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Nutrient management, manure management, nutrient management planning, manure management planning, and comprehensive nutrient management planning have all become buzzwords over the last decade. Sometimes they are used interchangeably by those in and outside of agriculture, but incorrectly, since each has a slightly different meaning. Incorrect use of these terms can be confusing and hinder communication. You might be using the same words, but if two people have a different understanding of what those words mean, they are not truly communicating even though on the surface they think they are. That’s where problems can arise.

To help address this issue, the Congressional Soils Caucus held a briefing in late September titled, “Nutrient Management: A Best Management Practice for Clean Water,” for congressional staff in Washington, DC. The Caucus was established in June 2006 with the help of the Soil Science Society of America to educate policymakers and stakeholders about the importance of soils and soil science. The briefing was a direct attempt at helping those who write legislation related to nutrient management to better understand not only the words but the practices, principles, and practical implementations. It is not only an issue for the farm bill debate but also for the Clean Water Act that will come up for renewal in 2008.

Participating in the briefing were Frank Coale, professor and department chair of the Department of Environmental Science and Technology at the University of Maryland; Steven Cromley, a certified crop adviser (CCA) at MFA, Inc., in Columbia, MO; Steven Oetting, a hog and row crop farmer from Concordia, MO; and Raymond Massey, an agricultural economist at the University of Missouri. Dr. Coale discussed the origin and importance of nutrients and gave a brief “101” on nutrient management; Steve Cromley described his activities as a CCA assisting producers in the development of nutrient management plans (NMPs); Steven Oetting gave the producer’s perspective on nutrient management and its importance in planning his farming operation; and Dr. Massey discussed the cost and benefits of NMPs both to the producer and society. The following is an overview of the presentation.

Crops need nutrients to grow. Nitrogen (N), phosphorus (P), and potassium (K) are considered macronutrients—they are the basic building blocks for plants, which absorb them from the soil. Amino acids, cell membranes, and ATP (adenosine triphosphate) all contain nutrients. Nitrogen is abundant in animal manure, ammonium fertilizer, crop residues, and in the nodules of leguminous plants, while phosphorus is found in human waste and livestock manure and in the form of “rock phosphate.” If any of the macronutrients are missing or hard to obtain from the soil, this will limit the growth rate for the plant.

Developing NMPs

Historically, the concept of nutrient management was very simple. Producers estimated the nutrients needed by the crop by subtracting the amount of nutrients available in the soil (obtained through soil sampling and testing) from the optimal level of nutrients needed to obtain yield goals (obtained from crop response data). They then applied the needed amount as either manure or fertilizer. Today, however, in addition to this simple calculation of nutrient requirement, CCAs and certified professional agronomists (CPAg’s) work closely with producers to develop NMPs that take into consideration many more factors such as areas sensitive to soil erosion, soil characteristics, potential for nutrient loss, crop rotations, and tillage practices. In addition to estimating the nutrient needs of crops, an NMP identifies the amount, sources, placement, and timing of nutrient applications needed to maximize plant uptake and improve yield while minimizing environmental risk. This requires the use of one or more of the following “tools” in a CCAs/CPAg’s toolbox:

- on-site evaluation;
- geographic information;
- soil, manure, and plant tests;
- nutrients;
- management practices; and
- planning software.
On-site evaluations identify areas vulnerable to water pollution as well as community concerns. Tools used in the evaluation process include GPS/GIS technology, aerial photos, and soil type maps. Yield maps are developed to collect yield data and track variances and monitor crop nutrient removal using GPS and GIS technology. Good record keeping is an important part of developing useful nutrient-specific maps and yield maps. Management practices such as field boarders can help provide wildlife food and cover, reduce erosion, and protect soil and water quality.

Applying too much N and P can result in nutrient pollution of surface and groundwater resources, which can lead to nitrate contamination of drinking water supplies or eutrophication of surface waters. Nitrogen and P take two very different pathways into our water resources. Nitrogen transport is primarily (~70%) through leaching and subsurface pathways whereas P transport is primarily (>90%) through surface runoff pathways. Therefore, runoff prevention strategies need to focus on the different delivery pathways for N and P.

**NMP costs**

Three broad cost categories associated with NMPs are preparation, implementation, and record keeping/maintenance. Specific costs associated with each category can vary greatly by region depending on local constraints. Preparation costs include soil sampling and soil analysis. Implementation costs include those associated with split applications of N, precise placement of fertilizer, limiting the application date to immediately before planting (which could result in potential yield reductions from late planting), and limiting the application rate to the annual P needs of the crop (which could require investment in new equipment). Record-keeping costs include those associated with hours spent scrutinizing NMPs for profit opportunities and creating and sending reports to the regulating agency as well as the potential loss of confidential business information.

The USEPA estimates that $1,450 to $32,500 is spent per year per animal-feeding operation to comply with NMP proposals, and $286 to $492 million is spent nationally. Assistance to help cover these costs comes in the form of EQIP (Environmental Quality Incentive Program), which provides $1 billion for conservation practices, and the Conservation Security Program (CSP), which provides $237 million in technical and financial assistance to promote conservation. Farmer resources and constraints can result in “slippages,” which occur when the intended environmental objectives are circumvented to seek business objectives. Slippage can be minimized if NMPs and regulations consider the objectives, resources, and constraints of decision makers.

America leads the world in the production of food and fiber in part due to the use of fertilizers containing N and P. Producers’ adoption of NMPs ensures a future of clean water without compromising America’s agricultural heritage.
ood crop production strategies will not increase the yield of the hybrids you grow. Instead, good production practices help hybrids yield closer to their genetic potential by reducing yield-robbing factors in the field. This concept underscores the significance of hybrid selection. Variety selection is not, however, quite as simple as “choosing the best one.” The difficulty arises in identifying which sources of information should be used to make selection decisions.

When viewing reports, the data are simply “numbers.” It is up to each of us to convert the data into information. If we can then properly utilize this information, we have gained knowledge. Having done that, we can make better variety selection decisions and improve our profitability.

Selecting varieties with high yield potential is crucial to maximizing your return, but variety selection is about more than just yield potential. At the same time, we must also acknowledge that variety selection revolves around yield. Growers will not knowingly select low-yielding varieties, even if they may have the best resistance to the current “pest of the year.” Growers identify high-yielding varieties and then sort among those to find the various combinations of maturities and defensive traits that are important to them.

But there is a catch, and this is where many researchers and ag professionals get tripped up: Variety selection is not about identifying which lines did best over the past year—it is about predicting which lines will do best in the future. This is not dependent upon how you use data reports. Instead, it depends on proper selection of which data reports to use in the first place. So how do you evaluate which sources of data can provide predictive information?

The answer is simple; the reasoning is a bit more complex. Predictive information, primarily for yield estimates, should come only from multi-environment trial averages. If your favorite data report does not include district or regional averages on your criteria of interest, you have a lower probability of
success because you are not incorporating all available data into your decisions.

Why are multilocation averages more predictive? Consider this: The data from a single location is a measure of the yields produced by the interactions of the varieties (genetics) with the environment (everything else). In these experiments, the environment is comprised of soil type(s), soil conditions, weather, nutrients, pests, pathogens, and any other factor that can impact the expression of genetic yield potential during that season. But the only factors in this equation that you can know for next season will be the soil type(s) where you plant and the genetics you choose. Because of this, you cannot expect the results from a single-location trial in one season to be duplicated in another season.

Be aware that varieties will perform differently at different locations, even when steps are taken to choose similar environments. In most yield trials, researchers attempt to test in as many different environments as possible. If these data are not averaged across locations, how then does one evaluate the results? If you want to select the best variety, from which location do you select? Many criteria could be used to choose the location upon which to base your variety selection. These include, but are not limited to, the location that:

- is nearest to you;
- is closest to your latitude;
- had the same rainfall you had;
- had the same heat units you had;
- had the same crop rotation you use;
- had the same tillage method you use;
- had the soil type most similar to yours; and
- had the same disease problems you had.

Remember that all of these criteria will interact in various unknown and unpredictable ways to impact the final data measurements in each field. Thus, for these results to be predictive, your field next year must experience conditions essentially identical to the yield trial field where the data were collected.

Since it is highly unlikely that next season’s conditions will be the same as those in any single location report, you will increase your probability of success by selecting a variety that can perform well in many environments. These varieties can be found in reports that display averages over locations and years.

Understanding the data

The most important aspect of reviewing reports involves understanding the data that are provided. Use information like the least significant difference (LSD) to help you sort through entries. Any entries that differ by less than the reported LSD for a trait (i.e., yield, maturity, disease rating, and pest resistance) must be considered equal for that trait. Measurements within an LSD for any trait could be due to a number of different factors, including site selection, seed quality, measurement error, or random chance. In an experiment, these differences are not considered to be significant and are not likely repeatable in your field under any circumstances.

The LSD is widely considered to be a measurement of the quality of an experiment. Lower values for an LSD give more statistically significant results and indicate higher-quality experiments. An added benefit of multilocation reports is that they will almost always have lower LSD values than single-location data. When evaluating various sources of variety information, reports with lower LSD values should be given a higher priority than others.

Do not rely on incomplete summary tables or diagrams to determine if one variety is better or worse than another—look for all of the supporting information. All data provided without LSD values should be considered unreliable and should not be used to make variety decisions or to help manage pest complexes. The risk is that viewing data without the accompanying statistics may lead to conclusions that are not supported by the experimental results.

Using the data

Now that you know how to evaluate reports, the next step is to sort through the data to make your selections. Variety selection is composed of two distinct but related components. The first is selecting high-yielding varieties for your operation. The second is risk management, as defined by the number of varieties you select, their mix of maturities, defensive traits, seed treatments, and their acreage allocation. If variety selection was just about finding the highest yield, it would be a simple task—use district summaries to identify the top varieties. It is the risk management element that makes variety selection difficult. Growers will use yield trial data in different ways to reach their appropriate combination of varieties, maturities, defensive traits, etc.

Even though the risk management aspect of variety selection can instill some variability in methodology, there are certain characteristics that should remain consistent among all users of yield trial data:

1. Only multiple-location data should be used to make predictive selection decisions.
2. Yield trials do not have to be performed on your farm, on your soil type, or even under your crop rotation scheme to provide relevant data.
3. Sort the data by yield. Make initial selections based on yield and appropriate maturity.
4. Once you have a pool of candidates, sort among these to identify lines that have the desired mix of defensive traits.
5. More information is better information, so use all reliable sources of data.

—Source: A fresh view of variety selection [Online]. ICM Newsletter. 498(3): 85–86. Iowa State University Extension, Ames. Editor’s note: This article was modified slightly to be inclusive of all crops, whereas the original focused on soybeans. See www.croptesting.iastate.edu/downloads/SoybeanVarietySelection.pdf.

www.agronomy.org
Northeast

By Greg Albrecht, CNMP Specialist, New York State Department of Agriculture and Markets, and Shawn Bossard, Chair, Northeast Region Certified Crop Adviser Board

Agricultural environmental management planner certification in New York State

The USEPA’s concentrated animal feeding operation (CAFO) regulation requires many larger livestock farms to operate according to nutrient management plans. In some states, such as New York State (NYS), comprehensive nutrient management plans (CNMP) are required to be developed and maintained for CAFO-regulated farms to guide the sound handling and storage of nutrients around farm facilities and the best use of nutrients in fields for crop production, water quality, and soil conservation. Comprehensive nutrient management plans are farm specific and developed according to federal and state permit requirements, Natural Resources Conservation Service (NRCS) standards, and land grant university guidelines.

The NYS Department of Environmental Conservation (NYSDEC) issued its first CAFO state pollution discharge elimination system (SPDES) general permit in 1999 (www.dec.ny.gov/permits/6285.html), under the authority of the USEPA. To meet the challenge of developing and annually updating high quality CNMPs for over 140 large CAFO farms and over 460 medium CAFO farms, a partnership including the NRCS, Cornell University, Cornell Cooperative Extension, NYS Department of Agriculture and Markets (NYSDEC), NYSDEC soil and water conservation districts, farmers, professional engineers, and Northeast Region certified crop advisers (CCAs) worked under the NYS Agricultural Environmental Management (AEM) umbrella (www.nys-soilandwater.org) to forge a unique approach: the Certified AEM Planner Program.

What is a certified AEM planner?

Certified AEM planners are professionals, certified by the NRCS and the NYSDEC, who develop and certify (i.e., signs along with the farmer) CNMPs in NYS. They are uniquely qualified to develop and certify CNMPs because of their CCA base as well as cross-training and expertise in environmental conservation, best management practices, and standards, farming, and environmental regulations. They apply their expertise and coordinate the efforts of other planning team members, such as farm managers, professional engineers, crop consultants, nutritionists, and others, to develop CNMPs that serve the farm and the environment. For CAFO-regulated farms, they are key advisers in guiding farm managers to effectively invest what can often be significant resources to achieve and maintain compliance.

What training and achievements are required?

Certification as an AEM planner is performance based and rigorous for the life of the certification. Certification requires that a planner:

- be a CCA in the Northeast Region, a distinction requiring education and experience in agricultural environmental management, continuing education requirements on a two-year cycle, and a code of ethics;
- pass the online NRCS Conservation Planning Course;
- take the four-day CNMP Training at the Water Quality Symposium in NYS to continue instruction in the standards, regulations, and guidelines for CNMP development in NYS;
- receive successful reviews (paper and on farm) of one or more randomly selected CNMPs submitted to the CNMP specialists at NYSDEC every two years.

Why are planners certified in New York State?

Planners are certified to assure:

- the public that experienced and properly trained individuals, working under the CCA code of ethics and with public oversight, are developing sound plans to protect and enhance the environment;
- farmers that the planner developing their plan has the training and experience necessary to develop an effective CNMP meeting regulatory requirements and the specific needs of their farm business;
- regulators that planning is done by qualified professionals who have been appropriately trained to meet federal and state standards and address the needs of specific watersheds; and
- all stakeholders that enough qualified planners, whether from the private or public sector, are available for the workload.

