soil scientists seek to grow the profession and bolster its image

Reclaiming our TURF
How can we squeeze more food from a RAINDROP?

Farming feeds the world, but it depends on vital natural resources. Just consider this: irrigation for agriculture consumes 2/3 of the world’s fresh water withdrawals.

Experts have concluded that agricultural output will need to double by 2050 to feed a growing world. We’ll need to get more from each drop of irrigated water.

We’ll also need to do more with the solution nature already provides: rain.

The challenge for farmers is squeezing the most out of unpredictable rainfall. That requires putting the latest science-based tools in farmers’ hands, including advanced hybrid and biotech seeds. Our goal is to develop seeds that significantly increase crop yields and can help farmers use 1/3 less water per unit produced.

Producing more. Conserving more. Improving farmers’ lives. That’s sustainable agriculture. And that’s what Monsanto is all about.

Non-irrigated agriculture produces 60% of the world’s food. It will need to do more.

Learn more at: www.ProduceMoreConserveMore.com
Feature

Soil science doesn’t get the recognition it deserves. Movies and books about soils often have to use the word “dirt” because “soil” isn’t marketable. Fewer students are choosing it as a career, and engineers, geologists, and other professionals are often assigned the work that soil scientists should be doing. A group of dedicated members of the Soil Science Society of America is looking to turn this around by growing the profession and bolstering its image.

10 Tales from the Pits | The tale of the crazed client.
12 Regional Roundup | News from the Canada East and U.S. North Central regions.
14 Certification | Continuing education for CPSS/C: what’s new with CEUs and what are your responsibilities?
16 Technology | New tools for conservation planning and doing business with NRCS.
18 Industry Perspectives | NRCS seeks to renew its TSP program by engaging more private-sector consultants.
22 Self-Study CEUs | Earn 2 CEUs in Crop Management.
35 Career Center | Recognize outstanding colleagues by nominating them for ASA and SSSA awards.
Soil science doesn’t get the recognition it deserves. Movies and books about soils often have to use the word “dirt” because “soil” isn’t marketable. Fewer students are choosing it as a career, and engineers, geologists, and other professionals are often assigned the work that soil scientists should be doing. A group of dedicated members of the Soil Science Society of America is looking to turn this around by growing the profession and bolstering its image.

Reclaiming our TURF

soil scientists seek to grow the profession and bolster its image

By Madeline Fisher
Crops & Soils magazine contributing writer
sciencewriter@sciencesocieties.org
A film about soil might seem like a doubtful draw for viewers. But in 2009, the documentary *Dirt! The Movie* debuted at none other than Robert Redford's independent film showcase, the Sundance Film Festival. Narrated by the actress Jamie Lee Curtis and promoted by other celebrities, *Dirt!* later aired nationwide on PBS, propelled by reviews that called it thought-provoking, invigorating, and fun.

Not bad for a movie whose sole aim was to take audiences inside the "wonders of the soil." Yet even for such a film, "soil" itself was something of a dirty word, as CPSS/C Larry Baldwin discovered when he got a chance to talk with one of the filmmakers.

"I asked him, 'Why did you call it *Dirt! The Movie!* Why not *Soils! The Movie!*'" recalls Baldwin, who is vice president of the North Carolina environmental consulting firm Land Management Group, Inc. and a member of the Soil Science Society of America (SSSA). "And he said, 'Because the word 'soils' has no marketing to it.'"

So it has gone with soils of late; the subject seems to hold scant appeal with the public. Students have been turning away from soil science in droves, leaving academic departments scrambling to reinvent themselves in order to survive. During the 1990s, membership in SSSA dropped significantly, although the numbers have since rebounded. Meanwhile, consultants like Baldwin have seen engineers, geologists, and other professionals muscling in on the rightful work of soil scientists.

All of this has led to a "groundswell of concern about where this profession is going," says SSSA member Nick Balster, an associate soil science professor at the University of Wisconsin–Madison who studies soil science education. It has also led to action by SSSA. A group of Society leaders has been teleconferencing monthly to discuss the issues, Baldwin says. In the meantime, an Advocacy/Education Task Force, convened in 2007 to study education and employment trends, published its results and conclusions in the September–October 2010 issue of the *Soil Science Society of America Journal* (SSSAJ 74:1429–1432). And last July, Dawn Ferris joined the Society as Soil Science Program Coordinator. Her charge: To improve relations between SSSA and state soil science societies, expand certification and licensing programs, and increase continuing education opportunities for professionals.

The steps are all extremely positive. Still, if soil science is going to bolster its image and gain the recognition it deserves, it will take not only a groundswell of concern, but also of thought and action. Ferris recommends that everyone read the task force's paper on trends in soil science education and employment as well as the article, "Growing the Soil Science Profession through Investment, Vestment, and Validation," published in the March–April 2010 issue of SSSAJ (74:453–460). She encourages members and certification holders to contact the Society with their questions, comments, and ideas.

"I really encourage people to talk with us," Ferris says. "That's how things are going to happen."

Ferris herself has been involved in SSSA for nearly two decades. A native of Wisconsin, she earned a B.S. and M.S. in soils and a Ph.D. in forest hydrology before embarking on a career that has included positions in consulting, government, and academia. In 1993, she began volunteering with SSSA, helping to develop a set of performance objectives for professionals that unambiguously defined the practice of soil science. A few years later, she was involved in bringing a licensing requirement for soil scientists into Minnesota, where she worked at the time. She also became a charter member of the Council of Soil Science Examiners (CSSE), which writes the national exams used for licensing and certifying soil scientists. She has served on the council ever since, including six years as chair.

### Enhancing certification, licensing

During much of this time, Ferris was also talking with Luther Smith, the Societies’ director of certification programs, about ways to enhance certification and licensing in soil science. When he offered her a job early in 2010 to do just that, Ferris was an assistant professor at Ohio State University and well on her way to tenure. In the end, however, she couldn’t let the opportunity pass.

"It occurred to me that I could do more for the profession of soil science being on staff at SSSA," she says, "than I could ever hope to do as a professor at OSU."

Much of Ferris’s passion to uphold her profession stems from the 14 years she spent as an environmental consultant. Like Baldwin, she was dismayed to see licensed engineers, geologists, and others doing the work of soil scientists. She also saw that soil scientists would never enjoy the same stature as these licensed professionals unless they became licensed themselves.

Licensure, she explains, is a legal requirement dictated by state law that aims to protect the health, safety, and welfare of the public. But licensure also protects soil science professionals because only those people who meet state standards for education, experience, and performance on exams are allowed to work as soil scientists in licensing states.

In granting licenses, however, states tend to be all over the map.
“[Licensure and certification] are protecting our practice. That’s what it comes down to.”
North Carolina, Minnesota, Texas, and Wisconsin, for example, all require professionals to pass both CSSE exams: the fundamentals exam and the professional practice exam. Several more states use one of these exams; others, like Tennessee and South Carolina, are deciding what their licensing rules will be. And many more states don’t yet license soil scientists, Ferris says.

The reason it’s important for states to require both CSSE exams, she stresses, is that this provides national consistency, or comity, in licensing. A soil scientist licensed in Wisconsin could immediately apply for a license to practice in North Carolina, for example, whereas this wouldn’t be true in a state that doesn’t share Wisconsin’s licensing requirements. Thus, Ferris spent much of her time last summer and fall meeting with officials in various states and encouraging them to adopt similar licensing rules so that soil scientists can easily cross state lines.

In the meantime, there is also certification. Although certification through SSSA (see www.soils.org/certifications/cpss-cpsc) is voluntary and doesn’t carry the legal status of licensing, it does convey to the public that a qualified person is carrying out the work, Ferris says. Importantly, many states’ laws also dictate that a certified soil scientist perform certain kinds of work; for example, the design and installation of septic systems. But this requirement is often left out of state law, as well, which is why professionals need to keep a close eye on legislation to make certain soil scientists are being named as rules are updated.


Baldwin agrees, adding that any profession—whether medicine, engineering, law, or soil science—has the same three legs. Professionals must acquire a specialized body of knowledge. They must then apply that knowledge responsibly in their work. But in between is the public call for the knowledge, which arises largely through laws, regulations, and policies. Without this public recognition and demand, a profession isn’t truly a profession, he says. “It’s just a body of knowledge.”

Finding opportunities to protect and enhance the profession was also the goal of the Advocacy/Education Task Force—a group of dedicated SSSA members, including Ferris and Balster, who had all heard stories for years about soil science’s decline. But when the members convened for the first time in 2007 under the leadership of SSSA and ASA member John Havlin at North Carolina State University, they realized that stories alone weren’t enough; they needed solid data. So in 2008, the task force commissioned a survey of soil science students, academic departments, and employers, which queried them on matters such as student enrollment trends, future career prospects, the downsizing (or growth) of academic programs, and the preparedness of soil science graduates.

Soil science’s image

The survey yielded a trove of information about these topics, Ferris says, which can be read about both in the SSSAJ article and in a longer, companion report. But perhaps the most interesting findings centered on something the task force hadn’t asked about explicitly: soil science’s image.

For one, students, employers, and departments all agreed that in the minds of many, soil science is still linked exclusively to production agriculture, when in fact the profession is much broader. When asked where they saw themselves employed in the future, student respondents—81% of which were graduate students, Balster notes—overwhelmingly chose the environmental sciences (agronomy ranked third, while soil science came in ninth). Similarly, many departments indicated that interest in the environment, land use, and sustainability seemed to be attracting more students to soils today. And when asked where future job growth would be, employers, too, said environmental science.

