But lower water use per unit area never should have been an end in itself. A better criterion is water use per unit of production (i.e., crop yield), termed “water use efficiency.” And this is how the new approach proved itself. Rather than ask crops to go thirsty without diminished performance, we began to ask crops how much better they could perform if they were grown in a constantly moist soil and prevented from ever suffering stress. When we tried that, we soon discovered that crops often show a pronounced increase in yield when irrigation is provided in sufficient amount and frequency that water never becomes a limiting factor, especially if nutrients are supplied along with the water (Rawitz and Hillel, 1974; Howell and Hiler, 1975; Hillel, 1987).

But could that condition be accomplished in a practical way? What had not been feasible in former decades became so with the advent of low-cost, weathering-resistant plastic tubes that could be fitted with variously de-
signed porous sections or spaced emitters so as to ooze or drip water into the root zone at a slow rate, either continuously or in frequent pulses. Such tubes could be laid on the ground or placed below the surface to conform to crop rows and the spacing of plants within the rows. To prevent clogging of narrow-orifice emitters (by suspended particles, algae, or precipitating salts), the irrigation water could be passed through filters. Later, the system was supplemented by ancillary equipment such as pressure regulators, metering valves to set the exact volume of water to be applied, and injectors to control the pH and/or feed soluble fertilizers into the water supply (Dasberg and Bresler, 1985).

With drip irrigation, it is possible to create favorable moisture conditions even in problematic soils (e.g., coarse sandy or gravelly soils) that had previously been considered nonirrigable. Moreover, the ability to target irrigation precisely to the major rooting zone of crops, thus wetting only a fraction of the surface while avoiding wetting the inter-row areas, helps to reduce evaporation, weed proliferation, and compaction of the soil by treading humans and machines. Where the irrigation water is somewhat brackish, the continuous supply of fresh water to the soil ensures that the salts do not concentrate progressively as plants extract water from the root zone. Moreover, since drip irrigation is applied underneath the plant canopy, it avoids the hazard of leaf scorch by brackish water and reduces the evaporation of intercepted water as well as the incidence of fungal diseases that thrive on wet foliage.

Properly applied, drip/trickle irrigation can help avoid the most common failing of conventional high-volume irrigation, namely excessive percolation. Precise, high-frequency, low-volume irrigation reduces the hazards of waterlogging and salination and also helps to lower drainage requirements. The system can be scaled down to any size of field or plot and operated at low pressure (hence at lower energy requirements), so it is flexible and adaptable to the needs of small-holders in developing countries.

No panacea despite advantages

Even given its potential advantages, however, drip/trickle irrigation is no panacea. Competent operators can achieve high efficiency with such systems, but incompetent ones can be just as wasteful as with conventional systems. The narrow orifices of drip emitters are prone to clogging by sand particles, chemicals, or algae carried in the water. The fact that only a fraction of the soil volume is wetted can also be a problem. Though many crops can thrive when water is supplied to no more than 50% of the soil volume, they become vulnerable to any disruption in the water supply. Any interruption of the system’s operation can cause crop failure, as the soil moisture reserve available without replenishment is so limited. Apart from the technical problems associated with installing and maintaining the irrigation system in perfect condition, there is the problem of ensuring the steady supply of water throughout the growing season from whatever source is available (e.g., stream, surface reservoir, or groundwater).

Ready-made commercial technology often fails when introduced arbitrarily into developing countries. Large, elaborate, and expensive systems (including automated pumps, self-flushing filters, pressure regulators, metering valves, fertilizer injectors, and precision-calibrated emitters), imported and installed in the hope of achieving instant modernization, are all too prone to failure for lack of maintenance and spare parts. Such installations can quickly become “white elephants”—idle monuments.

to hasty “progress” relying on ill-adapted technology that is unsuited to the social structure and means of small-scale family farm units.

A major task of our time is to apply the benefits of science to alleviate the plight of poverty-stricken societies in semiarid regions, particularly in the drought-prone areas of sub-Saharan Africa (Barghouti and LeMoigne, 1990; Rosegrant and Perez, 1995). Efficient and sustainable utilization of soil and water resources is an essential aspect of that task (Hillel and Vlek, 2005). The highly complex assemblages developed to serve drip irrigation systems in the industrialized countries obscure the concept’s essential simplicity. The main justification for such capital-intensive and energy-intensive systems is to reduce labor costs. Since the relative costs of equipment and labor in developing countries are often the reverse of those in industrialized countries, consideration must be given to simplifying drip irrigation systems so as to facilitate installation and maintenance while retaining the basic principles of efficient water use.

In closing, I wish to emphasize that high-frequency, low-volume partial-area (e.g., drip/trickle) irrigation is not so much a “product” as it is a basic concept; hence, its application in practice need not necessarily depend on expensive equipment and intensive energy inputs. Instead, it can be tailored to the low-capital circumstances of developing countries and can be flexible enough to permit downscaling to fit the needs of small-scale farmers. Rather than depend primarily on grand regional schemes and on the importation of prepackaged hardware systems, development efforts should be directed in many cases toward localized projects, mobilizing the skills and the improvisational ingenuity of indigenous artisans and utilizing available materials so as to apply the basic principles of efficient, low-volume microirrigation in ways most appropriate to the needs and constraints of each region. A booklet published by the United Nations Food and Agriculture Organization illustrates ways of achieving that aim in different circumstances (Hillel, 1997).

References

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