The combination of CCA accreditation and experience, an active program of continuing education and technical support for planners by the AEM partners, and performance-based CNMP reviews by the CNMP specialists all provide public oversight, quality control, and continuous improvement for CNMP development and annual updates. The NYSDEC completes the continuum of coverage by assessing farmer implementation of the CNMPs through on-farm inspections.

The certified AEM planner approach is supported by a wide range of stakeholders, including farmers, planners, regulators, and environmental advocacy groups. To date, over 40 planners from both the private and public sectors have been trained and certified through the program. These highly skilled professionals have led to the successful adoption of the CNMP
Southern

Reduce losses when feeding hay in Kentucky

This winter, hay supplies will be extremely tight on most farms across Kentucky. The 2007 spring freeze followed by prolonged drought led to a 30 to 50% reduction in hay production in the state this year. Therefore, it is important not to waste this valuable commodity when feeding it to cattle.

Reducing hay losses during feeding decreases waste, so cattle consume most of it, according to Garry Lacefield, forage specialist with the University of Kentucky College of Agriculture. Hay losses can be the result of trampling, leaf shatter, chemical and physical deterioration, fecal contamination, and simply the animal’s refusal to eat it.

Feeding losses in various research trials have ranged from less than 2% to more than 60% where no attempts were made to reduce loss. With an already reduced yield, farmers cannot afford to let their hay be reduced to rubbish, Lacefield says.

“Remember, too, when you lose hay, you are also losing money,” he says. “It does not matter whether you baled it yourself or purchased the hay, there is a cost involved with hay production.”

With some simple changes, feeding losses of 3 to 6% are quite common and acceptable for most conservative feeding programs, although the lower levels are associated with feeding programs requiring high labor and daily feeding.

Large round bales are the preferred choice for most cattle producers in Kentucky. One easy way to help reduce losses is to use hay rings or racks with large round bales. The rings limit access to the hay and can help reduce loss by keeping cattle from trampling and bedding down in the hay. Be sure to provide enough rings to accommodate the number of animals feeding and have the animals clean up the majority of the hay before providing more.

Producers should avoid feeding in areas of excessive mud which can cause waste and are hard on the animals. Hay feeding areas can be constructed by putting rock over geotextile fabric. Cost share programs are available to aid in construction. There is still time to build a feeding area before winter and information is available through the local office of the USDA Natural Resources Conservation Service.

Storage options can also impact the amount of hay your cattle will ultimately consume. Bales stored outside will degrade quickly and result in less hay available than bales stored under roof. Feed bales in outside storage first to reduce excessive loss.

—Source: University of Kentucky Cooperative Extension Service. See http://ces.ca.uky.edu/trimble/anr.
Western

Moth infestation spreads in California

The light brown apple moth (LBAM), an invasive species native to Australia, has recently been detected in Solano and Los Angeles counties, adding to the nine previously infested Bay Area and Central Coast counties of California. Single moths were detected in both new counties, and additional arrays of insect traps in both areas have detected no additional moths.

LBAM has been recorded from over 200 plants in 120 plant genera in 50 families. Some notable trees are apple, pear, peach, apricot, nectarine, citrus, persimmon, cherry, almond, avocado, oak, willow, walnut, poplar, cottonwood, coast redwood, pine, and eucalyptus. Some common shrub and herbaceous hosts are grape, kiwifruit, strawberry, berries (blackberry, blueberry, boysenberry, and raspberry), corn, pepper, tomato, pumpkin, beans, cabbage, carrot, alfalfa, rose, camellia, jasmine, chrysanthemum, clover, and plantain.

The pest destroys, stunts, or deforms young seedlings; spoils the appearance of ornamental plants; and injures deciduous fruit-tree crops, citrus, and grapes.

Development is continuous, with no true dormancy. In Australia, this moth typically has three generations per year and overwinters as a larva. Adults deposit egg masses containing 20 to 50 eggs on the upper leaf surface or on fruit. Larvae disperse and construct silken shelters on the underside of leaves, usually near a midrib or large vein. Older larvae roll together leaves and buds or fruit with webbing. Damage to fruit occurs as surface feeding by the larvae. Larvae will occasionally enter the fruit to feed. Pupation takes place within the larval nests.

Economic impact

The impact on production costs for LBAM hosts could top $100 million. It was estimated for Australia that LBAM causes AUS$21.1 million annually in lost production and control costs, or about 1.3% of gross fruit value, for apples, pears, oranges, and grapes. Applying this percentage to the 2005 gross value of these same crops in California of $5.4 billion (USDA-NASS, 2006), the estimated annual production costs would be $70.2 million.

This estimate does not include economic costs to the nursery industry nor to other significant host crops in California such as apricots, avocados, kiwifruit, peaches, and strawberries. If the same level of costs were incurred by these as for the previous four crops, the additional costs would be $63.1 million, based on their 2005 gross value of $4.8 billion. Therefore, the total lost production and control costs in California could be $133 million for all of the crops mentioned above.

In the vicinity of the newly detected infestations, regulatory actions will be directed at wholesale nurseries, retail nurseries, and community and school gardens. Regulations are enforced in a cooperative effort by the California Department of Food and Agriculture (CDFA), the USDA, and county agricultural officials. The details are as follows:

■ Wholesale nurseries—Wholesale nurseries in the infestation area will be asked to sign compliance agreements stating that they will inspect host plants before shipment and certify that they do not harbor the LBAM.

■ Retail nurseries—Retail nurseries will be inspected and, if infested, will be asked to remove infested plants and plant parts and then sign compliance agreements certifying that host plants to be sold are free-from the pest. Discarded plants and plant parts will be double-bagged and taken to landfills.

■ Community and school gardens—Host fruits and vegetables, leafy greens, tomatoes, bell peppers, broccoli, and cauliflower may not be removed from school and community gardens.

The CDFA is asking that green waste hauled by landscapers and lawn maintenance services be hauled only to approved locations, such as landfills, compost facilities, and biomass facilities.

In addition, the CDFA, USDA, and agricultural commissioners are requesting that residents of the infestation zone not remove any plants or plant parts from their property, including fruit and flowers.

The first detection of LBAM in the Bay Area came on February 27. Trapping and surveying will continue throughout the state to learn the parameters of the infestation.

The USDA and CDFA have assembled a technical working group comprised of international experts on
Biological nematicide technology for cotton

**By Robert H. Wells**

Delta researcher is using a new biological control technology to combat reniform nematodes, underground worms that cause cotton producers losses of millions of dollars annually.

“We are the first research group in the United States to investigate using a particular fungus for the biological control of reniform nematodes in cotton,” says James W. Smith, an entomologist at the Mississippi State University (MSU) Delta Research and Extension Center in Stoneville. “The product, NemOut, is labeled for nematode control on a variety of vegetable crops and turfgrass. Our early field tests using NemOut show positive results in cotton boll counts.”

Smith says using a fungus that attacks nematode populations in the soil offers a practical and environmentally friendly alternative to current reniform controls, such as chemical nematicides, which are poisons for nematodes.

“Nematicides are somewhat effective in improving yield where the nematode infestation is severe, but the products are expensive, difficult to apply, and hard to evaluate,” Smith says.

The researcher says crop rotation, especially with corn, increases cotton yields but is not always practical and has uncertain, short-term effects on nematodes. Another option, the development of reniform-resistant cotton varieties, might take a decade.

Smith will repeat the NemOut study this year using a higher concentration of the product, a formulation that the company marketing NemOut, Plato Industries, Ltd., plans to release. The USEPA is considering NemOut for registration in reniform nematode control in cotton, and the product could be available to cotton producers in 2008.

Aiding in Smith’s research into new reniform nematode control methods is a Veris cart that maps soil types throughout the field.

“We’re trying to connect soil types with nematode populations so we can predict infestations and treat portions of fields rather than entire fields,” Smith says. “This has been done successfully with other species of nematodes, but it has yet to be done with reniform nematodes.”

The most common product for reniform control, Temik, is a highly toxic chemical that is a danger to lungs, skin, and eyes and can be fatal if ingested. Cotton producers are aware of Temik’s health risks.

“I’d rather not use it if I didn’t have to,” says Harper Ross, a Mississippi cotton producer. “But I don’t want nematodes either, so we just do it.”

Ross says he has seen lint yield increases of 65 to 205 lb from using Temik on his cotton acres infested with reniform nematodes.

“You’ve just got to be careful handling it,” Ross says.

Gabe Sciumbato, a plant pathologist at MSU, has screened nematicides for six years in Stoneville and says there are several options for cotton acres with heavy reniform infestations.

“Producers may rotate their cotton with a nonhost plant for reniforms, such as corn,” Sciumbato says. “Or they may apply a soil fumigant before planting. Another treatment option would be to apply 7.5 lb of Temik per acre as a side-dress.”

The active ingredient of NemOut is an USEPA-registered, fungal nematicide produced by the German company ProPhyta. Smith is working with ProPhyta through Plato Industries, Ltd.

Smith used Delta and Pine Land’s DP555 seed in the study and applied infurrow treatments as liquid spray at 20 gallons per acre at planting. He selected the research field for its high nematode infestations on sandy loam soils, sampled all plots for nematodes prior to treatment and planting and at monthly intervals thereafter, and oversprayed plots weekly to eliminate insect effects, obtaining yields with a research cotton picker equipped with a yield monitor.

—SOURCE: Mississippi LandMarks. See www.dafvm.msstate.edu/landmarks.

Visit www.cdfa.ca.gov/phpps/pdep/ for more information on host species. For more information, visit www.cdfa.ca.gov/phpps/pdep/labam_main.htm.

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Dielectric water potential sensor

Decagon Devices recently announced the release of the MPS-1 Dielectric Water Potential Sensor. Most soil moisture sensors measure the water content of the soil, which is most useful for soil water balance studies. The MPS-1 measures the energy state or water potential of the soil, which the company says is often preferred over water content because it shows how water will move in a soil or from the soil to the plant. By measuring water potential, a researcher or grower can directly determine plant availability of soil water and simply schedule irrigation in any soil type.

The MPS-1 measures the water potential of the soil by equilibrating two ceramic discs with the soil, measuring the dielectric permittivity of the ceramic to find its water content, and then calculating the water potential of the ceramic through its moisture characteristic relationship. This is known as the solid matrix equilibration technique.

According to the company, the MPS-1 calibration equation is constant over all soil types and soil salinities up to at least 5 mmho/cm, and temperature effects on the sensor appear to be minimal. This means that no user calibration is required with the MPS-1.

For more information, see www.decagon.com or call 1-800-755-2751.

Herbicides for corn, soybean

Dow AgroSciences has introduced a new Technology for Traits portfolio of herbicides that provides growers with new weed control tools designed for high performance in herbicide-tolerant corn or soybean production systems.

SureStart, Sonic, and Durango DMA herbicides make up the portfolio. Damon Palmer, product manager for Dow AgroSciences, says the new herbicides have been designed to control weeds in Roundup Ready crops.

"Today’s growers are faced with increased weed pressure in herbicide-tolerant weed control systems that hurt their ability to produce larger yields to meet growing demand for corn and soybeans,” says Palmer. “We listened to growers and heard they needed new, more effective weed control tools. We developed the Technology for Traits portfolio of herbicides to help them better control weeds that are becoming more difficult to control in today’s Roundup Ready crops.”

SureStart and Sonic are designed to help protect the yield and profit potential of herbicide-tolerant corn and soybeans during early developmental stages from weed competition due to delayed glyphosate applications and the growing number of glyphosate-resistant and tolerant weeds. According to the company, they are ideal partners with it’s new glyphosate, Durango DMA.

Palmer says the herbicides within the Technology for Traits portfolio work together in a two-pass program in herbicide-tolerant corn or soybeans for better early-season control of tough weeds. Data from 35 experiments in nine states over the course of seven years found that a soil-applied herbicide in corn followed by glyphosate yielded 7% more than a post-treatment of glyphosate alone. Research from Southern Illinois University shows that for each inch of weed growth in soybeans, 0.7 bu/acre is lost, which amounts to $6 in lost profitability per inch of weed growth when soybean prices are $8.50/bu.

For more information, visit www.SureStart.com.

Multinutrient fertilizer

The Mosaic Company has released what it describes as a “unique three-in-one crop nutrient designed to make every single plant perform better.”

Called MicroEssentials, the new product uses a patented manufacturing process to combine the correct ratios of different vital nutrients in uniform granules, with each granule formed much like the partial layers on an onion’s skin. The company says every MicroEssentials granule contains three critical nutrients—nitrogen, phosphorus, and sulfur—in a proper ratio, giving every single plant a better shot at getting the essential nutrients it needs to produce the best results.

“MicroEssentials works better than other fertilizers for several reasons,” explains Mosaic U.S. Agronomy Manager, Dan Froehlich. “First, the granules are formed in a way that allows plants to absorb them more easily. They also contain two types of sulfur, the sulfate form which is available immediately to the plants, and the elemental form which becomes available later in the growing season. The new technology allows the nutrients to be spread more uniformly, ensuring that each and every plant gets the nutrients it needs. MicroEssentials is a versatile product that works well as a starter, a direct application fertilizer, or bulk blend ingredient.”

For more information, see www.mosaicco.com.
Looking for continuing education opportunities? The following is a list of upcoming CEU events. To find more details about each event, go to www.certifiedcropadviser.org and click on the “Continuing Education” link.