The results therefore suggest that soil science could sell itself better to students and the public by tying itself more closely to the environment. Similarly, job market trends indicate that departments may want to train students more broadly in environmental science—as indeed many of them are doing already. However, this also creates a dilemma for educators, Balster says. Broad, interdisciplinary education has well-known benefits. But in delivering it, departments may struggle to maintain the depth of training they’ve traditionally offered in subjects such as soil chemistry, soil physics, and classification. As a result, a “full-service” education in soil science may become less common, and graduating students may be less capable of passing soil scientist certification exams at the end.

But the implications could also go much deeper, Balster says. “It could easily change our knowledge base as a society because we might lose the contributions of specialized scientists and specialized students who really understand the soil system,” he says. “When I think about my role in society, these are the trade-offs that concern me as an educator.”

As an employer of new soil science graduates, Baldwin is already seeing evidence of this shift in the resumes that cross his desk. Increas-
“I think sometimes we’re our own worst enemy. As soon as you say the word ‘soils,’ half your audience has gone to sleep.”
Better communication

The above discussion points to another major finding of the survey: Students, departments, and employers need to be talking with one another more.

“What struck me was how many times the same complaint [about communication] came up in the responses of all three groups,” Ferris says. “Somewhere communication has to be better facilitated.”

For example, when asked how they got hooked on soil science, survey respondents cited a host of reasons, but one of the most common was completing an internship in soils work. Yet students also complained they had trouble finding both internships and jobs, noting that their departments seemed ill-equipped to provide such help. Employers, on the other hand, said they had lots of internships and jobs available. Their problem was finding qualified people to fill them. In fact, when asked about finding trained soil scientists in the future, 37% of employers thought it would be harder in the coming years, while only 7% thought it would be easier.

The findings indicate that there’s an apparent disconnect occurring between soil science departments and employers of our students,” Balster says, and it could be adding to soil science’s woes. Students may not be choosing soil science because they aren’t aware of the jobs they could get upon graduation. Departments may be inadvertently cutting courses that employers need students to complete, such as soil classification. And without information from employers about these needs, departments have a harder time justifying themselves to university administrators and fending off cuts.

“So I think more research is warranted to understand this disconnect and how it can be fixed so that we re-establish the conduit for our students into the profession,” Balster says.

Educating the public

A better connection needs to be established between two other groups, as well: soil scientists and the public. Despite an increasing awareness of environmental issues, U.S. citizens still seem mostly oblivious to the centrality of soils in problems such as food insecurity, water quality, erosion, and climate change. Instead, most people in the United States still think of soils merely as dirt—as the makers of Dirt! The Movie shrewdly recognized.

“That tells you right there that we don’t understand that the essence of soils is life,” Balster says. “In my opinion, there’s a critical societal change that needs to happen in how we appreciate the soil and view its role in the sustainability of this planet.”

The task force had several recommendations for SSSA on this front, as well:

• Promote the soil science profession and its connection to the environment at earlier stages of education, including high school.
• Integrate the subject more fully into K-12 curricula by building on the Society’s already established program in soil science education.
• Experiment with hiring a marketer, whose job would be to tell the public why soils are so vital to our existence and can’t be taken for granted.

If any one group can make progress on these issues, it’s SSSA, Baldwin says, with its national reputation, resources, and large membership base. Speaking of those members, however, Ferris hopes they recognize that, in the end, no better champions for soil science exist than soil scientists themselves.

“We need to put ourselves out there and reclaim our turf, no pun intended,” she says. “That’s what I want to help people do.”

agronomy.org/certifications | soils.org/certifications
The tale
of the crazed client

Editor’s note: A few readers have expressed interest in contributing a tale for this column—we look forward to welcoming new contributors in 2011! If you have not already done so, please consider writing a tale. Please make the stories generic enough so as not to identify a specific person or place, but still get the point across. You are allowed to take some creative liberties because these are tales, based on experiences and not necessarily a straight factual recount of what went on. The important part is the lesson learned, the practical message, or that “aha” moment. We are getting a lot of comments about this column and the usefulness of this type of article, so let’s keep it going!

If you have been in the consulting business long enough, you have figured out that your clients come in many types of personalities; some even seem to have several personalities unto themselves. This is the tale of one such client that I was lucky enough to have. Lucky in that his company gave me a lot of work, especially in doing wetland delineations for housing and retail development projects. I enjoyed working with this particular client and his very competent staff. He did, however, have a hard time keeping his staff around long term due to his temper.

At the time this tale took place, I actually worked for this client on many projects and had heard about the infamous temper, but I never experienced it myself. The project in question was a large retail development with one large “box” store, a series of strip malls, and stand-alone restaurants. Retail developments such as this one come with a lot of pressure for the developer who needs to fill out lease space on the strip malls once the big box owner is under contract and then make sure that the development moves forward in a timely fashion to meet the lease agreements. This was a particularly difficult site, characterized by sandy soils interspersed with wetlands and very little topographic relief. Add to that the difficulty in determining seasonal high-water tables in the soil profile and dealing with stormwater issues and the downstream impacts, etc. and we had a recipe for a lot of attention from the regulatory agencies.

To make a long story much shorter, I finished the wetland delineations and succeeded in getting the Corps of Engineers to agree with them after changing the site plans several times to minimize wetland impacts. However, due to the complexity of the site, the agencies also decided mitigation needed to be completed at a higher ratio than normal, which of course did not make the client happy, but he agreed to it. Some of the mitigation could be accomplished on site, and the remainder would need to be located offsite, but within the same watershed. It was not necessarily a huge issue, but it still meant some extra time and financial considerations for the developer.

I got the permit applications together, and the agencies wanted a joint meeting to go over the details. The client, who rarely came to these meetings (he usually sent his staff instead), decided to attend this one. These meetings are typically spent with the agencies questioning (sometimes to a great extent) the data in the permit applications. This was not an exception, and I was prepared since I had held numerous field meetings with agency personnel and could refer to items we viewed/changed in the field that they were familiar with.

No time for a tantrum

After the meeting had been going for a while, it became apparent that the questions got to be a bit much for my client since he thought he had already given up enough to put the permit applications together. First he started interrupting the conversation and then got red in the face and started yelling at the agency representatives. And then, and I kid you nor, he jumped up on his chair and then the table to lecture the agencies about regulations. What a wonderful spot to be put in by your client!
I knew his project applications were going to move forward, and I had told him that before we walked into the meeting. Unfortunately it was a day where I got my client’s alternate personality—the one with the temper—when he decided that his project should not be further scrutinized or questioned. This was not the personality I needed to show up that day!

After I got over my shock that my client was actually standing on the conference room table, I saw that something needed to be done—and quickly—or we were going to be shown the door and told to never come back. I managed to get my client’s attention and asked the agencies to please excuse us. We left the room, and then it was my turn to advise my client in no uncertain terms that while I was going back in the room to finish the meeting, he was not. This wasn’t done with any emotional investment; I was completely calm (someone had to be!). He had some very loud and choice words to express his opinion of that, but I finally told him that if he didn’t back down, the agencies would never listen to a project pitch from his company again and that given how much land he was planning on developing, he may as well find himself a different state to set up business in or go bankrupt. OK, maybe this was a bit on the extreme side, but it got his attention. He finally agreed to leave, but he was not at all happy about it.

Unfortunately it was a day where I got my client’s alternate personality—the one with the temper.

I walked back into the conference room and politely told the people sitting there that my client was sincerely sorry for the outburst and that he had felt it better that he not participate in the rest of the meeting. I’m not entirely convinced that anyone bought that story, but we continued the meeting, and the permit applications subsequently went through with minor changes/compromises.

The message of the tale this time is to be prepared for anything and then stay calm. Deal with your emotion to the issue later because the time or place to do that isn’t in the middle of a crisis. Learn to defuse the situation, not add to it. In this case, the agencies saw that the person they didn’t want to deal with was taken care of, and the client saw that the job was completed with the agencies.
Corn hybrid selection can be a daunting task. Seed corn companies are offering more choices of corn hybrids with a wider selection of traits than ever before. This wide selection allows growers and agronomists to individualize hybrid selection for specific fields. The Ontario Corn Hybrid Performance Trials are the most highly used source of data to aid growers and agronomists in the hybrid selection process.

To help make selection easier for Ontario growers and agronomists, the Ontario Corn Committee has introduced a web-based sorting feature into the testing-location tables. For more information, visit www.GOCorn.net. The new feature allows for sorting by any of the columns in the table, including corn hybrid heat unit rating, company, hybrid name, traits, and plant height.

In Ontario, there are 21 testing locations where hybrids are testing in a four-replicate randomized block design. Information on the 21 locations is summarized into seven tables by heat unit area. Within these tables, hybrid performance information is presented for one- or two-year averages across all locations as well as current-year data for individual testing stations. The new sorting features now allow growers to sort within these tables for yield index, percent moisture, lodging percent, and test weight.

There are three options for viewing the 2010 data tables
  1. A spreadsheet format
  2. A PDF format suitable for printing
  3. A graph of yield versus moisture

The graphs of yield versus location are interesting because they depict the yield index of hybrids vs. their moisture content. The 2010 results in many of the tables indicate a steeper slope to moisture vs. yield index. Growers who selected a long-season hybrid for their area were generally rewarded with higher yields without a high moisture penalty (Fig. 1). This is not always the case as evidenced by the shorter growing season in 2009 when harvest moistures were much higher (Fig. 2).

**Figure 1 (top)**: Ontario Corn Committee one-year averages (2010) for Area 4: Exeter, Ilderton, Thorndale, and Woodstock.