**Canada**

**Nova Scotia**—Organic Field Crop Management: Jan. 1, 2008, Truro, NS

**Ontario**—Regulations and Protocols: Jan. 8 and 16 and Feb. 6 and 19, 2008, Alfred and Woodstock, ON

**Ontario**—Nutrient Application Technician Licence Course: Jan. 9, 12, and 15, 2008, Mount Forest, ON

**Ontario**—Land Application Course (2 days): Jan. 16–17 and 22–23 and Feb. 18–19, 2008, Casselman, ON

**Ontario**—How to Prepare NMS/P Using NMAN (2 days): Jan. 30, 2008, Ottawa, ON

**Ontario**—Soil Fertility and Fertilizers—Level 2: Feb. 26, 2008, Kemptville, ON

**Ontario**—How to Prepare NMS/P Using NMAN (2 days): Feb. 27–28, 2008, Guelph, ON

**United States**

**California**—National Ag Division Meeting: Jan. 9, 2008, Garden Grove, CA

**California**—San Joaquin Valley Grape Symposium: Jan. 9, 2008, Easton, CA

**California**—Fruit II Meeting: Jan. 10, 2008, Garden Grove, CA

**California**—NT Chapter and Nutrient Seminar: Jan. 10, 2008, Tulare, CA

**California**—PAPA Seminar: Jan. 24, 2008, Fresno, CA

**California**—60th Annual California Weed Science Society Conference (3 days): Jan. 28–30, 2008, Monterey, CA

**Colorado**—Raising Your Wheat Yields and Profits: Jan. 7, 2008, Yuma, CO

**Colorado**—56th Annual Convention and Trade Show (2 days): Jan. 8–9, 2008, Denver, CO

**Colorado**—Weed ID Management and Control: Jan. 31, 2008, Greeley, CO

**Indiana**—Illiana Vegetable Grower’s School: Jan. 3, 2008, Schererville, IN

**Indiana**—Soil Fertility Workshop: Jan. 31, 2008, Terra Haute, IN

**Indiana**—Northern Indiana Soil Management Seminar: Feb. 4, 2008, Goshen, IN

**Indiana**—Soil Fertility Workshop: Feb. 12 and 14 and Mar. 4, 2008, Birch Run, MI

**Michigan**—MABA Annual Winter Conference and Trade Show (3 days): Jan. 14–16, 2008, Lansing, MI

**Michigan**—Grower Meeting: Jan. 15, 22, and 29, 2008, Merrill, MI

**Michigan**—Soil Fertility Workshop: Jan. 10, 2008, Garden Grove, CA

**Minnesota**—23rd Annual Soil Fertility Seminar: Jan. 8, 2008, Willmar, MN

**Ohio**—Crop Production Conference: Jan. 3, 2008, Columbus, OH

**Ohio**—Advanced Agronomy Workshop: Jan. 4, 2008, Columbus, OH

**Ohio**—National No Tillage Conference (4 days): Jan. 9–12, 2008, Cincinnati, OH

**Ohio**—Custom Applicator Day: Jan. 22, 2008, Waldo, OH


**Ohio**—Ohio Commercial Pest Recertification Conference: Mar. 5, 2008, Columbus, OH

**Oklahoma**—Southern Plains No-Till Seminar, Jan. 17, 2008, Hollis, OK

**Texas**—Texas Watershed Stewardship Program: Jan. 24, 2008, Wellington, TX

**Texas**—Big Conference–Grain Session: Jan. 25, 2008, Waco, TX


**Washington**—2008 Short Course: Jan. 24, 2008, Big Bend, WA

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Measuring nitrogen and phosphorus losses under different watering systems and tillage conditions

Managing nutrient systems requires considerations of a variety of conditions, including the amount and kind of water and nutrient addition, type of tillage and soil, and the kinds of crops being grown. As nutrient management becomes a very hot topic, research into how to measure the impact of nutrient addition becomes increasingly important.

While a great deal has been done in determining the particulars of nutrient management, sweeping assumptions do not further the accuracy or use of nutrient management on various kinds of farms. An area of interest is the effect of the quality of runoff from tillage and cropping systems in the southeastern part of the USA and the need to sharpen the tools used for risk assessment for nutrient contamination.

These tools are used to establish nutrient management plans and frequently use data derived from rainfall simulations. There is concern about the reliability of some simulations, but there is also support across disciplines for their use in estimating potential nutrient escape. A number of studies have evaluated nutrient losses across diverse cropping and tillage systems and loss of P from systems that may or may not incorporate nutrient sources including animal manure or inorganic fertilizers. Other studies have compared unfertilized systems with nutrient-added systems and found that sometimes nutrient losses decrease when nutrients are added or that there is not a significant difference.

Researchers from the USDA-ARS and the University of Georgia, after considering the great variation in results, decided to quantify and compare the effects of constant rainfall and variable rainfall, on inorganic N and P losses in runoff from a Tifton loamy sand, cropped to cotton, and managed with conventional- and strip-till systems.

Methods

The specifics of the tests included terrain (gently sloping broad upland Tifton loamy sands) and soil (fine-loamy, kaolinitic, thermic Plinthic Kandiudults) at the University of Georgia’s Gibbs Farm near Tifton, GA. The testing began in the spring of 2003, when the field was most vulnerable for surface runoff losses, as the fields are freshly plowed, vegetative cover has not yet emerged, and rainfall is likely. Tillage treatments, starting in fall 1998, included conventional till- ing with rye cover, and strip tilling, also with rye cover. The conventional-tillage treatment consisted of fall chisel plowing followed by spring disking and cultivator leveling. The winter rye cover for both treatments was planted in the fall and killed in the spring (April 1, 2003) with glyphosate. The winter cover crop was disk-harrowed into the top few inches of soil for the conventional-tilling treatment. The strip-till- age treatment consisted of strip tilling in the spring with the winter rye cover planted in the fall. As in the conventional-tillage treatment, winter rye was killed with glyphosate application and left on the surface. Both treatments were paratilled in the fall of 2002 and were managed in a three-year-cotton–one-year-peanut rotation. Cotton was planted in 1999, 2000, and 2001 followed by peanuts in 2002. In spring 2003, cotton was planted in sized rows for rainfall simulation before plants emerged. Tillage treatments were applied to 1-acre fields; within each tillage treatment, six rainfall simulation plots were established. Three constant-intensity rainfall and three variable-rainfall patterns were compared. The needed replications were run. Nutrients (N, P, and K) were applied for years 2001, 2002, and 2003. In years 2001 and 2002, nutrients were applied as broiler litter. In year 2003, N was applied as starter fertilizer. Application rates were equal for all treatments.

Rain patterns

Constant rainfall stimulation techniques are often used for studies of this type, but practitioners know that rainfall is seldom constant, and heavy rainfall may increase the degree of runoff and soil loss and can increase the amount of phosphorus transport. For this research, an oscillating-nozzle rainfall simulator with 80150 veejet nozzles (median drop size = 0.23 cm) was placed 9.8 ft above each plot. Simulated rainfall was applied at a target rate of 2.24 in/h for

<p>| Table 1. Mean total rainfall depth, standard deviation, and coefficient of uniformity for each tillage intensity treatment, from initiation of rainfall through 70 min of runoff.† |
|-----------------|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Tillage intensity treatment</th>
<th>Rainfall</th>
<th>Reps</th>
<th>Standard deviation</th>
<th>Coefficient uniformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT-Iv</td>
<td>6.38</td>
<td>3</td>
<td>0.25</td>
<td>73</td>
</tr>
<tr>
<td>CT-Ic</td>
<td>6.00</td>
<td>3</td>
<td>0.38</td>
<td>69</td>
</tr>
<tr>
<td>ST-Iv</td>
<td>6.38</td>
<td>3</td>
<td>0.25</td>
<td>66</td>
</tr>
<tr>
<td>ST-Ic</td>
<td>6.43</td>
<td>3</td>
<td>0.37</td>
<td>68</td>
</tr>
</tbody>
</table>

† CT-Iv, conventional tillage–variable intensity rainfall treatment; CT-Ic, conventional tillage–constant intensity rainfall treatment; ST-Iv, strip tillage–variable intensity rainfall treatment; ST-Ic, strip tillage–constant intensity rainfall treatment.
both constant and variable rainfall patterns. The coefficient of uniformity ranged from 66 to 73%. The variable rainfall intensity pattern was developed from 5- and 1-min natural rainfall data (30 yr) collected at Tifton, GA. Rainfall patterns during the months March, April, and May were analyzed to determine the pattern that occurred most frequently during the spring row crop planting season. Maximum intensity for variable intensity rainfall was ~5 in/h and occurred at 20 min after the start of the simulation. The constant-rate pattern was determined from the statistical average of the variable-intensity pattern. Rainfall duration for each simulation was 70 min. Rainfall total, standard deviation, and coefficient of uniformity for each treatment are presented in Table 1, and the rainfall patterns are illustrated in Fig. 1. Total rainfall volume applied over the 70-min duration was the same for constant rainfall intensity and variable intensity patterns. Water for each simulation, obtained from a nearby groundwater well, was pumped into a holding tank and used within two hours. Details of testing for nutrient components are in the original paper (see citation at the end of this article).

Nutrient analysis

Soil was analyzed prior to the experiments. Median pH was 6.5, and there was no significant difference in moisture content of the soil between tillage treatments. Analysis of soil particle size distribution indicated that both conventional- and strip-till treatments were on soils with about 80% sand down to 30-cm depth. Nutrient analysis of soils showed uniform distribution of soil test phosphorus and water-soluble phosphorus to 30 cm in the conventionally tilled plots. In contrast, soil test phosphorus and water-soluble phosphorus were accumulated in the surface layers in the strip-tilled plots. The conventionally tilled treatments, where in previous years broiler litter applications were incorporated into the soil, are well below these soil P concentrations (water-soluble phosphorus). Soil P concentrations for the standard tillage treatments, however, are similar to these soil P concentrations (water-soluble phosphorus). In both tillage

![Fig. 1. Rainfall intensity patterns for constant- and variable-intensity treatments. Note: 1 mm = 0.1 cm.](image-url)
systems, soil NO$_3$–N and NH$_4$–N concentrations were greater in the upper inch than in the lower depths.

**Effect of tillage on nutrient losses in runoff nitrogen**

There was no difference in the flow-weighted concentrations of NH$_4$–N between tillage treatments. Losses of NH$_4$–N were largest from conventional tillage with variable-intensity rainfall during the 25- to 35-min period. The larger loss of NH$_4$–N from the conventional-tillage treatments was apparently caused by a larger concentration of KCl-extractable NH$_4$–N in the upper inch of soil, which was evident after rainfall simulation. Ammonium in the upper inch of the soil was extremely variable before rainfall simulations, and there was no significant difference in soil NH$_4$–N. Soil samples taken after the rain had significantly greater NH$_4$–N in the conventionally tilled plots than in the strip-tillage plots. Incorporated residue has been shown to mineralize organic N at a greater rate than residues left on the surface and may be the reason for the difference in soil NH$_4$–N concentrations. The greater concentration of NH$_4$–N in the soil and the period of intense rainfall on bare surfaces resulted in the largest losses during the 25- to 35-min period from the conventionally tilled plots with the variable-intensity pattern.

The concentration of NO$_3$–N was significantly greater for strip tillage than for conventional tillage. There was an interaction between tillage and rainfall intensity treatment for loss of NO$_3$–N at the end of simulation. Differences between tillage systems were much greater for constant rainfall intensity than for variable rainfall intensity. Both flow-weighted concentration and cumulative loss of NO$_3$–N were significantly larger for strip-tillage treatments at the end of the rainfall simulations. During the 5- to 15-min period, strip tillage had a significantly larger concentration of NO$_3$–N than conventional tillage. Although there were no differences between tillage treatments in soil NO$_3$–N content at any depth investigated, a significant relationship ($p < 0.05$) was found between soil NO$_3$–N levels (before rainfall) at 0 to 2 and 2 to 8 cm and NO$_3$–N in runoff for strip-tillage treatments. As soil NO$_3$–N levels at both depths increased, so did NO$_3$–N in runoff from strip-tillage treatments.

Total N losses were found to be the opposite of NO$_3$–N losses in runoff. Conventional tillage had larger flow-weighted total N concentrations than strip tillage during the 25- to 35-min period. Losses were even more significant and much more extensive with conventional-tillage treatments losing more than four times the amount of N for the 70-min duration than the strip-tillage treatments. Significant differences in losses began at the 25-min period, which was similar to NH$_4$–N losses although significant differences in NH$_4$–N losses ended by 40 min of runoff.

**Phosphorus**

Cumulative flow-weighted concentration of PO$_4$–P per quart and loss of dissolved reactive phosphorus as PO$_4$–P per acre in runoff were significantly greater for strip-tillage treatments than for conventional-tillage treatments immediately after 15 min of runoff. Some interaction between tillage and rainfall intensity treatments was seen immediately following peak rainfall intensities (25 min) for the variable-rate treatment and in the last runoff periods (65 to 70 min) when variable rainfall intensities were below constant rainfall intensities. The effect of tillage was greater for the constant rainfall pattern than for the variable rainfall intensity pattern. In grassland systems when fertilizers were freshly applied, N and P losses of both dissolved and total unfiltered forms were greater in runoff when broiler litter was surface-applied than when incorporated into the soil. In several previous studies, it appears that the depth of incorporation of litter and the degree of contact between fertilizer and soil affects the amount of nutrients that are released to runoff. The depth of incorporation of litter and the degree of contact between fertilizer and soil affects the amount of nutrients that are released to runoff. The depth of incorporation of litter in the strip treatment did not produce significant difference in concentration of dissolved reactive phosphorus in this study; however, there were significant differences between depth of tillage and nutrient loss for conventional-tillage systems. Water-soluble P from the shallow depth could be expected to be more easily solubilized during natural rainfall events and translocated into the first few inches of soil, leaving behind the more tightly bound STP.