**Figure 2 (bottom)**: Ontario Corn Committee two-year averages (2009–2010) for Area 4: Exeter, Ilderton, Thorndale, and Woodstock.
North Central

Nominations open for Wisconsin CCA of the year

The Wisconsin CCA board is currently accepting nominations for the 2011 Wisconsin CCA of the Year Award. This annual award is presented at the CCA luncheon prior to the start of the Wisconsin Crop Management Conference. The winner is automatically nominated by the board for the International Certified Crop Adviser of the Year Award, which is presented each year at the Annual Meeting of the American Society of Agronomy.

As a nominator (especially as a successful nominator), you will feel good about helping a friend and colleague be recognized for a job well done. You will also send the message that his/her job performance is recognized and appreciated. Please make it a priority to nominate a deserving CCA. After all, if you don’t do it, then who will?

The official nomination form consists of five questions and must be completed in full for the committee to review. Two letters of reference are also required. An individual may only receive the award once. The deadline for application submission is Mar. 1, 2011. Electronic applications are preferred; however, applications may be faxed or mailed. Unsuccessful applications will not automatically be reconsidered the following year. For more information or to nominate a CCA, contact Bryan Jensen, Department of Entomology, 1630 Linden Dr., Madison, WI 53706 (email: bmjense1@facstaff.wisc.edu; fax: 608-262-3322).

What’s happening in your region?
Email cropsandsoils@agronomy.org

Rite in the Rain®
ALL-WEATHER WRITING PAPER

Outdoor writing products for Outdoor writing people

Rite in the Rain is an All-Weather Writing Paper designed to protect your valuable field data from water, sweat and grime.

Our patented manufacturing process is pollution free. The only by-product is steam. Made from renewable wood fiber, Rite in the Rain can be recycled with plain paper.

www.RiteintheRain.com  J.L. DARLING CORPORATION • (253) 922-5000 • TACOMA, WA
Continuing education for CPSS/C’s:

What’s new with CEUs and what are your responsibilities?

By Dawn R. Ferris, Ph.D., PSS, and CPSS
Soil Science Program Coordinator for the Soil Science Society of America; 608-819-3900 or dferris@sciencesocieties.org

Continuing education is required for all CPSS/C’s that are certified by the Soils Certifying Board of the Soil Science Society of America (SSSA). As such, it is important to understand your responsibilities with respect to earning CEUs, reporting them, and keeping records that document your attendance or participation in activities that earn CEUs. This article provides some general information on continuing education as well as recent updates to the CEU process.

New! Paperless reporting of CEUs

On Oct. 7, 2010, CPSS/C’s should have been notified via email that SSSA was migrating to paperless tracking and reporting of CEUs, which was effective upon receipt of the email. It is SSSA’s hope that you will embrace this paperless (green) opportunity to track and report your CEUs on the SSSA website. We will continue to send out email reminders regarding CEU reporting deadlines.

What counts for CEUs?

This information can be found on the SSSA website (www.soils.org/certifications) but is also included below. You must log in to the SSSA site to check or report CEUs. Starting in 2011, all certificants will also be required to complete a minimum of 1 CEU in Ethics during every renewal period. This change was instituted by the Soils Certifying Board during its fall 2010 meeting. To ensure access to an ethics course, SSSA will be developing a webinar and associated quiz that will be available starting early this year. CEUs can be counted for the following activities:

- **Professional Meetings** (no maximum): Short courses, workshops, clinics, conferences, symposia, seminars, field days, college courses, scientific presentations, and distance education.
- **Self-Directed Study** (20 CEU maximum): Scientific journals (reported by article; 1 CEU = 2,000 to 2,500-word article), books, and videos.
- **Community Service** (10 CEU maximum): Election to professional boards; service to the profession (e.g., professional Society committees, exam committees, standards/ethics panel, certification boards, and editorial boards); city, town, and county committees; and community service related to the profession.
- **Author/Educational Materials** (10 CEU maximum): Scientific papers and books, popular articles, and preparation of educational materials.

The rule of thumb for CEUs is that one hour of activity = 1 CEU. Round off to the nearest half hour. Use the guidelines in Table 1 for individual items. Starting in 2011, 1 CEU in Ethics will be required every renewal period.

Record keeping, preparing for audits

Professionals should keep documentation on file such as meeting agendas, programs, handouts, etc. For activities:

<table>
<thead>
<tr>
<th>Activity time</th>
<th>No. of CEUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 to 45 minutes</td>
<td>0.5 CEUs</td>
</tr>
<tr>
<td>46 to 75 minutes</td>
<td>1 CEUs</td>
</tr>
<tr>
<td>76 to 105 minutes</td>
<td>1.5 CEUs</td>
</tr>
</tbody>
</table>

Table 1. Guidelines for CEU credits based on continuing education activity time.
ties that did not include documentation, such as self-directed study and some types of community service, document the activity yourself. You can also ask for a letter or note that indicates your involvement with a group. In other words, keep anything that shows that the time spent earning the CEU(s) was related to the listing of eligible CEUs for the certification program. It is recommended that you keep a file of your CEUs and associated documentation as it occurs. Keep the documentation for two years after the reporting date in case an audit should occur.

Audits are conducted on 10% of the certified soil scientists each calendar year. The audit process is random and is a “rolling audit,” so not all audits are completed at once but are spread out throughout the year. If you are audited, you will be required to provide documentation of your attendance or participation in gaining CEUs for the reporting period. Providing false information is a violation of the Code of Ethics and may cause the revocation of your certification.

Are pre-approved CEUs available?

There has been a lot of discussion over the years on the soil science licensing boards as to how to approach validation of CEUs for the continuing education requirements associated with licenses. Most licensing states (not certification) have opted for self reporting within a set of guidelines that are usually set in their licensing legislation. This is also the method that the Soils Certifying Board for CPSS and CPSC uses. The CCA program does it differently and “approves” CEUs prior to the program, but its overall structure is also set up differently. The CCA program has state boards that can review applications for CEU programs more easily (and faster) than a national program such as the Soils Certifying Board or SSSA can. We are currently not set up to approve CEUs except during the audit process, but we are discussing how we might change this using, for example, the state soil science societies—especially if they are chapters within SSSA. If you have comments or suggestions on this topic, I would like to hear them—please contact me!

We will be trying to move toward a more automated system of being able to have some CEUs reported at the time of an event (as is available with the CCA program) by scanning your certification card where a scanner is available. Also remember that as certified soil scientists,
New software tools are now available to help technical service providers (TSPs), conservation districts, and other USDA-NRCS conservation partners work with their producers’ data. These tools help conservationists download data from NRCS, carry out their specific conservation-planning activities based on NRCS standard practices, and deliver the resulting plan electronically.

This innovation can facilitate access to more than 200,000 conservation plans under the NRCS conservation planning and program services, supported by more than 2,800 USDA service centers and program delivery points across the country.

Now, in addition to having conservation-planning data available in these USDA facilities and computers within their network, a TSP, conservation district staff, or other conservationist with proper data access authorizations can access the data from any computer connected to the internet, saving time and simplifying information exchange among all parties involved.

“This is a great tool to facilitate collaboration among technical service providers, USDA-NRCS, and clients,” says Dennis Godar, a CCA, CPAg, and TSP from ManPlan Inc., Rochester, IL, who is using the tools to develop and report comprehensive nutrient management plans and other conservation-planning activities. “It helps a great deal to ensure that the TSP, client, and NRCS personnel are all on the same page.”

How it works

The starting point is to have the proper permissions to access a producer’s data, since the system is linked to the USDA authorizations and permissions system, assuring that the same level of data privacy and confidentiality is achieved as if working on a USDA computer. Conservation districts and other NRCS affiliate entities can use their existing access to information. Technical service providers will need to have the producer sign a permission form, which they need to deliver to the NRCS office. (To download the form, go to www.wikiagro.com and search “TSP permission form.”)

Using GeoAgro CPlanner, the component that connects
with the NRCS, the conservationist can select the customer’s farm, view existing plans and practices, and enter new plans, practices, or land units through guided assistants, based on existing NRCS guidelines. Also, a documents folder is shared with the field office, making it possible to upload plans, technical specifications, pictures, or other relevant information.

Information can also be downloaded to a geographic information system (GIS), which can be managed in GeoAgro GIS or other GIS software used by the conservationist. In this environment, the user can quickly set up the farm base map, since the land unit boundaries can be downloaded from the NRCS, together with images, soils, and other land resource information that is available from USDA servers and other sources.

Challenges and opportunities

There have been some challenges with the initial implementation, since it’s addressing a new way of doing business with NRCS. Issues related to communication, lack of familiarity with the system, data quality, and software are some of the different problems for which solutions needed to be found during the initial months. But it also brings opportunities; when plan data are accessible from the internet, it helps to improve data quality and bring forth new ideas on how tasks are carried out. By exposing problems, solutions can be developed along with more efficient conservation delivery.

For more information, please feel free to email me at ed@geoagro.com or visit www.geoagro.com and click on “NRCS Programs.”

Continuing education [continued from p. 15]

you are eligible to obtain continuing education from applicable CCA educational materials or seminars.

How can an organization offering CEUs be sure they will count?

The short answer is that the organization cannot be sure, but there are steps that can be taken to clearly document how the CEUs meet SSSA’s requirements. As stated in the previous section, I would like to look at this issue in more detail and see how it could work better. In the meantime, I am recommending that the following procedure be followed to formalize CEUs being offered by organizations:

1. Document the program, especially how it relates to CEU value and soil science. Provide a very thorough explanation as to what attendees are being exposed to and how it relates to soil science.

2. Using the current guidelines for CEU credits (see Table 1) and figure out how many CEUs are earned from your program and in what category. Only active learning times are allowed, i.e., not lunch, breaks, or travel time.