**Conclusions**

- The effect of tillage on nutrient losses in runoff had contrasting results depending on nutrient fraction.
- Strip-tillage treatments lost significantly more dissolved nutrients while conventional-tillage treatments lost significantly more total N and P.
- Strip-tillage treatments retained more N and P. In fact, total P losses were more than nine times greater in the conventional-tillage treatments than dissolved reactive phosphorus losses in the strip-tillage treatments.
- Total N losses from conventional-tillage treatments were more than three times larger than dissolved N losses from strip-tillage treatments, indicating that strip-tillage systems may be losing more soluble fractions than conventional-tillage systems, but only a fraction of the total N and P being lost to the environment through overland flow is from conventional-tillage systems.

The researchers found no evidence of significant differences in losses of total N or total P in runoff from either rainfall intensity pattern for the 70-min duration. In contrast, losses of dissolved reactive phosphorus and NO$_3$–N were

**Correction:** In the fall issue of *Crops & Soils*, on page 25, the price listed for completing the self-study quiz was worth two CEUs in Crop Management was incorrect. The price is $23 by check and $20 if completed online. We apologize for any confusion.
found to be greatest for strip tillage–constant rainfall, followed by strip tillage–variable rainfall, conventional tillage–constant rainfall, and conventional tillage–variable rainfall in diminishing order.

Test results indicate that constant-intensity rainfall simulations may overestimate the amount of dissolved nutrients lost to the environment in overland flow from cropping systems in loamy sand soils. The use of rainfall simulators that simulate natural rainfall patterns may yield better estimates of the potential for nutrient loss in surface runoff when dissolved fractions are a concern.


Winter 2008 Self-Study Quiz
Measuring nitrogen and phosphorus losses under different watering systems and tillage conditions (no. SS 03772)

1. At the end of the simulation, which factors showed an interaction that affected the loss of NO$_3$–N?
   - a. tillage method and rainfall intensity.
   - b. soil pH and rainfall intensity.
   - c. soil particle size and tillage method.
   - d. soil particle size and rainfall intensity.

2. Total N losses were
   - a. similar to NO$_3$–N losses in runoff.
   - b. Higher for conventional tillage.
   - c. higher for strip-tillage test fractions.
   - d. Lowest for the conventional-tillage treatment when a long duration of rainfall occurred.

3. Peak rainfall intensities increase phosphorus runoff
   - a. especially in strip-tilled areas.
   - b. immediately after rainfall in conventionally tilled systems.
   - c. when broiler litter is tilled at a shallow depth into the soil.
   - d. above that of constant-rainfall conditions.

4. The effect of tillage on nutrient losses in runoff had contrasting results depending
   - a. on nutrient fraction.
   - b. temperature.
   - c. soil particle size.
   - d. crops being grown.

5. Strip tillage treatments lost significantly more dissolved nutrients while conventional-tillage treatments lost
   - a. Less total nutrients.
   - b. significantly more total N and P.
   - c. more bound moisture.
   - d. more soil structure.

6. Total N losses from conventional-tillage treatments were more than three times larger than dissolved N losses from strip-tillage treatments, indicating that
   - a. conventional tillage collected more overall rain.
   - b. dissolved nutrients are easier to measure.
   - c. strip tillage systems may be losing more soluble fractions than conventional tillage systems, but only a fraction of the total N and P being lost to the environment through overland flow is from conventional-tillage systems.
   - d. no conclusions can be drawn.

7. Test results indicate that constant-intensity rainfall simulations may overestimate the amount of dissolved nutrients lost to the environment in overland flow from cropping systems
   - a. in very wet weather.
   - b. in loamy sand soils.
   - c. In very dry, hot weather.
   - d. In heavy clay soil.
8. Cumulative flow-weighted concentration of $\text{PO}_4^{3-}$ per quart and loss of dissolved reactive phosphorus as $\text{PO}_4^{3-}$ per acre in runoff were significantly greater for strip-tillage treatments than for conventional-tillage treatments

- a. within 48 h of rain.
- b. immediately after 15 min of runoff.
- c. the next day.
- d. immediately.

9. What crop was the test performed on?

- a. corn.
- b. soybeans.
- c. canola.
- d. cotton.

10. The purpose of the study was to

- a. determine how best to conserve water.
- b. determine what tillage method is best.
- c. refine current risk assessment tools for nutrient contamination.
- d. identify the effect of water on crops.

**SELF-STUDY QUIZ REGISTRATION FORM**

Name: ________________________________

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City: ________________________________

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CCA certification no.: ________________________________

☐ $15 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 December 2007 expires December 2010*

**SELF-STUDY QUIZ EVALUATION FORM**

Rating Scale: 1 = Poor 5 = Excellent

Information presented will be useful in my daily crop-advancing 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: __________________________________________________________
Common waterhemp growth and fecundity as influenced by emergence date and competing crop

Most weed management approaches deal only with the existing weed problem and fail to address the reasons for persistent weed infestations. Increasing knowledge of weed biology and ecology provides a better understanding of the interference mechanisms of undesirable plants, expands crop loss prevention techniques, and leads to better long-term management strategies. For example, knowing the potential of seed production provides an opportunity for predicting the nature of forthcoming weed populations. In addition, information on seed production of weeds that escape control can add a new dimension to decisions of when to control weeds and which weeds need to be controlled. Lastly, understanding seed production, especially of late-emerging species, may allow prediction of species that have high probabilities of escaping control in systems that rely only on nonresidual postemergence herbicides.

Minimum tillage coupled with the use of glyphosate-resistant (GR) cultivars changes weed diversity in fields because the weed species may either be tolerant or have developed resistance to glyphosate, may be too large to be controlled effectively by either chemical or mechanical control techniques, or emerge after the season’s final weed control method (chemical or mechanical) has been completed. Common waterhemp was not recognized as a problem in crop fields before 1990. However, it was one of the first weeds recorded to escape control in GR soybean crops throughout the midwestern United States.

Common waterhemp has been described as the perfect weed because of season-long emergence patterns, a fast growth rate, prolific seed production potential with >2 million seeds produced per plant, and populations that can be resistant to many herbicides with diverse modes of action. In addition, common waterhemp plants often escape control and survive under the crop canopy in GR crops either because early emerged plants are often too large to be controlled by a postemergence application or plants emerge...
after the final postemergence application of a nonresidual herbicide. Uncontrolled weeds can produce viable seeds that continue the infestation.

While the potential seed production of a plant population may be very high, seed production of an individual can be influenced by factors such as time of emergence, plant size, and the amount of interference or competition exerted by surrounding plants. In general, plant fecundity decreases when plants emerge late in the growing season, although even a few viable seeds can be enough to reinfest an area or further spread an infestation. The crop species with which the weed is competing also can influence plant growth and, ultimately, seed production.

Continued replenishment of the soil weed seed bank is one of the reasons given for control decisions of late-emerging weeds. The objective of this study was to determine the seed production potential of common waterhemp at four simulated emergence dates when grown alone or with corn or soybean. These data can be used to help guide decisions and recommendations about the extent of control needed for late-emerging plants based on their seed production potential.

Materials and methods
Variable waterhemp emergence was simulated by transplanting seedlings into corn, soybean, and bare plot areas at differing crop growth stages during two growing seasons in western Minnesota. The 2001 and 2002 field study was conducted at the Swan Lake Research Farm of the USDA-ARS facility in Morris, MN. The soil type was a Barnes loam with
a pH of 7.3 and organic matter content of 6%. The plot area was moldboard-plowed in the fall and field-cultivated in spring of the growing season. The previous crop in the corn plot area in 2001 was wheat, whereas the previous crop in the soybean plot area was corn. In 2002, the plots of corn and soybean were interchanged.

Planting of GR corn and GR soybeans occurred on May 29 in both 2001 and 2002. Individual plots were four rows wide with a 30-in row spacing and 13 ft long. Seeding rates were 32,000 corn seeds per acre and 180,000 soybean seeds per acre. Emergence for both crops was on June 6 in 2001 and on June 5 in 2002.

Common waterhemp seed were collected locally and planted in peat pots in a greenhouse several times during the season, about eight days before each transplanting date. Waterhemp plants that were at the first-true-leaf growth stage were transplanted into field plots at four crop growth stages each year. When the crop was at the desired growth stage, 64 peat pots that each contained one common waterhemp plant were transplanted between the rows of each crop at equidistant spacing for a density of one waterhemp plant per two square feet. In addition, common waterhemp was transplanted into bare plot areas that had been fertilized similarly to corn (high fertility) or soybean (low fertility) in the same pattern at each time to determine maximum growth and seed production potential. Treatments (i.e., timing of common waterhemp transplanting) were replicated four times in a randomized complete block design.

To keep plots free of extraneous weeds, glyphosate was applied to plots not containing transplants using a backpack sprayer four days before each transplanting date. Weeds that emerged after transplanting were removed by hand, whenever necessary, throughout the rest of the growing season.

During the season, the height of four common waterhemp plants per plot was measured from the soil surface to the tip of the tallest plant part. In addition, at these sampling times, canopy diameters from the same plants were estimated using the main stem as the center point and measuring the widest plant span. After flowering, seedheads of four randomly selected common waterhemp plants for each replication were enclosed in nylon mesh bags that allowed air movement and penetration of sunlight but avoided seed loss. After the first frost, bagged plants were harvested by clipping them at ground level. Plants were divided into vegetative and reproductive structures, dried, and weighed. One hundred seeds per plant for each treatment and replication were counted and weighed. These measurements were used to estimate the total number of seeds produced per plant by treatment from the total seed weight per plant.

Air temperatures were collected on site at a 6-ft height to calculate growing degree days (GDD). Data were not pooled across years because common waterhemp was transplanted at slightly different growth stages of the crop each year. Data were not distributed normally and did not have constant variance; therefore, data were log<sub>10</sub>-transformed before the analysis of variance. Mean comparisons were made using Duncan’s Multiple Range Test (P = 0.05). Equations were developed for each crop to describe the relationship between cumulative GDD exposure and dry matter production or seed production.

Results and discussion

**Common waterhemp growth and vegetative dry matter production.** The earliest transplanted common waterhemp plants were generally the tallest, had the greatest canopy diameter, and had the greatest vegetative dry weight at the end of the season when compared with later transplants. Branch biomass was reduced to a greater extent than main stem and leaf biomass when vegetative biomass of early and late transplants was compared within any treatment.

Common waterhemp plants grown alone had greater canopy diameters and had dry weights that were up to 10 times greater than plants grown in competition with either crop. In high-fertility plots (i.e., corn), late-transplanted common waterhemp produced 19 to 21% of the biomass of the early transplants. In the low-fertility plots, late-transplanted common waterhemp produced 9 to 11% of the biomass of early transplants.

Common waterhemp transplanted into corn always was below the corn canopy. For each year at the end of the season, average maximum corn height was 8 ft whereas common waterhemp height ranged from 7.5 ft (VE) to less than a foot (V9, 2001 and V10, 2002). Maximum soybean height was about 3 ft each year, and common waterhemp was taller than soybean when transplanted at VE and V3 (2001) and V1 (2002) but shorter than soybean when transplanted at later soybean growth stages.

Common waterhemp had about 2.2 and 9 times greater vegetative biomass when transplanted into soybean at VE (2001) and V1 (2002), respectively, than when transplanted in corn at the same growth stages in the same years. When transplanted into either crop at V5 or later in 2001, or V4 or later in 2002, the amount of vegetative biomass produced was very low (<1 oz per plant). While common waterhemp survived very late transplanting (V8–V11) in corn, all transplants in soybean died when planted at or after V8.

**Common waterhemp seed production.** Common waterhemp seed production from plants grown alone ranged from 33,500 to over 1 million seeds/plant. Compared with common waterhemp grown alone, corn competition reduced seed production by 90% or more, whereas soybean competition had less effect at VE (about 33% seed reduction) and more effect (no seeds produced) when transplanted at V8 or V11. The seed production in corn reported here is higher than numbers reported in an Illinois study but similar to numbers reported in an Iowa study.

However, in contrast with the Iowa data that reported no seed production when the weed emerged at the V8 corn stage, plants in this study survived and produced 100 to 150 seeds/plant even when transplanted at the V9 to V10 corn growth stages. These data indicate that even very late-emerging common waterhemp plants possibly can survive in
corn and produce seeds to maintain or increase infestations. About 1 to 5% of the common waterhemp seeds from the soil seed bank germinate annually. Thus, fecundity rates as low as 100 to 150 seeds/plant conceivably could maintain viable replacement populations of waterhemp.

Common waterhemp plants that were transplanted into soybean from VE to V3 had a greater seed production potential than comparable plants grown in corn. Equations that fit total common waterhemp dry weight and seed production (Fig. 1 and 2) to GDD based on time of transplanting indicated that the two crops had different effects on common waterhemp. Total dry weight and seed production of plants transplanted into corn fitted exponential decay curves when plotted against cumulative GDD exposure after transplanting (Fig. 1). In contrast, equations that fit GDD vs. total dry weight or seed production of plants transplanted into soybean were sigmoidal curves (Fig. 2). These data indicate that corn competition had a larger effect on common waterhemp than that of soybean during the first stages of crop growth. Soybean was a weak competitor during these initial stages, allowing common waterhemp to grow taller than the crop.

Light intensity differences between crop canopies most likely influenced common waterhemp growth and seed production patterns. For example, in prior studies at the Morris location, maximum corn leaf area index (LAI) of 3.75 was attained at about 450 GDD after planting, whereas soybean did not reach 3.75 LAI until about 550 GDD (about one week later). Moreover, final maximum soybean LAI of about 7 was 86% greater than corn LAI and attained at about 700 GDD after planting (about two weeks after corn maximum LAI). These canopy closure and maximum LAI differences between crops would result in light-intensity penetration differences in the crop canopy. Seed production in common waterhemp has been reported to be associated closely and negatively with shading.

**Conclusions**

The results from this research indicated that common waterhemp could survive late emergence into crop canopies and have the potential to produce seeds. Corn and soybean affected common waterhemp growth and seed production differently. Soybean was a weak competitor up to the
Winter 2008 Self-Study Quiz

Common waterhemp growth and fecundity as influenced by emergence date and competing crop (no. SS 03773)

1. Common waterhemp can be a troublesome weed because of its
   a. prolific ability to produce seeds.
   b. typical emergence just as the crop reproductive period begins.
   c. very large seeds.
   d. resistance to mechanical cultivation.

2. An objective of this study was to
   a. study weed biotypes common in Midwest crop rotations.
   b. determine the seed production potential of waterhemp in different situations.
   c. determine dominant weed species in corn and soybean ecosystems.
   d. assess how weeds affect grain quality.

3. This study showed the number of seeds an individual common waterhemp plant can produce when growing alone is
   a. 1,000 to 1,500.
   b. up to 10,000.
   c. more than 1 million.
   d. over 1 billion.

4. Plot management for this study included
   a. two tillage systems.
   b. weed growth monitored twice weekly.
   c. six-row plots.
   d. different weed planting dates.

5. Data collected periodically during the growing season included
   a. air temperatures.
   b. weed weight.
   c. rainfall.
   d. canopy light penetration.

V4 stage of soybean growth, and control of common waterhemp emerging before this growth stage would be critical to prevent future infestations. However, transplants into soybean after the V5 stage of soybean produced few seeds, and those transplanted after V6 did not survive. These data indicated that control of very late-emerging seedlings may not be necessary because of the competition exerted by soybean. In contrast, late-emerging common waterhemp plants growing in corn produced many more seeds. An effective control method for these late but seed-bearing plants would be recommended.

9. The sigmoidal curve of dry weight and seed production of common waterhemp transplanted into soybeans indicated
   a. soybean growth slowed substantially after the V3 stage.
   b. waterhemp's growth response to GDDs differed from that of soybeans.
   c. soybean was a relatively weak competitor with common waterhemp at the start of the season.
   d. seed production patterns were much different when comparing 2001 and 2002.

10. As a result of this study, one of the conclusions of the authors was that
   a. late-emerging waterhemp may be more of a problem in corn than in soybeans.
   b. black nightshade is an extremely competitive weed in soybeans.
   c. due to lower canopy height, even late-emerging common waterhemp can outcompete soybeans.
   d. it is difficult to control late-emerging weeds with herbicides.
Soil water use by 10 crops for managing dynamic cropping systems

Dynamic cropping systems principles require that farmers consider climatic, market, and ecological factors on an annual basis in making crop choices. The objectives of a recent study were to determine the variability of seasonal soil water depletion and spring soil water recharge among crops and to apply results to dynamic cropping systems practices.

Looking at long-term strategies for sustaining soil and land resources while maintaining and improving farm income has resulted in the development of dynamic cropping systems to improve the management of soils and crops. The dynamic cropping systems concept may be defined as a long-term strategy for sustainable soil–crop management that is implemented by farmers who make decisions each crop year in response to changing environmental, economic, and agronomic conditions. The research described in this article involved the study of 10 crop species that can be used to replace the historic wheat-based biennial crop–fallow system, and the more recently used fixed, shorter-duration rotations. Practice of dynamic, flexible, and continuous cropping improves yields through ecological synergisms, uses available rainfall more efficiently, and protects the soil from erosion, but places a greater emphasis on using a diversity of crop species that are appropriate to soil and water conditions.

Gaining information about the water requirements of a variety of crops makes it easier for the farmer to make good crop choices—ones that enhance his or her bottom line while protecting the environment beyond the farm gate. Understanding the systematics of crop and soil ecology—how one crop species affects subsequent crops through annual effects on the soil and aboveground environment—is particularly important. In a water-limited region, soil water use by one crop affects following crops, so comparative information about seasonal soil water depletion and water use (evapotranspiration, the sum of soil water depletion and seasonal precipitation) by crops is valuable.

Earlier research has reported water use differences for five crops in eastern Montana, showing greater water...
use by safflower and sunflower compared with spring wheat and barley. The relatively high water use by sunflower has been shown to decrease yields of subsequent crops in eastern Colorado as well as other dryland areas. Observations of water use by crop species in various dryland environments have indicated that longer-season, more deeply rooted oilseed crops such as safflower have the greatest water use while crops such as dry pea with a shorter growing season have the lowest water use. These results were seen in the xeric (wet winter, dry summer) region of the Pacific Northwest and in the continental climate (peak rainfall in summer) of North Dakota. Earlier studies at the USDA-ARS Northern Great Plains Research Laboratory comparing both soil water depletion and root growth of various crops concluded that crop season length was a better predictor of water use than rooting depth.

This research reports comparative soil water depletion and soil water recharge measurements of 10 crop species based on the Phase III Crop Sequence Experiment of the Northern Great Plains Research Laboratory. Crops included sunflower, corn, grain sorghum, spring wheat, canola, proso millet, buckwheat, chickpea, lentil, and dry pea. The study has included standard, newer, and emerging crops and examined principles and factors relating to characteristic differences in water use among crop species. A further purpose was to explore how information about soil water depletion and recharge characteristics of crops may be applied to the principles of dynamic cropping systems.

Research approach

To provide agriculturalists with soil–crop ecological information needed to use the principles of dynamic cropping systems, several alternative crop and crop sequence projects have been implemented at the USDA-ARS in Mandan, ND. The Phase I Alternative Crops Project and the Phase II Crop Sequence Project have been completed. Soil water measurements reported here were made in the Phase III Crop Sequence Project.

The study was conducted under no-till management on silt loam Haplustoll soils in Morton County, North Dakota. The experiment was performed by seeding the 10 crop species in strips during one year and seeding the same crops in strips perpendicular to the first set during the following year, creating a crop matrix so the results of 100 different crop sequences could be observed. The checkerboard-like crop matrix blocks were replicated four times at each of two sites that were on the same soil type about one and a quarter miles apart. Crops planted in the first year of crop matrix formation at a site are referred to here as the residue crops, and crops planted in the second year of crop matrix formation are termed the matrix crops. Residue crops at Site 1 and Site 2 were seeded in 2002 and 2003, respectively, and matrix crops at Site 1 and Site 2 were seeded in 2003 and 2004, respectively. Spring wheat crops were seeded in the year before formation of the crop matrices, in 2001 and 2002 at Site 1 and Site 2, respectively.

Agronomic information for the 10 crops is given in Table 1. Weeds were controlled by preseeding application of glyphosate with additional use of postemergent herbicides. Granular fertilizer was applied through the seeder implement at two different rates. Leguminous crops (chickpea, dry pea, and lentil) did not receive N fertilization but did receive appropriate Rhizobium inoculants at seeding. Canola received sulfur fertilization at a single rate.

Soil water content was measured at weekly intervals with a neutron moisture meter at 11.8-in increments in steel access tubes to a depth of 6.9 ft. Moisture levels were taken in each block on those plots of the 10 crops where spring wheat had been planted in the year before. Measurements were taken in residue crop plots at Site 1 in 2002, in residue crop plots at Site 2 in 2003, and in matrix crop plots at Site 2 in 2004.

Results and discussion

Precipitation during the years of the experiment was considerably less than the long-term average (Table 2). In 2002, spring precipitation was less than average, but July and August precipitation was average or above average that year. Among the years of the study, the period between April and September had the lowest precipitation during 2002. May precipitation was much above average in 2003, but June and especially July and August precipitation amounts were below average. This pattern favored shorter-season, earlier-seeded crops such as dry pea and spring wheat compared with longer-season, later-seeded crops such as sunflower. In 2004, spring precipitation for April through June was much

<table>
<thead>
<tr>
<th>Crop</th>
<th>Cultivar</th>
<th>Seeding date (avg.)</th>
<th>Harvest date (avg.)</th>
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<td>Oct. 25</td>
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<td>Spring wheat</td>
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<td>100</td>
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<tr>
<td>Canola</td>
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<td>May 10</td>
<td>Aug. 16</td>
<td>98</td>
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<td>Earlybird</td>
<td>June 9</td>
<td>Sept. 20</td>
<td>103</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>Koto</td>
<td>June 8</td>
<td>Sept. 18</td>
<td>102</td>
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<tr>
<td>Chickpea</td>
<td>B-90</td>
<td>May 11</td>
<td>Aug. 21</td>
<td>114</td>
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<tr>
<td>Lentil</td>
<td>Richlea</td>
<td>May 11</td>
<td>Aug. 16</td>
<td>109</td>
</tr>
<tr>
<td>Dry pea</td>
<td>DS Admiral</td>
<td>April 29</td>
<td>July 30</td>
<td>92</td>
</tr>
</tbody>
</table>
below average so that the six-month (April to September) precipitation was below average.

The ranking of the crops and their three-year average soil water depletion amounts (over 5.9-ft soil depth) were: sunflower, 13.5 cm; corn, 12.6 cm; sorghum, 11.0 cm; spring wheat, 10.6 cm; canola, 10.0 cm; millet, 9.6 cm; buckwheat, 9.4 cm; chickpea, 8.5 cm; lentil, 8.1 cm; and dry pea, 5.0 cm. Highest and lowest soil water depletion of sunflower and dry pea were 29 and 11% of average May soil water (46 cm), respectively.

Four crops, including two oilseed crops and two grains (sunflower, canola, spring wheat, and dry pea), were included in the present study that had been in the previous Phase II Crop Sequence Project. Despite considerable difference in climatic conditions between the below-average precipitation of the present crop sequence project and the average to above-average precipitation of previous projects, the pattern of soil water depletion attributed to crop species common to various projects was similar: sunflower > canola, which was about the same as spring wheat > dry pea. Canola had the greatest variability in year-to-year soil water depletion values, which was also observed in earlier projects. In work conducted at the same research facility, researchers found that sunflower had the greatest seasonal water use compared with six other broadleaf crops and that while dry pea had relatively poor at snow capture. The ranking of average soil water recharge among crops (Table 3) roughly reflects differences in evapotranspiration. Soil water recharge is more dependent on stochastic landscape hydrologic processes resulting in runoff and runon. Other factors that can affect soil water recharge are snow capture by crop residue, weed growth, and soil evaporation.

Snow capture measurements showed that only about a quarter of snow trapped by sunflower residue and measured in February remained by early March, a result apparently caused by the less-durable standing residue and nondurable leaf residue of sunflower leading to greater snow loss. About two-thirds of the snow captured in corn stubble remained by early March. Spring wheat was best at capturing and retaining snow, and four other crops were able to capture considerable amounts of snow: canola, buckwheat, millet, and sorghum. The three legume crops—chickpea, lentil, and dry pea—having low-lying and less durable residues, were relatively poor at snow capture. The ranking of average soil water recharge among crops (Table 3) roughly reflects differences in snow capture (Fig. 1). Sunflower had the least amount of recharge (10th ranked), and chickpea, lentil,

| Table 2. Precipitation near the two sites of the Phase III crop sequence project. |
|-------------------------------|-------|-------|-------|-------|
|                             | 2002  | 2003  | 2004  | Long-term avg. (92 yr) cm |
| Three months (January–March) | 2.0   | 2.1   | 5.0   | 3.6   |
| April                        | 2.5   | 2.1   | 1.5   | 3.7   |
| May                          | 1.3   | 13.2  | 3.2   | 5.6   |
| June                         | 3.2   | 5.3   | 4.9   | 8.4   |
| July                         | 6.6   | 1.2   | 6.7   | 6.5   |
| August                       | 4.9   | 1.0   | 6.1   | 4.6   |
| September                    | 0.9   | 4.1   | 4.1   | 3.7   |
| Six months (April–September) | 19.4  | 27.0  | 26.5  | 32.5  |
| Three months (October–December) | 2.8  | 4.0   | 3.5   | 4.9   |
| Annual                       | 24.2  | 33.1  | 35.0  | 41.1  |

Snow depth, cm

Fig. 1. Depths of snow entrapped in residue structures measured on two dates in 2004. Letters refer to Tukey’s Studentized range test at P < 0.05 applied to dates separately.

The farmer’s bottom line in terms of amounts of seasonal water use and subsequent overwinter soil water recharge under various crops is how much water is stored in the soil profile the following spring that is available to support a new crop. Because the period of the experiment was relatively dry, overwinter recharge was less than seasonal depletion. Spring soil water was 10 cm greater following dry pea than following sunflower, which left the least amount of water in the soil. Corn left the second lowest amount of springtime water in the soil. Ranking of crops for spring water storage roughly followed the reverse of soil water depletion rank, with several exceptions, notably spring wheat, which had greater water available from superior snow capture and left almost as much water in the soil as dry pea.

The amount of soil water left in the soil in springtime depends on how overwinter recharge modifies soil water differentials developed by seasonal soil water depletion. In general, soil water depletion should be expected to be more variable among crops than soil water recharge because it depends on differences in crop phenology that determine differences in evapotranspiration. Soil water recharge is more dependent on stochastic landscape hydrologic processes resulting in runoff and runon. Other factors that can affect soil water recharge are snow capture by crop residue, weed growth, and soil evaporation.
and dry pea were also low ranking: ninth, eighth, and seventh, respectively.

Soil biology, plant diseases, weed growth interactions, or crop water use differences may affect crop production systems. Under average to above-average rainfall conditions in the Phase II Crop Sequence Project, sunflower showed overall positive crop sequential effects on other species during the crop matrix years and had positive effects on spring wheat crops that were seeded after the crop matrices. The spring wheat results of this project were interpreted as showing that greater water use by sunflower helped lessen plant diseases that flourished with continuous wheat crops. However, crop sequential effects of sunflower were negative when conducted under the drier-than-average precipitation conditions of the Phase III Crop Sequence Project, the subject of this report.

Understanding the management of dynamic cropping systems requires application of the key principles of adaptability, diversity, environmental awareness, information awareness, multiple enterprises, and reduced input costs.