3. Organizations may advertise by saying something like: “The California Forest Soils Council (CFSC) has followed SSSA CEU guidelines and estimates that participants would be eligible for XX CEUs for this program. The CPSS/CPSC CEU program is self-reporting, and final CEU eligibility is at the Soils Certifying Board’s discretion should you be audited. The CFSC strongly recommends that if you claim CEUs for this program, you should save all materials/documentation describing the program and make sure you get a certificate of attendance for your files.”

The organization can then hand out materials for the program, which also provide the documentation. The organization would also need a sign-in sheet (attendance) and then have everyone sign again at the end of the day so that you have something on file that shows they were there all day (or part of the day for partial credit). You can then take that list and provide certificates of attendance (on organization letterhead) verifying that the person was indeed there and didn’t just pay the fee, not show up, and still claim CEUs. Certificates can be handed out that day or mailed to attendees. This formalizes the process, protects the organization if there are ever any questions, and provides attendees with proof that they attended the program for their files.

The organization’s responsibility in this is to make sure that people who get certificates of attendance were actually there. The organization can assert that it was following, to the best of its ability, the guidelines set out by SSSA. It is also important to put a caveat in the materials that you cannot guarantee acceptance by the Soils Certifying Board (as shown in the example text above).

One other thing that the organization can do to make a case for the CEUs is to send me the documentation and the list of names that you certified as attending for our files. That way if the Soils Certifying Board has questions, I have materials on hand to answer them during an audit.

The above procedure is used by many organizations in many states to provide documentation of CEUs for soils professionals and attendance at these events. This type of procedure helps professionals if they are audited and provides some formalization of the CEU process for the organization putting on the program.

If you have questions regarding what is new with the CEU program or with the process in general, please contact me at dferris@sciencesocieties.org.
NRCS seeks to renew its TSP program
by engaging more private-sector consultants

By Thomas Green, Ph.D., CCA, TSP
President of IPM Works LLC, board president of the IPM
Institute of North America, member of the USEPA Pesticide
Policy Dialogue Committee, director of the Entomological
Foundation, and co-chair of the NRCS and IPM Working
Group; ipmworks@ipmworks.com

USDA-NRCS needs you! There is simply too much work to be done to address pressing conservation needs for the agency to do it all by itself. Private-sector consultants are key to addressing the many challenges we face, illustrated most recently in the Conservation Effects Assessment Program (CEAP) reports for the Upper Mississippi River Basin. This comprehensive evaluation indicated that more than 60% of our cropland could benefit from additional conservation measures to prevent nutrient losses.

Fifteen percent of cropland was lacking even basic conservation practices that have been proven to reduce the impacts of agricultural production without compromising long-term profitability. On the upside, the CEAP report detailed substantial improvements in soil, water, and air quality from conservation practices successfully implemented on the large majority of our agricultural acres.

Changes being implemented this year in the Technical Service Provider (TSP) program are clear evidence of NRCS’s desire to engage more private-sector consultants. The changes are extensive and responsive to the concerns expressed by the CCA program, the National Alliance of Independent Crop Consultants (NAICC), and other organizations that have established memoranda of understanding (MOUs) with NRCS, recognizing their role in certifying competent professionals. The improvements aim to help NRCS meet increased workloads and acquire special skills and expertise that county NRCS offices may lack, including planning and implementing conservation on farms.

Formed in 1935 as the Soil Conservation Service, NRCS celebrated its 75th anniversary in 2010. The NRCS name (Natural Resources Conservation Service) reflects the agency’s broader mission to protect all of our natural resources, including soil, water, air, plants, and animals that contribute to productive lands and healthy ecosystems. NRCS accomplishes its mission in large part through technical and financial assistance to private landowners valued at more than $1 billion per year.

To ensure competent delivery of technical assistance and good use of taxpayer dollars, NRCS created the TSP program. Farmers contract directly with the agency to implement conservation. As part of the contract, NRCS may require farmers to hire a qualified TSP to provide the expertise, assistance, and verification of conservation practices.
When the program was rolled out, many consultants saw TSP status as a good opportunity to meet the needs of clients, potential clients, and our natural resources. At peak, participation exceeded 3,000 consultants; however, enrollment has since declined and now stands at less than half that today.

Improving the program

In 2009, a working group was created to identify barriers to the TSP process and make recommendations for improvement. All TSP processes were inventoried and evaluated by the team, and opportunities for streamlining were identified through focus groups and one-on-one consultation with partners. The team also requested input from TSPs, TSP state coordinators, NRCS field staff, and outside agencies and organizations.

Barriers included a difficult, time-consuming registration and certification process. The NRCS training module, AgLearn, can be difficult to navigate and the content is sometimes elementary, falling short on skills already certified by credible programs, including CCA and Certified Professional Crop Consultant (CPCC) credentials. Payment rates sometimes fail to provide sufficient dollars to adequately compensate consultants for the time required to complete contracted services. Administration of the TSP program varied geographically, with some county NRCS offices welcoming consultants with open arms and others not at all familiar with how the program was supposed to work. Farmers were even less familiar, making for weak demand.

According to the agency’s May 2010 TSP Express newsletter, the 2009 streamlining survey conducted by NRCS indicated more than two-thirds of all TSPs viewed the qualification process as overly difficult and nearly 60% rated payment rates inadequate.

“We have had years with big TSP workloads, and years with nearly none,” reports Stan Winslow, a TSP with 30 years experience serving producers. “I can’t justify days or weeks of training for myself and my crew on a program with inconsistent work and which could go away with the next farm bill.” Stan has been an NAICC member since 1995 and holds state certifications in nutrient and pest management in North Carolina and Virginia. Luther Smith, director of certification programs at the American Society of Agronomy, relates that “CCA’s initial enthusiasm was dampened by lack of demand and bureaucratic hurdles. The frustrations translated into declining participation.”

NRCS actively engaged Winslow, Smith, and others to provide feedback and develop solutions now being rolled out.

Mark Parson, NRCS Environmental Quality Incentives Program Manager, reports, “As a result of the survey, the agency is implementing changes to some of the qualifications required of TSPs and other improvements to the process for certification.” According to Barbara Eggers, NRCS Acting National TSP Team Leader, “By summer of 2011, TSPs and those interested in becoming TSPs will see substantial improvements. Steps to be taken include moving TSP certification to the national TSP Team to improve consistency, reducing training requirements for MOU organizations, and improving the quality of training offered. The required online TSP training for MOU organization members will be streamlined to focus on NRCS program expectations. Credit will be given for expertise already demonstrated by MOU organizations. TSP rates have been revised to allow states the flexibility to modify rates to meet local market rates.”

“The frustrations translated into declining participation.”

The National TSP Team will be adding additional staff to handle the increased workload. Tim Pilkowski, formerly TSP Coordinator for Maryland, accepted a position with the national team in November. “One of our goals is to move some of the TSP training to the TechReg website in order to give us the ability to manage content in a timely fashion,” he says. “NRCS has also entered into an agreement with GeoAgro to offer a tool to assist TSPs with conservation planning. The CPlanner tool allows TSPs, with landowner permission, to access conservation plans electronically. CPlanner also provides GIS and GPS tools to develop the conservation practices. CPlanner is flexible, supporting different types of plans and local needs, while complying with NRCS national program standards.”

One of those very much looking forward to greater private-sector consultant participation in the TSP program is Dan Meyerhoff, Assistant State Conservationist for Kansas NRCS. Meyerhoff has been assisting with the TSP streamlining process at the national office and is looking for additional TSPs because current demand in his state for conservation plans exceeds what NRCS staff can deliver.

1For CEAP reports on the benefits delivered by proven conservation practices, and challenges yet to be met, see www.nrcs.usda.gov/Technical/nri/ceap.
2Visit the home page for the TSP program at http://techreg.usda.gov to learn more. Includes tutorials for getting started.
3For more on the CPlanner tool, see page 16 or visit www.cplanner.com.
The Next Generation Agronomy Management System

ADVISOR IS A COMPREHENSIVE WEB-BASED AGRONOMY MANAGEMENT SYSTEM providing decision support for agronomic best practices, GIS based field activity, and connectivity between all participants in the food production continuum.

With its comprehensive approach to crop production, ADVISOR can be applied to virtually any input requirement for optimizing crop production.
Combining Agronomy & Technology

- Web-based for Mobility and Flexibility
- Full GIS/Mapping Features
- Sampling, Scouting, and Trap Monitoring
- Crop Protection, Soil Performance, and Crop Production
- Precision Ag and VRA Support

CDMS | Data Logic Knowledge
800.237.2367 | sales@cdms.net | www.cdmsadvisor.com
Management-intensive rotational stocking as part of a livestock production system has been increasing in the United States. This trend is primarily the result of reported increased net profits from decreased feeding and harvesting costs. Studies in the northeastern United States show an increase in profits from $40 to $300 per cow for management-intensive rotational stocking compared with confined dairies.

Animal production (either milk or meat) in grazing systems depends on the combination of forage quantity and quality produced. Research in natural grassland ecosystems has shown that environments with broader plant diversity tend to provide greater and more consistent plant community biomass. In a recent study that analyzed the economic impact of forage plant diversity on a whole-farm scale, a six-species mixture was found to improve net return compared with a grass monoculture fertilized with N.

Long-term evaluation of pasture alternatives takes time and costs money. Carrying out long-term studies of pasture alternatives in the “real world” becomes cost-prohibitive. An alternative is to use computer simulation to study the long-term performance and economic impact of alternative management options where limited field data is used to support model predictions.

Among several farm models available, the Integrated Farm System Model (IFSM) is most suitable because it provides a process-based simulation that integrates all major production processes at the whole-farm level. It integrates all important production aspects, from land use and cropping systems to timeliness of tillage, planting, and harvesting operations. The IFSM calculates the economic return based on feed production and purchase, feed utilization, production costs, and income from production sales and estimates environmental aspects of the specific production and soil characteristics. The IFSM and its predecessor, the Dairy Forage System Model, have been used to evaluate the whole-farm influence of multiple-species pasture dynamics.

In the July–August 2010 issue of Agronomy Journal (102:1201–1209), researchers report on a study they conducted to evaluate the economic impact of altering the grazing strategy and the forage base on a typical dairy farm in Pennsylvania. The IFSM was used to assess:

(i) the effect of grazing initiation based on canopy height or plant morphology and

(ii) the effect of increasing forage species diversity from pure grass stands and a simple grass–legume mixture, up to a seven-species mixture.

The economic impact of these alternatives was measured based on feed production, feed use, and net return of a typical dairy farm in Pennsylvania in the short-term (two years) and long-term (25 years) and under extreme weather (five consecutive dry and wet years).
Integrated Farm System Model

The IFSM simulates crop production, feed use, and the return of manure nutrients back to the land for up to 25 years of weather on a crop, beef, or dairy farm. Growth and development of alfalfa, grass, pasture, corn, soybean, and small-grain crops are predicted on a daily time step based on soil water and N availability, ambient temperature, and solar radiation. The multispecies pasture component predicts sward botanical composition, net herbage accumulation, and the crude protein and neutral detergent fiber contents of the herbage. Tillage, planting, harvest, storage, and feeding operations are simulated to predict resource use, timeliness of operations, crop losses, and nutritive changes in feeds.

Feed allocation and animal response are related to the nutritive value of available feeds and the nutrient requirements of the animal groups making up the dairy herd. When available, pasture is given first priority in the allocation of forage in animal rations. Any remaining forage requirement is met through farm-produced and purchased hay and silage. Rations for each animal group are balanced using energy and protein concentrate feeds to meet nutrient requirements for the target growth and milk production.

Simulated performance is used to determine production costs, incomes, and economic return for each year of weather. Annual fixed costs for equipment and structures are the product of their initial cost and a capital recovery factor where this factor is a function of an assigned economic life and real interest or discount rate. The resulting annual fixed costs are summed with predicted annual expenditures for labor, resources, and products used to obtain a total production cost. Labor cost accounts for all field, feeding, milking, and animal-handling operations. This total cost is subtracted from the total income received for milk, animal, and excess feed sales to determine a net return to the herd and management. Tax implications or other government subsidies are not included in the economic analysis.

Farm description and management scenarios

Short-term analysis

To evaluate grazing management and mixture complexity effects on net return of a dairy farm, eight different management scenarios (two grazing-strategies and six forage alternatives ranging from a monoculture up to a seven-species mixture) were compared on a representative farm. Each scenario was modeled as an established production system; hence, transition from one management alternative to another was ignored.

The base farm represented a 247-ac dairy farm in Pennsylvania. The soil was a clay loam of medium depth with gently sloping terrain (3–8%). For the present study, stand life was set to five years for all forage treatments to represent an average stand life. Alfalfa was harvested primarily as silage (first, third, and fourth harvests) with one harvest (the second) for dry hay. Maize was harvested as silage to fill the existing silo; the remaining maize crop was harvested as high-moisture grain. The pasture was grazed by all classes of cows during the growing season.

Prices were set to represent long-term relative prices by averaging prices for each input over five years (Tables 1 and 2, next page). A real interest rate of 6% per year was applied to all investments in machinery and facilities. Annual property tax was set at 2.3% of the estimated assessed value of land and buildings. Simulations were done for two consecutive years using weather data collected at State College, PA.

Two grazing management strategies and six forage treatments (represented by the pasture land use) were simulated and compared (Table 3, p. 26). These scenarios were achieved by modifying the pasture subroutine of IFSM to allow manual input of pasture production and nutritive values in contrast to most previous uses of the IFSM, where pasture production was predicted using its process-based submodel. Thus, when dynamics of the pastureland were simulated, the program read data generated in a field experiment performed near State College, PA.

Long-term analysis

To evaluate long-term impact of the alternative management scenarios on overall farm performance and economics, IFSM was used to simulate farm production over 25 years of weather. This was accomplished by adjusting the pasture yield potential so that the average simulated yield was similar to the measured yield in the field study for that treatment while maintaining the year-to-year variation due to weather effects.

Extreme-weather analysis

The model was run to determine the impact of these alternative management scenarios on net return during dry and wet years. Long-term weather data (103 years of data from the Russell E. Larson Agricultural Research Center near State College, PA) were analyzed to find a string of 25 years that had five dry years, five wet years, and 15 normal years. From the original weather data file, the five driest and five wettest years were extracted and saved as new weather files for the dry and wet runs, respectively. For the dry years, pasture yield was calibrated to produce,
on average, the dry matter (DM) produced in the 2005 field experiment, and for the wet years, pasture yield was calibrated to produce, on average, the DM produced in the 2006 field experiment. Data are reported as means for all 25 years, the five driest years, and the five wettest years.

Results

Short-term analysis

Differences in the economic return between the two grazing strategies were primarily due to a lower pasture production in the morphology-based grazing strategy. The morphology-based grazing strategy produced more consistent net returns year to year compared with the height-based strategy as indicated by a smaller coefficient of variation. Forage diversity mostly affected forage DM production and subsequently the amount of excess forage for sale and the income generated by those sales. Despite higher seed costs, the five- and seven-species mixtures generated greater net returns compared with either the orchardgrass–alfalfa mixture or orchardgrass monoculture. The seven-species mixture generated the greatest net return, and the orchardgrass monoculture with applied N fertilizer yielded the lowest net return.

Although the addition of N fertilizer to the orchardgrass monoculture increased forage production, this increase was not reflected in the net return. This effect is explained by the relatively high price of N fertilizer and the level of N applied, which offset the increase in forage production. When N fertilizer prices are high, lowering the application rates or including legumes in pastures is more cost effective.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor wage rate</td>
<td>$11/hour</td>
<td>Animal and feed prices</td>
<td></td>
</tr>
<tr>
<td>Diesel fuel price</td>
<td>$2.27/gal</td>
<td>Cull cow</td>
<td>$0.45/lb</td>
</tr>
<tr>
<td>Property-tax rate</td>
<td>2.3%/year</td>
<td>Calf</td>
<td>$80/animal</td>
</tr>
<tr>
<td>Land rental</td>
<td>$101/ac</td>
<td>Milk</td>
<td>$1.25/gal</td>
</tr>
<tr>
<td>Annual livestock expenses</td>
<td>$238/cow/year</td>
<td>Straw bedding</td>
<td>$98/tons DM</td>
</tr>
<tr>
<td>Cow free stall barn (initial cost)</td>
<td>$1,000/cow</td>
<td>Maize grain</td>
<td>$107/tons DM</td>
</tr>
<tr>
<td>Feed shed (initial cost)</td>
<td>$70/cow</td>
<td>Alfalfa hay</td>
<td>$125/tons DM</td>
</tr>
<tr>
<td>Fertilizer prices</td>
<td></td>
<td>Soybean meal</td>
<td>$241/tons DM</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>$0.35/lb</td>
<td>Protein mix</td>
<td></td>
</tr>
<tr>
<td>Phosphorus</td>
<td>$0.33/lb</td>
<td>Mineral/vitamin mix</td>
<td>$295/tons DM</td>
</tr>
<tr>
<td>Potash</td>
<td>$0.19/lb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual seed and chemical costs</td>
<td></td>
<td>Economic life</td>
<td></td>
</tr>
<tr>
<td>New forage stand</td>
<td>varied (Table 2)</td>
<td>Storage structures</td>
<td>20 years</td>
</tr>
<tr>
<td>Established forage</td>
<td>$6/ac</td>
<td>Machinery</td>
<td>10 years</td>
</tr>
<tr>
<td>Maize following maize</td>
<td>$63/ac</td>
<td>Salvage value</td>
<td></td>
</tr>
<tr>
<td>Maize following other crop</td>
<td>$55/ac</td>
<td>Structures</td>
<td>0%</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>6.0%/year</td>
<td>Machinery</td>
<td>30%</td>
</tr>
</tbody>
</table>

† Prices are averages over five-year period presented in 2006 dollars.
The production variability decreased (i.e., smaller coefficient of variation for net return) as pasture diversity increased. Increased plant diversity has been suggested to render biomass production more consistent in natural grasslands. In the present study, the first year (2005) was dry, and similar to previous findings, complex mixtures produced greater forage production compared with simple mixtures and pure grass stands. Forage DM production created a significant proportion of the variation in net return (Fig. 1, next page).