### Table 3. Soil water depletion to the 5.9-ft depth during the mid-May to mid-September growth period and overwinter recharge on land seeded to listed crops. Measurements in 2002 and April 2003 were taken at Site 1, and those taken in 2003 through April 2005 were done at Site 2. Also, shown is soil water depletion as the percentage of water use (evapotranspiration, ET) and soil water depletion accounting periods.†

<table>
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<td>5.6a</td>
<td>16.1a</td>
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<td>8.2ab</td>
<td>4.3a</td>
<td>3.6a</td>
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<td>5.4a</td>
<td>15.0ab</td>
<td>11.5a</td>
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<td>10.6</td>
<td>6.0</td>
<td>1, 2</td>
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<td>9.9b</td>
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<td>12.6ab</td>
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<td>2.7ab</td>
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<td>9.4</td>
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<td>13.3ab</td>
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<td>1.3ab</td>
<td>8.5</td>
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<td>Lentil</td>
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<td>8.1</td>
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<td>Dry pea</td>
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<td>7</td>
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<td>Average</td>
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<td>5.4</td>
<td>13.2</td>
<td>7.1</td>
<td>1.5</td>
<td>1.9</td>
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<table>
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<th>Year</th>
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<th>2003</th>
<th>2004</th>
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<td>Four-month seasonal precipitation, cm</td>
<td>16.1</td>
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<td>Depletion, % of water use (ET)</td>
<td>39–57</td>
<td>45–53</td>
<td>–47–13</td>
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<td>Avg. depletion, % of water use (ET)</td>
<td>48</td>
<td>48</td>
<td>7</td>
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<tr>
<td>Avg. mid-May soil water, cm</td>
<td>54.2</td>
<td>47.4</td>
<td>37.0</td>
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</table>

† Entries in a column with the same letter are not significantly different at $P < 0.05$ according to Tukey’s Studentized range test.
A farmer using information about comparative water use effects for making cropping decisions about an upcoming season would illustrate application of several of the principles of dynamic cropping systems. Farmers can choose a low-water-using crop species for the year following a higher-water-using crop, and planting a crop choice that changes agrobotanical family type can reduce disease risk.

To get the most benefit from crop water use information, farmers should carry out monitoring of the soil water status of their land, especially in springtime. The choice of higher-water-using crops, such as sunflower or corn, can be made when springtime soil water is known to be sufficiently high and the prior crop was not a heavy water user. If the prior crop produced little residue, like dry pea or lentil, then spring wheat, canola, or millet are likely to be better choices than sunflower because they provide better protection against soil erosion.


Winter 2008 Self-Study Quiz
Soil water use by 10 crops for managing dynamic cropping systems (no. SS 03774)

1. The dynamic cropping systems concept
   □ a. is a long-term strategy implemented by farmers to ensure sustainable crop management, making annual decisions that respond to changing conditions.
   □ b. is a system that responds to immediate differences to make best crop decisions for that year.
   □ c. is a federally instituted program to promote production of plants most needed that year.
   □ d. affects crop subsidies.

2. What are the advantages of continuous cropping?
   □ a. The system uses available rainfall efficiently and protects the soil from erosion, but places a greater emphasis on using diverse crop species that are appropriate to the soil water conditions.
   □ b. The system permits better crop yields in corn after corn.
   □ c. The system works best when irrigation is possible.
   □ d. The system chooses between species for their current cash value.

3. Which crop was not studied for its characteristics regarding water use?
   □ a. sunflower.
   □ b. corn.
   □ c. canola.
   □ d. cotton.

4. Precipitation during the years of the experiment was considerably less than the long-term average, indicating that
   □ a. during times of low precipitation, farmers should plant corn.
   □ b. shorter-season, earlier-seeded crops such as dry pea, lentil, or spring wheat should be planted compared with longer-season, later-seeded crops such as sunflower.
   □ c. precipitation doesn’t affect crops for more than a few weeks.
   □ d. precipitation affects all crops equally.

5. Four crops (sunflower, canola, spring wheat, and dry pea) were included in the present crop sequence study that had been in a previous crop sequence study. Climatic conditions were different during the studies, but which of the following soil water depletion observations were similar?
   □ a. Corn depleted soil water more than soybean.
   □ b. Canola depleted soil water more than sunflower.
   □ c. Sunflower depleted soil water more than canola.
   □ d. Spring wheat depleted soil water more than soybean.

6. Which crop had the greatest variability in year-to-year soil water depletion values?
   □ a. corn.
   □ b. spring wheat.
   □ c. sunflower.
   □ d. canola.
7. Which crop showed the best snow capture in the study?
- a. corn.
- b. spring wheat.
- c. soybean.
- d. dry pea.

8. Which four other crops were described as good at capturing and retaining snow?
- a. pea, rye, millet, and corn.
- b. canola, buckwheat, proso millet, and grain sorghum.
- c. soybean, pumpkin, rye, and oat.
- d. spring wheat, sunflower, canola, and corn.

9. Which oilseed crop and which legumes had the least amount of water recharge?
- a. sunflower, chickpea, lentil, and dry pea.
- b. canola, lima bean, alfalfa, and soybean.
- c. corn, kidney bean, lentil, and alfalfa.
- d. canola, alfalfa, navy bean, and soybean.

10. If the prior crop produced little residue, like dry pea or lentil, then spring wheat, canola, or millet are likely to be better choices than sunflower because they provide better protection against
- a. soil erosion.
- b. water table contamination.
- c. nitrogen overload.
- d. poor crop yield.

**SELF-STUDY QUIZ REGISTRATION FORM**

Name: ____________________________
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City: __________________________
CCA certification no.: ___________

☐ $15 check payable to the American Society of Agronomy enclosed.
☐ Please charge my credit card (see below)

Credit card no.: __________________________
Type of card: ☐ Mastercard ☐ Visa ☐ Discover ☐ Am. Express
Name on card: __________________________
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 December 2007 expires December 2010_

**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: __________________________
The great variety of soils and water conditions on farmland in the Farm Belt makes specific study of the best way to maximize crop yield difficult to pin down. Although continuous no-till cropping systems are appropriate on highly erodible land, concern among producers about potential yield reductions has limited their adoption in the northern Corn Belt, especially on poorly drained soils. No-till adoption trends for Minnesota (1995–2000) have been steady to slowly declining according to the Conservation Technology Information Center’s 2000 report. Researchers have categorized grower’s use of no-till practices throughout the northern Corn Belt and found that the lack of adoption has been linked to yield reductions in long-term no-till. Short-term no-till or rotational tillage systems may be advantageous in this region because of time, labor, fuel savings, and conservation compliance.

There have been several studies reported on rotational tillage systems describing residue cover and yield, but very few reports evaluate economic return. Some studies have focused on periodic full-width moldboard plow or chisel plow tillage while others have evaluated deep-zone tillage or subsoiling implements and their immediate and residual effects. Generally, rotational tillage, either full width (moldboard plow and chisel plow) or deep zone, has improved crop yields on moderately well to somewhat poorly drained soils and/or soils with dense layers. Other researchers have found little to no effect of tillage on soils varying from poorly to well drained.

No-till soybean production is more common than no-till corn throughout the Corn Belt. The effects of tillage on soybean production are covered extensively in one study, which compares soybean yield in various tillage systems at five Iowa sites for periods ranging from 8 to 15 years. When no-till soybean yields were compared with other tillage systems over time (five-year intervals), neither significant improvement nor deterioration of yield was found. The researchers of that study concluded that no-till soybean yields were usually within 5% of other tillage systems but generally had equal or greater economic returns. A study in 2003 reported that soybean yields were not affected by deep tillage, although improvements in surface soil compaction and permeability were noted.

A recent study was conducted to quantify the effects of rotational full-width tillage compared with long-term no-till and zone-tillage systems with and without in-season row cultivation on corn and soybean yield and economic return. The study was conducted in south-central Minnesota on a tile-drained clay loam soil. A secondary objective was to characterize the effects of these tillage systems on residue coverage, early growth of corn, and soil penetrometer resistance.

Corn and soybean yields

When full-width tillage for soybean was rotated with zone tillage or strip tillage for corn, the resulting corn yields were greater, and economic return...
increased compared with annual full-width tillage systems. Soybean yields were maximized by rotational tillage; but the differences between tillage practices produced small differences in yield and no difference in economic return. When both corn and soybean production was considered, rotational tillage practices were likely to maximize yields but not economic return.

During these seasons, temperatures did not deviate much from long-term normals in any of the four years of the study, except for cooler-than-normal temperatures in May 2002. Precipitation changes, both growing season and monthly, deviated markedly from long-term normals. Precipitation was 19 and 14% greater than normal in 2000 and 2001, respectively, and 31% less than normal in 2003. On a monthly basis, the growing seasons of 2000 through 2002 were characterized by months of significantly greater than and less than normal precipitation, while in 2003, precipitation was slightly to significantly less than normal in all months.

**Economic return to tillage costs**

Economic return for the combined corn–soybean rotation was affected by the main effects of year and row cultivation. Economic return, averaged across tillage treatments, was significantly greater in 2002 compared with other years because of greater corn yields. Row cultivation of corn reduced economic return $2.84/acre compared with no-rotation, when averaged across year, tillage for corn, and tillage for soybean. The small corn and soybean yield responses to tillage for soybean and corn yield response to tillage for corn found in this study did not affect the economic return of those main effects in this study.

The effect of the specific climatic conditions of given years changes the economic picture. In 2001, no-tillage for soybean produced greater economic return than chisel plowing and spring field cultivation for soybean for all tillage-for-corn systems, but in 2000 and 2002, chisel plow and spring field cultivation for soybean had significantly greater return than no-till for soybean, but only when zone tillage or zone or strip tillage was used for corn. In 2000 and 2002, the greatest economic returns were obtained when zone or strip tillage was used for corn and chisel plowing and spring field cultivation was used for the previous year’s soybean. In summary, rotational tillage practices are likely to maximize yields of corn and soybean but not consistently increase economic return on these clay loam soils.

**Surface residue cover after planting corn**

Residue cover measured after planting was affected by all of the tillage treatments. Residue cover was 67, 41, 56, and 41% with no-till, zone tillage, strip tillage, and spring field cultivation for corn, respectively, when averaged across year, tillage for soybean, and row cultivation. No-tillage for the previous year’s soybean crop resulted in an 11% greater residue cover for corn compared with other tillage systems when averaged across year, tillage for corn, and row cultivation. These percentage residue covers are typical for continuous reduced-tillage systems in a corn–soybean rotation in the northern U.S. latitudes due to slow decomposition. Data indicate that residue coverage in strip tillage can be similar to no-till in years where overall residue levels are less.

**Residue cover after planting soybean**

Residue cover, measured after planting soybean, was affected by the main effects of environmental conditions of the year and tillage for soybean but not by the residual effects of tillage or in-season row cultivation of corn. No-tillage for soybean had significantly greater residue cover (79%) compared with chisel plowing and spring field cultivation (33%). Residue cover in all treatments was greater than the 30% threshold that has been recommended for minimizing soil erosion when averaged across the three-year study period.

**Corn plant height**

Early growth of corn, often measured in terms of plant height, is frequently used by farmers and agricultural advisors to evaluate the relative performance of conservation tillage systems. Plant height at about 35 days after emergence was affected by all of the main effects. When no-tillage was used for soybean compared with chisel plowing and spring field cultivation, corn plant heights were reduced considerably when averaged across year, tillage for corn, and row cultivation. Plant heights were affected by tillage for corn and were ranked zone tillage > strip tillage > spring field cultivation = no till when averaged across year, tillage for soybean, and row cultivation. Zone tillage increased plant heights 4% compared with strip tillage but had no effect on corn yields. Row cultivation of corn decreased plant height although the difference was small and inconsequential. These data demonstrate the beneficial effects of in-row tillage and residue removal in the seed–row zone with strip tillage and zone tillage for greater early growth of corn. The row cultivation × tillage for soybean interaction had no plausible explanation.

**Conclusions**

Tillage system research conducted on a tile-drained clay loam soil for corn and soybean production in south-central Minnesota showed:

- Corn grain yields were greater with zone tillage and strip tillage for corn than no-till and spring field cultivation, and in two of four years, corn yields were greater when chisel plow plus spring field tillage was used for the previous year’s soybean crop compared with no-till for soybean;
- Soybean seed yields were increased in only one of three years when averaged across years by chisel plow and spring field cultivation tillage for soybean compared with no-till for soybean;
- The small corn and soybean yield responses to tillage did not improve the economic return in this corn–soybean rotation;
Continuing Education

Earn 1 CEU in Crop Management

1. What is a concern of farmers about use of no-till cultivation in areas where corn and soy are rotated on poorly drained soils northern Corn Belt?
   - a. reduced yields.
   - b. nitrogen loss.
   - c. water loss.
   - d. planting difficulties.

2. No-till adoption trends for Minnesota (1995–2000) have been moving in what direction, according to the Conservation Technology Information Center’s 2000 report?
   - a. increasing rapidly.
   - b. steady to slowly declining.
   - c. remaining the same.
   - d. dropping rapidly.

3. When no-till soybean yields were compared with other tillage systems over time (five-year intervals), researchers found that
   - a. yield increased sharply.
   - b. yield dropped, then stabilized.
   - c. yield increased, then dropped.
   - d. yield neither significantly improved nor deteriorated.

4. Soybean yields were maximized by rotational tillage; but the differences between tillage practices produced small differences in yield and no difference in economic return. When both corn and soybean production was considered, rotational tillage practices were likely to
   - a. reduce yield slightly.
   - b. make little difference in yield.
   - c. maximize yields but not economic return.
   - d. reduce grade of yield.

5. No-till cultivation for the previous year’s soybean crop resulted in greater residue cover for corn compared with other tillage systems when averaged across year, tillage for corn, and row cultivation. How much more cover was identified?
   - a. about 22% more.
   - b. about 11% more.
   - c. 4% more.
   - d. about 50% more.