### Long-term analysis

Long-term trends are better predictors of how different forage treatments affect overall farm economics. The height-based grazing strategy produced more forage DM on pasture, which in turn increased the sale of excess forage. Because of differences in nutrient content, the morphology-based grazing strategy needed more protein and mineral supplements and less purchased grain than the height-based grazing strategy. These differences in feed quantities purchased led to a greater feed cost for the morphology-based grazing strategy. In all, the height-based grazing strategy produced greater net return than

---

**Table 2. Costs of establishing forage treatments used for the analysis of different grazing management and forage mixtures on a representative Pennsylvania dairy farm. Costs were based on actual inputs used and prices paid in establishing the forage mixtures in the field trials of Deak et al. (2009; Agron. J. 101:408–414).**

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td>$4.22/lb</td>
<td>44.60</td>
<td>26.74</td>
<td>17.84</td>
<td>13.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicory</td>
<td>$5.99/lb</td>
<td>10.16</td>
<td>10.16</td>
<td>10.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orchardgrass</td>
<td>$3.04/lb</td>
<td>36.09</td>
<td>36.09</td>
<td>18.05</td>
<td>18.05</td>
<td>9.02</td>
<td>5.42</td>
</tr>
<tr>
<td>Perennial ryegrass</td>
<td>$2.27/lb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.46</td>
</tr>
<tr>
<td>Red clover</td>
<td>$2.95/lb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.77</td>
<td>14.77</td>
</tr>
<tr>
<td>Tall fescue</td>
<td>$1.41/lb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.53</td>
<td>11.09</td>
</tr>
<tr>
<td>White clover</td>
<td>$4.90/lb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.31</td>
</tr>
<tr>
<td>Total seed cost</td>
<td></td>
<td>36.09</td>
<td>36.09</td>
<td>55.83</td>
<td>59.60</td>
<td>63.36</td>
<td>65.75</td>
</tr>
<tr>
<td>Glyphosate herbicide</td>
<td>$65.10/gal</td>
<td>27.88</td>
<td>27.88</td>
<td>27.88</td>
<td>27.88</td>
<td>27.88</td>
<td>27.88</td>
</tr>
<tr>
<td>Herbicide application</td>
<td>$19.80/pass</td>
<td>15.98</td>
<td>15.98</td>
<td>15.98</td>
<td>15.98</td>
<td>15.98</td>
<td>15.98</td>
</tr>
<tr>
<td>Total chemical</td>
<td></td>
<td>43.82</td>
<td>43.82</td>
<td>43.82</td>
<td>43.82</td>
<td>43.82</td>
<td>43.82</td>
</tr>
<tr>
<td>Total cost of seed and chemicals</td>
<td></td>
<td>79.91</td>
<td>79.91</td>
<td>99.65</td>
<td>103.42</td>
<td>107.18</td>
<td>109.57</td>
</tr>
<tr>
<td>Field operation costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disking</td>
<td>$32.00/pass</td>
<td>25.89</td>
<td>25.89</td>
<td>25.89</td>
<td>25.89</td>
<td>25.89</td>
<td>25.89</td>
</tr>
<tr>
<td>Conventional planting</td>
<td>$34.60/pass</td>
<td>28.00</td>
<td>28.00</td>
<td>28.00</td>
<td>28.00</td>
<td>28.00</td>
<td>28.00</td>
</tr>
<tr>
<td>Total cost of tillage and planting</td>
<td></td>
<td>73.72</td>
<td>73.72</td>
<td>73.72</td>
<td>73.72</td>
<td>73.72</td>
<td>73.72</td>
</tr>
<tr>
<td>Total establishment cost</td>
<td></td>
<td>153.63</td>
<td>153.63</td>
<td>173.37</td>
<td>177.13</td>
<td>180.90</td>
<td>183.28</td>
</tr>
</tbody>
</table>
the morphology-based grazing due to greater income from feed sales and lower feed production costs. Additionally, production variability was lower (smaller coefficient of variation of net return) for the height-based grazing strategy compared with the morphology-based grazing strategy. Production variability in this study (both for the short and long term) was mainly affected by environmental variation because input and output prices remained constant, so the long-term results are a better predictor of production dependability because they encompass a broader array of weather scenarios.

**Extreme-weather analysis**

During the five driest years, net return increased as mixture complexity increased. The differences in pasture production in dry years were such that production systems with orchardgrass monocultures or orchardgrass–alfalfa required the purchase of forage, whereas three-, five-, and seven-species mixtures produced excess forage that could be sold.

During years of above-average rainfall, both the two- and three-species mixtures produced more forage and greater net returns than the other treatments. It is also interesting to note that the addition of N fertilizer to pure grass stands led to greater net return in wet years than in dry years. When comparing the difference in net return obtained by a particular forage treatment in dry vs. wet years, the net return from the five- and seven-species mixtures was reduced only 25 to 27%. However, the reductions in net return ranged from 36% for the three-species mixture up to 55% for pure grass stands.

**Conclusions**

Grazing management and pasture species diversity affect overall farm net economic return. This is a consequence of greater pasture DM production with certain grazing and forage treatments. Botanically diverse forage mixtures (greater than three species) had lower production variability in all analyses. Consequently, complex forage mixtures are a useful strategy for use on dairy farms to reduce forage production variability in dry years and thereby increase and stabilize annual net returns.

---

**Table 3.** Seeding ratio of forage treatments established at the Haller Farm near State College, PA, to determine their effect on forage production and weed invasion of the resulting pasture (Deak et al., 2009; Agron. J. 101:408-414).

<table>
<thead>
<tr>
<th>Mixtures</th>
<th>Species seed percentage in each mixture †</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100% orchardgrass with 225 lb N/ac</td>
</tr>
<tr>
<td>2</td>
<td>100% orchardgrass without added N fertilizer</td>
</tr>
<tr>
<td>3</td>
<td>50% orchardgrass/50% alfalfa</td>
</tr>
<tr>
<td>4</td>
<td>50% orchardgrass/30% alfalfa/20% red clover</td>
</tr>
<tr>
<td>5</td>
<td>25% orchardgrass/25% tall fescue/20% alfalfa/20% red clover/10% chicory</td>
</tr>
<tr>
<td>6</td>
<td>15% orchardgrass/15% tall fescue/15% perennial ryegrass/15% alfalfa/15% red clover/15% white clover/10% chicory</td>
</tr>
</tbody>
</table>

† Seed percentage is based on number of live seeds.

---

January–February 2011
self-study quiz

Optimizing pasture value with forage mixtures (no. SS 04115)

1. In a recent study that analyzed the economic impact of forage plant diversity on a whole-farm scale, a
six-species mixture was found to improve net return compared with

☐ a. a grass monoculture fertilized with N.
☐ b. grain and pasture feeding combined.
☐ c. grain feeding in an enclosed system.
☐ d. a two-species mixture.

2. Among several farm models available, the Integrated Farm System Model is most suitable because it

☐ a. integrates most important production aspects, providing a real-time simulation of plots.
☐ b. provides a process-based simulation that integrates all major production processes at the whole-farm level.
☐ c. evaluates each aspect of land use and cropping systems and assigns priorities.
☐ d. is compatible with the Dairy Forage System Model.

3. In the study, the five- and seven-species mixtures generated

☐ a. lower returns than the orchardgrass–alfalfa mixture due to decreased biomass as a result of competition among the species.
☐ b. slightly greater volume of biomass than the orchardgrass–alfalfa mixture.
☐ c. lower returns than the orchardgrass monoculture due to higher seed costs.
☐ d. greater net returns than the orchardgrass–alfalfa mixture or the orchardgrass monoculture.

4. Although the addition of N fertilizer to the orchardgrass monoculture increased forage production, this increase was not reflected in the net return due to the

☐ a. increased harvesting costs.
☐ b. the high price of seed.
☐ c. high price of N fertilizer and the level of N applied.
☐ d. the low value of the forage that year.

5. Increased plant diversity has been suggested to render biomass production

☐ a. more consistent in natural grasslands.
☐ b. more resistant to extreme wet conditions.
☐ c. more dependent on proper moisture.
☐ d. less dependent on nitrogen requirements.

6. With the Integrated Farm System Model, growth and development of crops are predicted on a daily time step based on

☐ a. soil water and N availability, ambient temperature, and temperature variability.
☐ b. soil water and N availability, ambient temperature, and solar radiation.
☐ c. soil water and N availability, ambient temperature, and daylight length.
☐ d. soil water and N availability, K availability, and organic inputs.

7. The addition of N fertilizer to pure grass stands

☐ a. led to greater net return in wet years than in dry years.
☐ b. produced less forage in normal years than the two-species mixtures.
☐ c. led to lower net return in wet years than in dry years.
☐ d. produced more forage in normal years than the three-species mixtures.

This quiz is worth 1 CEU in Crop Management. A score of 70% or higher will earn CEU credit.

Directions
After carefully reading the article, answer each question by clearly marking an “X” in the box next to the best answer. Complete the self-study quiz registration form and evaluation form on the back of this page. Clip out this page, place in an envelope with a $20 check made out to the American Society of Agronomy (or provide your credit card information on the form), and mail to: ASA c/o CCA Self-Study Quiz, 5585 Guilford Road, Madison, WI 53711. Or you can save $5 by completing the quiz online at www.agronomy.org/certifications/self-study.

Quiz continues next page
8. When N fertilizer prices are high, it’s more cost effective to
   a. lower the application rates or include legumes in pastures.
   b. lower the application rates or add fescues or chicory.
   c. lower the application rates or include several varieties of grass.
   d. lower the application rates or reduce planting rates.

9. Complex forage mixtures are a useful strategy for use on dairy farms to reduce forage production variability in dry years and
   a. thereby increase and stabilize annual net returns.
   b. thereby produce more milk with less grain.
   c. ensure that the farm has enough forage.
   d. stabilize forage production in wet years.

10. In this study, the differences in pasture production in dry years were such that production systems with orchardgrass monocultures or orchardgrass–alfalfa
   a. required the purchase of forage compared with the mixtures, which produced excess forage that could be sold.
   b. produced enough forage in four out of five years, with the mixtures producing enough in all five years.
   c. produced excess forage that could be sold compared with the mixtures, which required the purchase of forage.
   d. produced enough forage in all five years, with the mixtures producing less in three of five years.

Self-Study Quiz Registration Form

Name: ________________________________  Address: ________________________________  City: ________________________________
State/province: __________________ Zip: __________________  CCA certification no.: __________________
$20 check payable to the American Society of Agronomy enclosed.  Please charge my credit card (see below)
Credit card no.: ______________________  Name on card: ________________________________
Type of card:  □ Mastercard  □ Visa  □ Discover  □ Am. Express  Expiration date: __________________
Signature as it appears on the Code of Ethics: ________________________________
I certify that I alone completed this CEU quiz and recognize that an ethics violation may revoke my CCA status.

This quiz issued January 2011 expires January 2014

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: ______________________________________________________________
Effect of deficit irrigation and fertilization on cucumber

Earn 1 CEU in Crop Management by reading this article and completing the quiz at the end. CCAs may earn 20 CEUs per two-year cycle as board-approved self-study articles. Fill out the attached questionnaire and mail it with a $20 check (or provide credit card information) to the American Society of Agronomy. Or, you can save $5 by completing the quiz online at www.agronomy.org/certifications/self-study.

Cucumber is a popular vegetable cultivated in many parts of the world. U.S. per capita consumption of fresh cucumbers rose about 15% (1 lb per capita) from 1995 to 2005. Consumption of cucumbers was steady from 2005 to 2009, with fresh cucumber use forecast at 6.6 lb per capita in 2009. There are several types of cucumbers grown throughout the world. India exports significant quantities, especially the very small fruit called gherkins that are usually used for pickling. Cucumbers, as well as the other cucurbits such as watermelon, cantaloupe and honeydew melons, squash and pumpkins, are indigenous in Asia and Africa, partly because of the warm climate. Cucumbers are thought to have originated in India, where wild relatives of the crop are found. These wild varieties often have bitter fruit and are not eaten. Currently, China, followed by Turkey and Iran, are the major producers of cucumbers for pickling.

Cucurbits require more water than grain crops. Researchers have found that fresh fruit yields of cucumber were highly affected by the total volume of irrigation water at all growth stages. The least productive irrigation regimes were those that had water deficiencies during fruiting stages. Studies have reported similar findings for other crops such as melons and onions. Variation in soil moisture in the root zone from beginning to end of the growing season will be small under trickle irrigation due to the small volume of wetted soil. Consequently, irrigation water applied plus rainfall that achieves the corresponding yield can be mostly considered as plant evapotranspiration until deep drainage occurs as in surplus irrigation application. Optimum application water estimated to equal standard evapotranspiration achieves the maximum yield.

In dry regions where irrigation is needed for crop production, growers are seeking ways to save water by increasing irrigation efficiency. Optimizing irrigation scheduling by basing the pattern on water use and response to water deficit may improve efficiency. Trickle irrigation applies less water than sprinkler and surface systems since only a portion of the soil surface area is irrigated. Nutrients are essential to plant growth, and maximum plant growth is achieved when the nutrient availability coincides with water availability. Mineral fertilizers are readily available after application, and application can be timed to meet crop needs throughout the growing season. Nutrient release from organic fertilizers is temperature dependent and relatively slow during the season. Consequently, the nutrient release from organic fertilizers may not coincide with crop needs. If the nutrient released is mobile, like nitrate, and is not used by the crop, it can be leached from the root zone and pose a potential environmental hazard, and if organic fertilizers include a manure component, unsafe vegetable products can result when the vegetable has physical contact with manure.

A study published in the November–December 2009 issue of Agronomy Journal (101:1556–1564) evaluated the effect of nutrient source and irrigation management on the growth and yield of cucumbers grown in the arid area of
Egypt. A field experiment was conducted using cucumbers grown in northern Egypt at Shibin El-Kom in 2006 and 2007 to evaluate water use and fertilizer rate and type. Three irrigation deficits and seven fertilization types were arranged in a randomized split-plot design with irrigation rates as main plots and fertilizer treatments within irrigation rates (Fig. 1). Irrigation treatments were a ratio of crop evapotranspiration (ET) as: 1.0 ET, 0.84 ET, and 0.64 ET. Fertilization treatments were T1 (143 lb/ac N), T2 (71 lb/ac N with 7.6 tons/ac farmyard manure), T3 (143 lb/ac N with 7.6 tons/ac farmyard manure), T4 (71 lb/ac N with 3.1 ton/ac rabbit manure), T5 (143 lb/ac N with 3.1 ton/ac rabbit manure), T6 (71 lb/ac N with 3.1 ton/ac chicken manure), and T7 (143 lb/ac N with 3.1 ton/ac chicken manure). Chemical analysis of the manure sources are given in Table 1. The commercial fertilizer source was ammonia nitrate, and total amounts of N, P, and K applied are shown in Table 2. A 1.2 ET treatment was only conducted under mineral treatment (T1) in the experiment to determine cucumber yield under surplus irrigation. This treat-

Table 1. Chemical properties of the manures used in the study.

<table>
<thead>
<tr>
<th>Manure fertilizer</th>
<th>Total organic matter</th>
<th>pH</th>
<th>EC</th>
<th>N</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>mmho/cm</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmyard</td>
<td>39.2</td>
<td>6.20</td>
<td>3.40</td>
<td>0.50</td>
<td>0.51</td>
<td>0.60</td>
</tr>
<tr>
<td>Rabbit</td>
<td>41.4</td>
<td>6.18</td>
<td>3.30</td>
<td>1.70</td>
<td>1.18</td>
<td>1.05</td>
</tr>
<tr>
<td>Chicken</td>
<td>44.4</td>
<td>6.15</td>
<td>3.28</td>
<td>2.20</td>
<td>1.20</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Table 2. Total N, P, and K rates for each fertilizer treatment.

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb/ac</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>143</td>
<td>147</td>
<td>219</td>
<td>178</td>
<td>249</td>
<td>209</td>
<td>280</td>
</tr>
<tr>
<td>P</td>
<td>43</td>
<td>121</td>
<td>121</td>
<td>117</td>
<td>117</td>
<td>118</td>
<td>118</td>
</tr>
<tr>
<td>K</td>
<td>89</td>
<td>180</td>
<td>180</td>
<td>155</td>
<td>155</td>
<td>134</td>
<td>134</td>
</tr>
</tbody>
</table>

Fig. 1. Layout of the cucumber experiment in 2006 and 2007. Note: 1 m = 3.3 ft.
ment was replicated three times. The amount of nutrients added to the experimental field was the recommended rate for cucumber production in this area.

Crop response between yield and water use under deficit irrigation was determined by a linear response model. The model showed a sloped straight line in the deficit water application and a horizontal line for the crop response for surplus applications indicating no yield reduction by overirrigation.

In practical terms, irrigation systems apply water with a degree of nonuniformity. If irrigation amount applied \( (d) \) is considered between minimum and maximum depths of water distribution \( (Z_{\text{min}} \leq d \leq Z_{\text{max}}) \), then the area wetted by the irrigation system will be divided into surplus and deficit areas and the situation will be considered underirrigated. When \( d \geq Z_{\text{max}} \), the whole area will be deficit irrigated. For \( d \leq Z_{\text{min}} \), the whole area will be surplus irrigated.

Irrigation and fertilizer both affect particular conditions in cucumber and other vegetables and fruits. Yield, chlorophyll, flower type, leaf volume, and quality of fruit are some of the characteristics noted in this and other studies.

**Chlorophyll production**

There were highly significant differences in chlorophyll \( a \) and \( b \) values within either irrigation or fertilizer treatments but no significant interaction between ET and fertilizer treatments. The highest chlorophyll values were achieved when adequate water was applied (1.0 ET) within a fertilizer treatment. Chlorophyll \( a \) and \( b \) significantly increased when \( N \) amounts increased. The highest chlorophyll values were obtained when chicken manure was used in combination with the recommended \( N \) and half-\( N \) doses (T7 and T6). These treatments were followed by rabbit manure (T5 and T4) in combination with mineral \( N \). These results were explained by the content of organic \( N \) in chicken and rabbit manures, which was available later in the growing season. The efficacy of \( N \) in increasing chlorophyll content was reported by researchers in squash and on lettuce. In the treatments with a half rate of \( N \) in combination with the chicken or rabbit manure, there was a significant difference in chlorophyll \( a \). A significant difference was found in chlorophyll \( a \) in plants fertilized with rabbit manure, farmyard manure, and mineral treatments. Chlorophyll \( b \) differences were significant among all treatments. Higher chlorophyll \( a \) and \( b \) produced higher fruit yields and are thought to also increase sugar content in certain crops.