6. The effect of the specific climatic conditions of a given year changes the economic picture more than the effect of
   - a. cultivation system.
   - b. cultivation depth.
   - c. amount of ground cover.
   - d. changes in cultivation system.

7. What is the effect of no-tillage systems for the previous year’s soybeans compared with chisel plowing and spring field cultivation on corn plant heights?
   - a. Plant heights were reduced considerably when averaged across year, tillage for corn, and row cultivation.
   - b. Plants were bigger and leafier.
   - c. Plants were darker in color.
   - d. Plants were thinner and somewhat spindly.

8. On a tile-drained clay loam soil for corn and soybean production in south-central Minnesota, corn grain yields were greater when zone tillage and strip tillage was used for corn than when no-till and spring field cultivation was used, and in two of four years, corn yields

- were reduced when spring field tillage was used the previous year.
- were greater when chisel plow plus spring field tillage was used for the previous year’s soybean crop compared with no-till for soybean.
- improved when no-till was used for previous year’s soybeans.
- were reduced when chisel plow plus spring field tillage was used for the previous year’s soybean crop compared with no-till for soybean.

9. Corn plant heights were affected by tillage for corn and were ranked: zone tillage > strip tillage > spring field cultivation = no-till when averaged across year, tillage for soybean, and row cultivation. What do farmers try to measure with early corn height?

- the vigor of hybrid corn.
- the nitrogen status of the field.
- the relative performance of conservation tillage systems.
- the fertility of the soil.

10. Zone tillage increased plant heights 4% compared with strip tillage but had no affect on corn yields. Row cultivation of corn decreased plant height, resulting in

- small, inconsequential differences in plant height.
- major differences in root depth.
- small differences in in-field residue.
- differences in fertility of the soil after tillage.

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**SELF-STUDY QUIZ REGISTRATION FORM**

Name: ____________________________

Address: ____________________________

City: ________________________________

State/province: ____________________ Zip: _______________________

$15 check payable to the American Society of Agronomy enclosed.

CCA certification no.: ________________________

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 December 2007 expires December 2010

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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: __________________________
Moving ahead

By Kim Polizotto, ICCA Chair, kwpolizotto@potashcorp.com or 317-462-2485

As the new incoming ICCA chair, I have to recognize Tom Kemp for the tremendous job he did leading our organization this past year. Tom led the CCA board and executive committee in many discussions with the ASA leadership to help define our relationship with ASA, both organizationally and financially. He worked very hard to get the CCA program needs front and center with ASA. He also represented CCA interests and was a great spokesman in many meetings and forums in Washington, DC and across the country. We all owe Tom a great big “thank you” and “job well done” for his efforts. Fortunately, Tom will still serve on the executive committee for the next year, so we will continue to use his experience and expertise.

As I take over as chair this year, I see some exciting things taking shape in the CCA program, and I have identified a few things I would like to accomplish this year. I see this publication, Crops & Soils, as the flag ship of CCA communications. We will work hard to make sure the articles are timely and relevant. Plans are in place to regionalize articles to serve the needs of different areas and crops and to make the magazine financially self-sustaining. Again, this is our flagship, and we need to do what is necessary to make sure it is financially healthy and viable. I think we’re off to a great start, but we will work hard to make it better.

Upgrading the CCA Toolbox

There will be continued effort to upgrade the CCA Toolbox on the CCA website, www.certifiedcropadviser.org. If you have any suggestions for conversion charts, tables, or tools you would find useful, or would like to share tools you use, please contact Luther Smith at the headquarters office (lsmith@agronomy.org or 608-268-4977). We recently opened the CCA discussion board as part of the CCA Toolbox, so CCAs from around North America can communicate with each other. What a great way to get help with a tough question or problem! (See page 37 for more information.)

The CCA program has also entered into an advertising agreement with Successful Farming magazine to promote CCAs to farmers. Starting this month and continuing throughout 2008, the CCA program will be advertised in the magazine and on the agriculture.com website to help educate farmers about the value of working with CCAs. Getting our message into a national publication with the reach of Successful Farming is exciting and should serve us well. (See page 41 for more.)

Reviewing our finances

From an operational standpoint, we are planning on taking a close look at all of our finances. Right now we are doing OK financially, but in order to sustain our budget and programs, we need to make sure our financial plans are sound over the long term. One of the things we want to take a hard look at on the financial side is how we can merge the international and local exams into a single exam. Incorporating questions from each local exam with key questions from the international exam could reduce our exam costs. Merging exams would reduce exam updating and maintenance costs as well as the overall cost of printing, administering, and grading exams. It would also help eliminate redundant questions on the local and international exams, give the opportunity to offer a single but unique exam for each local program, and maybe even help us move to electronic testing.

I think the next year will bring some interesting opportunities for CCAs. I truly believe that this time next year, farmers in the U.S. and Canada will have an understanding of the CCA program and better value their relationships with you, their advisers.

I look forward to serving as your chairman this year.

Electronic reporting of CEUs

Do you conduct educational programs for CCAs? Would you like a simpler, faster way to report those who attended your sessions? The ICCA board has invested in technology for automating the sign-in sheets and electronically reporting CEU attendees. Each CCA will have a credit card-type card that contains a magnetic strip and bar code. As a meeting vendor, all you need is the card reader. CCAs will swipe their cards through the reader, which will record their name and CCA number. The readers are self contained, run off of battery power, and are very portable. They are not much bigger than the cards themselves.

You can borrow a reader from your local CCA office or the international office at the ASA headquarters. If you hold several meetings a year, you may want to invest in your own equipment. The equipment comes with software that allows you to email the files to the office. The price for a reader is $362.50 plus shipping. Please contact the ICCA office (cca@agronomy.org or 866-359-9161) if you would like more details or to place an order.
Certifying boards hold annual meetings

The boards of the International Certified Crop Adviser (ICCA), Certified Professional Agronomist (CPAq), and Certified Professional Soil Scientist/Classifier (CPSS/C) programs all met this fall in St. Louis, MO. Each board meets annually to discuss how the programs are performing and to make any adjustments in policies and procedures. A major topic is how to continually increase value of being certified and how to reach out to future professionals while meeting the needs of those who are already certified. The highlights follow.

ICCA board meeting

The ICCA board approved to go ahead with a new advertising campaign in Successful Farming magazine starting this month. The ad campaign will run through 2008 and is targeted at farmers to make them more aware of the benefits of working with CCAs. Check out the ad on page 41.

The board approved establishing the “CCA Candidate” status for applicants who have passed both exams and met all of the requirements except experience. This category will primarily apply to students completing a degree in agronomy or a closely related field. The applicants will be encouraged to sit for the exams while still in school so that they are prepared for the work world and more attractive to employers. The CCA Candidate status will be limited in time equal to the experience requirement with no demand for fees or CEUs. Once the experience is gained, the candidate moves to regular CCA status. This change will be implemented in January 2008.

The board reviewed budget projections for 2008 and beyond. The program is on sound financial footing and is taking action to invest in expanding services to CCAs. Reserve dollars will be used to establish Crops & Soils, conduct the advertising campaign, and provide scan card readers to streamline the CEU reporting process. To compensate for increased costs, ICCA exam fees are going to increase along with self-study CEU quiz fees.

A new board structure was approved. Currently the board consists of 17 voting members along with an advisory council. The new structure will combine the ICCA board and advisory council and will include a representative from each local board along with the standing committee chairs and executive committee. This new structure has the potential to greatly improve communications with and direct involvement by the local CCA boards.

The Northwest CCA board will be conducting a pilot test to develop certification specialty areas around cropping systems. Due to the great number of different crops grown in the Northwest region (Nevada to Alaska), the proposal outlined how CCAs could focus their training and continuing education along with the exam process around specific crops.

Each local CCA board will receive a scan card reader to be used at continuing education events. The card each certified person received will be able to be used to report CEU attendance if the vendor has the card reader equipment available. Any vendor interested in purchasing card reader equipment should contact the ICCA office for de-
tails (cca@agronomy.org or 866-359-9161).

**CPAg board meeting**

The CPag board is evaluating the credential booklet for any necessary changes. The board added the requirement for applicants to include a cover letter and explanation on why they want to become certified.

The board reviewed the promotional efforts being done including new brochures highlighting the benefits of certification, a new booth exhibit, the new magazine (*Crops & Soils*), articles on certification in the trade press, discussion boards on the website, and a poster going to all university agronomy departments promoting certification to students.

**CPSS/C board meeting**

The CPSS/C board is evaluating the credential booklet. It will be adding geographical information systems (GIS), three semester hours/five quarter hours, to the supporting core requirements.

The CPSS/C board will be adding language to the polices that describe what is acceptable and how the process will work for those whose certification laps for legitimate reasons. It will describe the time frames allowed before someone would need to reapply including retesting.

The board received an update on the state-based certifying board pilot project being started in Florida and Ohio. Florida is organizing its board and determining how best to incorporate its unique soil conditions. Ohio has organized its board and is working through a grandfathering process for those that were certified in the Ohio AOP program.

The board also reviewed the promotional efforts being conducted. New brochures, the discussion boards online, website upgrades, appeal to university departments to utilize the exams as an assessment tool, a poster promoting certification to students in all soils departments, and the new magazine (*Crops & Soils*) have been implemented or will be soon.

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**New services available, CEU deadline reminder**

Did you ever want to talk with other certified professionals in agronomy and soils? Maybe discuss a new challenge you haven’t faced before to learn how others handled it or share a success story so others could learn from it? Now you can! A new feature on the certification websites are the CCA, CPag, and CPSS/C online discussion boards. These discussion boards are only open to the respective certified people, so you will need to log in on the website before going in. Only fellow professionals are involved in the discussions.

The discussion boards are only for topics related to agronomy and soils. No unprofessional conduct will be allowed. Check out the latest discussion or start one yourself at www.certifiedcropadviser.org, www.agronomy.org/certification, or www.soils.org/certification.

**New toll free number for CCAs**

CCAs can now call the Madison office toll free by using **866-359-9161**. This number will connect you with our automated menu system. If you know the extension of the person you are trying to reach, you may enter it or call them directly.

**CEU reminder**

As 2007 comes to a close, CEUs are due by December 31 for those who are ending their two-year cycle. You can check what you have on record by going to the website or calling the office. All certification programs require a minimum total of 40 CEUs every two years.

CCA also requires a minimum of five CEUs in nutrient management, soil and water management, integrated pest management, and crop management. There is no minimum or maximum in professional development. All CCAs now have the opportunity to self-report up to 20 CEUs. You can do this by using the self-reporting form found on the website. Self-reported CEUs are the same as board-approved CEUs, but they have not been reviewed by a certifying board.

Short a few CEUs? Don’t forget you have the option to earn self-study CEUs—up to 20 of them every two years. They are the most economical way to continue your education. The information is based on the latest peer-reviewed journal articles of the American Society of Agronomy and Soil Science Society of America, so you can trust what is being said. Conveniently accessed from anywhere, no travel time or time away from the job is required, and you can select from a long list of topics. They are found in this magazine or on the website. Help your clients by keeping up on the latest agronomic, soil, and environmental research.

**CCA exam study guide available**

Individuals preparing for the 2008 International Certified Crop Adviser (ICCA) exam will be interested to know that an updated edition of the popular study guide offered by the International Plant Nutrition Institute (IPNI) is now available. The 173-page training guide presents subject information for each performance objective, supplemented by sample questions. It includes an answer key for the sample questions.

The 2008 edition of the ICCA exam study guide (Item #50-1000) is available for purchase directly from IPNI for $45 (includes shipping and handling). Call 770-825-8082, fax 770-448-0439, or email circulation@ipni.net. The guide may also be purchased online at www.ipni.net/ccamanual.
CCAs are ‘key team members’ of farm operation

Don Villwock was having a hard time keeping up with all of the new products and the latest management practices. In addition to managing his 2,400-acre farm in Edwardsport, IN, Villwock was very involved with the Farm Bureau (both locally and nationally) as well as serving on numerous agricultural task forces and committees. He felt he needed someone to help him bring it all together and make the connection between soil types, hybrids, and climate and how they work together.

“It’s just kind of hard to follow all those things,” Villwock says. “My ability and time allocation to go to a lot of field days like I once did and look at plots and data just became very limited.”

Villwock says he “went the typical farmer route” and relied on his fertilizer dealer as his adviser. His dealer had good expertise in fertility but wasn’t as knowledgeable on herbicides, fungicides, and insecticides. His dealer would refer him to various representatives at other companies to fill those knowledge gaps, but Villwock felt they were more interested in trying to sell their products rather than give good, objective advice. That’s where Eugene Flaningam, a certified crop adviser (CCA) from Vincennes, IN, came in.

“I liked the idea of having an independent adviser that had an exposure to many farmers,” Villwock says. “My CCA, Gene Flaningam, has some of the best and brightest and progressive farmers as his clients. He brought a broader range of not only soil fertility but also tillage management practices as well as herbicide, fungicide, and insecticide knowledge to the table. In our operation, whether they’re a CCA, accountant, or a banker, they’re team players for Villwock Farms, and he is one of the key team players. He’s fantastic.”

Villwock says Flaningam has helped his operation design plots to see what they can do under different weather scenarios and using different hybrids.

“Gene knows our cropping patterns and our ability to switch to what the market dictates. He also helped keep us in compliance with rules that we have in Indiana that I wasn’t quite as aware of as I should have been.”

Because of his positive experience with Flaningam, Villwock says he would look for another CCA “immediately” if for some reason he was no longer able to work with Flaningam.

“I see how important all the things that they bring to the table are for our operation. Gene keeps me on the cutting edge of what new things are out there because he gets exposed to them. I also consider him a good friend, and so it’s a win–win situation.”

Since 2002, Villwock has served as president of the Indiana Farm Bureau. He says it’s important to continue to build a relationship between the CCA program and the Farm Bureau on a state-by-state basis.

“It’s a natural win–win. I think [building this relationship] is a critical component to not only keeping profitable, but in our ability to farm. All this policy stuff that we’re involved with is important, but really what it boils down to is making our members money and more profitable. And with the regulatory community, if we cannot hold up our integrity in being judicious producers protecting water, soil, and air quality, we’re going to lose our license with society to do the things that we do.”
Gene Flaningam has been a certified crop adviser (CCA) since 1994, almost as long as the CCA program has been in existence. Back then, Flaningam had a lot going on in his life. He had just started his own crop-advising business and got married the same year. But, he still made time to become certified, and says certification is a way to identify quality professionals in the industry.

“The ability to supply good quality people to the industry is what the CCA program has tried to do,” he says. “These are quality individuals that can pass the exam and maintain their status—that’s saying something.”

Flaningam certainly fits this description—he won the 2007 CCA of the Year Award that is sponsored by ASA and the International CCA program. He provides agronomy services to more than 45 farm clients located within a 50-mile radius of Vincennes, IN. His primary services include soil fertility management and integrated pest management on specialty crops during the summer months.

“The majority of my clientele is grain farmers—corn, wheat, soybeans,” Flaningam says. “They raise second-crop soybeans followed by wheat. I do intensive management with my wheat growers to try to get that extra yield out of that wheat crop. I’ve got probably about six or seven growers that grow specialty crops such as vegetables, and we spend a lot of time scouting those in the summer.”

Flaningam says a lot of his growers are diversifying their production, primarily growing grain but reserving some acres for specialty crops like watermelon. With growers who adopt these types of diversified cropping systems, it requires a CCA to be more involved on a daily basis with them, which helps in building close personal relationships. These relationships have helped Flaningam in his other business—selling and servicing federal crop insurance. When he can’t sample soil in the winter, he spends time on the insurance business, and many of his contacts have come from his agronomy clients.

“The growers aren’t going to necessarily make more money than they did two or three years ago, but they’re going to handle more,” Flaningam says. “They’re going to get more back when they sell their grain, but they’re also putting a lot more into it up front to get that crop out. The lenders see that as risk and so they want them to carry insurance.”

In late February or early March when the weather breaks, Flaningam will start soil sampling again for all of his growers that spread fertilizer in the fall. Then a few months down the line, he’ll go through all the results of the samples and make recommendations for the growers by the end of August or early September. So that way, the growers are ready to apply their fertilizer before they go to the field in the fall. Likewise, he samples soil in the fall and early winter for his growers that spread fertilizers in the spring.

“We try to stay one step ahead of the combine and the grower,” Flaningam says. When planting starts, he’ll go out in the fields and check emerging crops to make sure things are going well and spends most of his summers troubleshooting problems. He says things get really hectic in the spring—the phone calls start as early as 7:00 am and continue seemingly nonstop throughout the day. Overall, Flaningam says he likes being self-employed, but there can be some challenges as well.

“Being your own boss gives you the ability to spend a little more time with your family if you can get away,” he says. “But when you’re self-employed, you don’t have a lot of benefits that a lot of people have who work for companies as far as insurance. And you have to be your own accountant and manager in addition to being an agronomist.”

We congratulate Flaningam on being named 2007 CCA of the Year.
Newly certified

The following list includes newly certified individuals and those that have added additional certifications since the last issue of Crops & Soils. For example, Janet Fallon from Tully, NY was part of last issue’s list. Janet added the Northeast CCA certification but was already certified in Pennsylvania as a CCA and has been a CPAg for over 15 years. We wanted to clarify who was on this list so as not to misrepresent anyone. The list is alphabetized by state/province and by surname within each state/province.

Canada
Friesen, Randall, Three Hills, AB (CCA)
Leitch, Amy, Rocky Mountain House, AB (CCA)
Matson, Constance, Edmonton, AB (CCA)
McNinch, Mark, Lethbridge, AB (CCA)
Gomez Lopez, Francisco, Vancouver, BC (CCA)
Sutherland, Iain, Armstrong, BC (CCA)
Armitage, Trevor, Minotia, MB (CCA)
Brooks, Travis, Morden, MB (CCA)
Buhler, Kevin, Niverville, MB (CCA)
Chappellaz, David, St. Claude, MB (CCA)
Crandell, Andrea, St Jean Baptiste, MB (CCA)
Elliot, Brian, Brandon, MB (CCA)
Froese, Marlin, Altona, MB (CCA)
Gilliard, Cheryl, Portage La Prairie, MB (CCA)
Gouldsborough, Lyle, Gilbert Plains, MB (CCA)
LaPointe, Kerrilee, Neepawa, MB (CCA)
Morissette, Kelly, Fannystelle, MB (CCA)
Neurenberg, Jenneth, Brandon, MB (CCA)
Paul, James, Rapid City, MB (CCA)
Sawchuk, Jaret, Ste. Rose du Lac, MB (CCA)
Schnell, Brad, Sanford, MB (CCA)
Vernette, Denis, Morris, MB (CCA)
Walker, D. Scott, Wawanesa, MB (CCA)
Clemens, Shelley, Goose Bay, NL (CCA)
Drumelsmith, George, Dutton, ON (CCA)
Dunnett, Sean, Cambridge, ON (CCA)
Fletcher, Andrew, London, ON (CCA)
Hodgins, Steven, Dorchester, ON (CCA)
Issa, Ammar, Mississauga, ON (CCA)
Jacques, Jeffrey, Palmerston, ON (CCA)
Sahota, Tarlok, Thunder Bay, ON (CCA)
Workman, Cheryl, Wingham, ON (CCA)
Aberhart, Terry, Langenburg, SK (CCA)
Franko, Brent, Quill Lake, SK (CCA)
Kirk, Wayne, Melfort, SK (CCA)
Konkel, Gavin, Yorkton, SK (CCA)
Ortman, Brian, Swift Current, SK (CCA)
Parker, Phillip, Norquay, SK (CCA)
Pederson, Steven, North Battleford, SK (CCA)
Scowen, Troy, Nipawin, SK (CCA)
Sedgwick, Kevin, Kindersley, SK (CCA)
Sproat, Brady, Kipling, SK (CCA)
Vaskevicius, Casey, Morse, SK (CCA)
Wielgosz, Kristin, Yellow Creek, SK (CCA)

United States
Hitz, George, Fairbanks, AK (CCA)
Craig, William, Monette, AR (CCA)
Mayers, Robert, Hickory Ridge, AR (CCA)
Abruzzi, Daniel, Marysville, CA (CCA)
Beene, Aaron, Merced, CA (CCA)
Bogetti, Robert, Ripon, CA (CCA)
Brummeier, David, Stockton, CA (CCA)
Ray, Vincent, Easton, CA (CCA)
Ramer, Robert, Stockton, CA (CCA)
Rogers, James, Antelope, CA (CCA)
Sawchuk, Jaret, Ste. Rose du Lac, MB (CCA)
Suderman, Marc, Kingsburg, CA (CCA)
Wade, Scott, Lamar, CO (CCA)
Hines, Cheryl, Delta, CO (CCA)
Lorenzini, Jason, Ft. Morgan, CO (CCA)
O’Neill, Kelly, Del Norte, CO (CCA)
Powell, Aaron, Holyoke, CO (CCA)
Schaal, Craig, Wray, CO (CCA)
Thayer, Branden, Haxton, CO (CCA)
Achtle, Robert, Felda, FL (CCA)
Hutcheson, Allan, Auburndale, FL (CCA)
Parks, Felicia, Fort Myers, FL (CCA)
Sherrard, Joseph, Felda, FL (CCA)
Berglund, Ross, Webster City, IA (CCA)
Buck, Tanner, State Center, IA (CCA)
Burmeister, Clayton, Hampton, IA (CCA)
Collison, Robert, Onawa, IA (CCA)
Drake, Benjamin, Dunkerton, IA (CCA)
Franzenburg, Tyler, Keystone, IA (CCA)
Freund, Clint, Webster City, IA (CCA)
Grandon, Darrell, Aplington, IA (CCA)
Kluesner, Scott, Farley, IA (CCA)
Kramer, Duane, Walcott, IA (CCA)
Pietig, Keith, Ankeny, IA (CCA)
Pigott, Adam, Cherokee, IA (CCA)
Shuler, William, Council Bluffs, IA (CCA)
Stender, John, Maquoketa, IA (CCA)
Thomas, Benjamin, Clear Lake, IA (CCA)
Tremel, Brian, Eldora, IA (CCA)
Van Beek, Benjamin, Sheldon, IA (CCA)
Barton, David, Geneseo, ID (CCA)
Blaser, Shain, Rexburg, ID (CCA)
Hobson, Jared, Jerome, ID (CCA)
Shewmaker, Philip, Nampa, ID (CCA)
Stewart, R. David, Shelley, ID (CCA)
Chappell, Jolene, Fairbury, IL (CCA)
Chenoweth, Shannon, Adair, IL (CCA)
Fuhr, Phillip, Taylor Ridge, IL (CCA)
Garrett, Cade, Belleville, IL (CCA)
Hasty, Ryan, Effingham, IL (CCA)
Hermes, William, Waverly, IL (CCA)
Iutzi, Frederick, Macomb, IL (CCA)
Jacob, Mark, Carthage, IL (CCA)
Jefferson, Justin, Alhambra, IL (CCA)
Lane, Jerrod, Waterman, IL (CCA)
Litherland, Tiffany, Shefiled, IL (CCA)
Mette, Steven, Teutopolis, IL (CCA)
Milner, Dwayne, Jerseyville, IL (CCA)
O’Rourke, Mark, Downs, IL (CCA)
Port, Eric, Morris, IL (CCA)
Schmidgall, Bradley, Forrest, IL (CCA)
Spray, Heather, Laura, IL (CCA)
Thacker, Shane, Sumner, IL (CCA)
McCammack, Nicole, Cleverdale, IN (CCA)
Schoenhals, Kevin, Haven, KS (CPAg)
Allen, John, Centeretown, KY (CCA)
Deckard, Kevin, Tompkinsville, KY (CCA)
Harris, Timothy, Campbellsville, KY (CCA)
Heightchew, Steven, Pleasureville, KY (CCA)
Williams, Joseph, Princeton, KY (CCA)
Fedewa, Anthony, Portland, MI (CCA)
Pagels, Dustin, Sturgis, MI (CCA)
Sallee, James, Jackson, MI (CPSS)
Shedd, Adam, Tekonsha, MI (CCA)
Taylor, Ronald, Fennville, MI (CCA)
Wendzel, Steven, Ithaca, MI (CCA)
Arnonson, Jeffery, Fairbault, MN (CCA)
Barrett, Jon, Fairmont, MN (CCA)
Einck, Jeff, Pipestone, MN (CCA)
Hagen, Nathan, Broomen, MN (CCA)
Jenss, Jason, Alexandria, MN (CCA)
Kruize, Kevin, Owatonna, MN (CCA)
May, James, Rochester, MN (CCA)
McCollum, Trent, Bejou, MN (CCA)
Radermacher, James, Renville, MN (CCA)
Rowe, Mitchel, Jackson, MN (CCA)
Scheider, Scott, Belle Plaine, MN (CCA)
Sturm, Nicholas, Springfield, MN (CCA)
Thaden, Scott, Willmar, MN (CCA)
Wadd, Trent, Waseca, MN (CCA)
Ward, Cory, Alexandria, MN (CCA)
Westberner, Jennifer, Long Prairie, MN (CCA)
Withers, Sarah, Jackson, MN (CCA)
Bowing, Dustin, Tina, MO (CCA)
Greene, Richard, Columbia, MO (CCA)
Kowalski, Edward, Portageville, MO (CCA)
Mason, Tyler, Trenton, MO (CCA)
Mckibben, Michael, Kansas City, MO (CCA)
Murphy, Jennifer, Bernie, MO (CCA)
Pitford, Penny, Edina, MO (CCA)
Byford, Joshua, Hernando, MS (CCA)
Riddick, William, Inverness, MS (CCA)
Smith, Clyde, Madison, MS (CCA)
Fandrich, Bryan, Billings, MT (CCA)
CCA advertising campaign

The ICCA Program recently entered into an agreement with Successful Farming magazine to advertise the service CCAs provide. The ad below will appear in the print version of the magazine, and there will be buttons on their website, agriculture.com. Successful Farming magazine reaches farmers across the U.S. and is highly read by its subscribers.

“Getting our message into a national publication with the reach of Successful Farming is exciting and should serve us well,” says Kim Polizotto, Chairman of the ICCA board.

This is a great opportunity to promote to farmers the benefits of working with CCAs and the positive relationship that exists between farmers and their advisers. When a farmer clicks on one of the online buttons, they will be taken to a page of the CCA website specifically for them. They will have access to the online directory as well as information about the program, who CCAs are, and why it is important for their adviser to be certified.

The ads will run throughout 2008 and be available for local CCA boards and CCAs to use in their state, province, or regional publications. If you are interested in using the ads, please contact the ICCA office (cca@agronomy.org or 866-359-9161). They are available in quarter-, half-, and full-page sizes.
As a CCA, your certification shows the world that you have the experience, education, expertise, and ethics that make you a trusted partner for farmers. You take your responsibility to maintain your technical expertise and education seriously—so you should seriously consider membership in the American Society of Agronomy this year. The benefits are many:

**Education**—Earn necessary CEUs through Society branch and Annual Meetings.

**Research**—Access the latest research, including quick-read summaries through our research highlights and abstract searches.

**Networking**—Talk with experts and share knowledge through access to our Member Directory, Discussion Boards, and Divisions of Interest.

**Advocacy**—Support efforts to secure necessary funding and Congressional support on the issues that effect you and your customers.

Membership in ASA opens up a world of possibilities, enhancing your CCA status. For more information, please visit [www.agronomy.org](http://www.agronomy.org) and click “Member Services.”

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Leaf area, morphological analysis, diseased area, pest damage, foliar disk analysis,...

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