**Leaf area index**

Leaf area index (LAI) differences were significant between the two growing seasons even though there was less solar radiation in 2007 compared with 2006. Measured at full growth, LAI showed significant differences among irrigation treatments at the 5% level for the same fertilizer treatment. Leaf area index also showed significant differences among fertilizer treatments but not between T1 and T2. The results showed no interactions among year, fertilizer, and irrigation treatments. Leaf area index was significantly different among all irrigation treatments within a fertilizer treatment. The highest LAIs were obtained when water was adequately applied (1.0 ET treatment). High numbers for LAI appear to produce the best yields, and early signs of good leaf growth can predict yield.

| Table 3. Means for cucumber yield, sex ratio, and leaf area index (LAI). |
| ------------------ | ------ | ------ | ------ |
| Item              | Yield  | Sex ratio | LAI    |
|                   | tons/acre |         |        |
| **Year**          |        |         |        |
| 2006              | 13.7B* | 3.5B    | 8.6B   |
| 2007              | 13.7A  | 4.6A    | 8.9A   |
| **Irrigation**    |        |         |        |
| 0.64 ET           | 11.6C  | 3.2C    | 8.0C   |
| 0.84 ET           | 13.7B  | 4.7A    | 8.8B   |
| 1.0 ET            | 15.9A  | 4.2B    | 9.4A   |
| **Fertilizer†**   |        |         |        |
| T1                | 11.7F  | 3.6G    | 8.2E   |
| T2                | 11.4G  | 3.6F    | 8.0F   |
| T3                | 12.3E  | 3.9E    | 8.3E   |
| T4                | 14.0D  | 4.3B    | 8.7D   |
| T5                | 14.2C  | 4.6A    | 9.1C   |
| T6                | 16.1B  | 4.1D    | 9.2B   |
| T7                | 16.2A  | 4.2C    | 9.6A   |

* Treatment means with the different letter are significant at the \( p \leq 0.05 \) level.
† Fertilization treatments imposed for this study were: T1 (143 lb/ac \( N \)), T2 (71 lb/ac \( N \) with 7.6 tons/ac farmyard manure), T3 (143 lb/ac \( N \) with 7.6 tons/ac farmyard manure), T4 (71 lb/ac \( N \) with 3.1 ton/ac rabbit manure), T5 (143 lb/ac \( N \) with 3.1 ton/ac rabbit manure), T6 (71 lb/ac \( N \) with 3.1 ton/ac chicken manure), and T7 (143 lb/ac \( N \) with 3.1 ton/ac chicken manure).
Sex ratios

Significant differences in sex ratios (male/female flowers) occurred with increasing irrigation water deficit (Table 3, previous page). The F value in Table 3 showed significant differences among treatments in irrigation, fertilizer, or year with no interaction among them. The highest values of sex ratio were achieved when 64% of adequate water was applied (0.64 ET) within a fertilizer treatment. Water deficit increases sex ratio as it increases carbohydrate accumulation according to studies showing that lower carbohydrates and higher N contents in cantaloupe plants resulted in the induction of female flowers. The relation between carbohydrates and sex ratio was previously observed in squash. Cucumber sex ratio significantly decreased when N application increased within an irrigation treatment. The lowest values were obtained for a recommended rate of N supplemented with chicken manure (T7) followed by a half N rate plus chicken manure (T6), followed by rabbit manure in combination with N rates within irrigation treatments (Table 3). Decreasing sex ratio meant an increase in female flowers, and this appeared logical as N was frequently reported to positively affect female flowers in cucumbers. An increased number of female flowers increases the number of fruit borne on plants.

Crop response

Cucumber yield was affected by fertilizer form within an irrigation regime in both growing seasons. A non-significant difference was found between cucumber yield obtained by both 1.0 and 1.2 ET treatments with mineral treatment (T1). Cucumber yield significantly decreased in linear relationship with increasing water deficit within fertilizer treatment. However, it was not significantly changed by water applied above 1.0 ET. The highest yields were achieved with the 1.0 ET treatment. Similar results were obtained by others on cucumber and cantaloupe. There was a significant effect of manure source on cucumber yield with yields highly increased with rabbit or chicken manures (T4, T5, T6, and T7) compared with the T1 treatment within irrigation treatment. Yield was insignificant among T1, T2, and T3 treatments (mineral and farmyard manure fertilizer treatments). The highest yields were achieved using chicken manure compared with the other fertilizer treatments. The minimum value of yield was achieved using a half rate of N with farmyard manure (T2), which had less N and slower N release from organic manure than other treatments. Chicken manure has been reported to increase bulb yield of onion. Previous studies have found that rabbit and chicken manures positively affect female flowers and consequently fruit yield of cucumber, and a similar result was observed in this study. Cucumber yield was significantly higher in the 2007 season since vegetative growth was significantly lower in the 2006 season. The T6 and T7 fertilizer treatments showed an increase in yield across all irrigation treatments in both years (Table 3).

Results showed that year, irrigation, and fertilizer effects on cucumber yield were significant and interaction actually existed among them. Crop response to water changed according to the amount of water applied; however, the yield response to N showed inconsistencies due to varying N sources.

Optimal irrigation scheduling

Relative cucumber yield was related to the irrigation schedule parameter for different uniformity coefficient of variation (CV) values. The irrigation schedule parameter specifies the deviation of any schedule irrigation depth to the average of the water distribution depth in terms of CV. Based on a study in Egypt when irrigation system CVs were less than 30%, complete overirrigation was desired because water cost was insignificant compared with return yield. Consequently, optimal scheduling was derived from the maximization of yield.

Maximum yield was achieved for all CV values as the water applied was adequate. However, relative yield was reduced when water applied was insufficient. It was evident that the yield was significantly affected by both the irrigation schedule parameter and CV in underirrigation and complete deficit situations.

Conclusions

Cucumber grown in optimal weather and soil conditions requires both water and nutrient availability. Irrigation systems are essential to apply water in arid regions; however, optimal use of water to meet crop requirements is essential to achieve maximum water use efficiency. Organic fertilizers offer the potential to recover nutrients from animal operations but are not used as frequently with the availability of commercial fertilizers. Growers are becoming interested in using animal manures as substitutes for commercial fertilizers, and there is little information about the combinations of commercial fertilizer and manures under different irrigation management regimes.

The study reported in this article focused on cucumber growth and yield as affected by both water and N management. Maximum cucumber yield was obtained with adequate water applied within fertilizer treatment and with increasing amounts of N applied. Leaf chlorophyll a and b and LAI were greatest when irrigation amounts were maintained as 1.0 ET and when high rates of N (280 lb/ac) were applied with a combination of commercial fertilizers and manures. The ratio of male/female flowers, which is the primary factor reducing cucumber
yield, increased with decreasing amounts of N and water. Cucumber yield was not increased by surplus irrigation treatment. Results showed that year, irrigation, and fertilizer could individually or together significantly improve the cucumber yield. Management of cucumber for maximum yield requires optimizing irrigation water supply in combination with N management, all other parameters being equal.


January–February 2011 self-study quiz
Effect of deficit irrigation and fertilization on cucumber (no. SS 04116)

1. Nutrients are essential to plant growth, and maximum plant growth is achieved when the nutrient availability
   - a. coincides with water availability.
   - b. is greater than water availability.
   - c. occurs prior to water availability.
   - d. is constant, so that water is not wasted.

2. Nutrient release from organic fertilizers is temperature dependent and relatively slow during the season. Consequently, the nutrient release may
   - a. not coincide with crop needs.
   - b. be lost in surface water.
   - c. not be useful for crops at all.
   - d. contain the wrong nutrients for a given crop.

3. If organic fertilizers include a manure component, unsafe vegetable products can result
   - a. if too much manure is used.
   - b. if the manure gets into the water supply for irrigation.
   - c. if workers become contaminated.
   - d. when the vegetable has physical contact with manure.

4. The least productive irrigation regimes were those that had water deficiencies during
   - a. fruiting stages.
   - b. planting.
   - c. early growth.
   - d. flowering stages.

5. If irrigation amount applied (d) is considered between minimum and maximum depths of water distribution ($Z_{\min} \leq d \leq Z_{\max}$), then the area wetted by irrigation system will be divided into surplus and deficit areas, and the situation will be considered
   - a. deficit irrigated.
   - b. underirrigated.
   - c. overirrigated.
   - d. well balanced.

6. Higher chlorophyll a and b produced
   - a. more biomass.
   - b. larger fruit.
   - c. higher fruit yields.
   - d. greener fruit.

7. Leaf area index, measured at full growth, showed significant differences among irrigation treatments
   - a. at the 5% level for the same fertilizer treatment.
   - b. at the 10% level for different fertilizer treatments.
   - c. when radiation was higher.
   - d. when fertilizer was adjusted.

Quiz continues next page
8. Which of the following is true regarding the cucumber sex ratio in this study?
- a. Decreasing sex ratio means an increase in female flowers.
- b. Decreasing sex ratio means more male flowers.
- c. Decreasing sex ratio means higher pollination rates.
- d. Increasing sex ratio reduces yield.

9. The ratio of male/female flowers, which is the primary factor reducing cucumber yield, increased with
- a. increasing amounts of N and decreasing amounts of water.
- b. increasing amounts of N and water.
- c. decreasing amounts of N and increasing amounts of water.
- d. decreasing amounts of N and water.

10. Leaf chlorophyll a and b and LAI were greatest when irrigation amounts were maintained as 1.0 ET and when high rates of N (280 lb/ac) were applied with a combination of
- a. commercial fertilizers and manures.
- b. commercial fertilizers only.
- c. poultry manures only.
- d. fishmeal only.

---

Self-Study Quiz Registration Form

Name: ____________________________
Address: ____________________________  City: ____________________________
State/province: ____________________________  Zip: ____________________________
CCA certification no.: ____________________________

☐ $20 check payable to the American Society of Agronomy enclosed.
☐ Please charge my credit card (see below)

Credit card no.: ____________________________  Name on card: ____________________________
Type of card:  ☐ Mastercard  ☐ Visa  ☐ Discover  ☐ Am. Express
Expiration date: ____________________________

Signature as it appears on the Code of Ethics: ____________________________

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

This quiz issued January 2011 expires January 2014

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: __________________________________________________________
Recognize the achievements and leadership of your colleagues by nominating them for awards through the American Society of Agronomy (ASA) and Soil Science Society of America (SSSA). These awards are targeted to practicing professionals who provide outstanding service, products, and programs in their organizations and communities. Recipients are recognized in Crops & Soils and CSA News magazines and at the ASA and SSSA Annual Meetings and other venues. Consider nominating a worthy colleague today!

Agronomic Industry Award

The intent of this award is to recognize outstanding performance by a private-sector agronomist in the development, acceptance, and implementation of advanced agronomic programs, practices, and/or products. Personal relations, professionalism, integrity, and credibility are highly valued. The award consists of a certificate and $1,000 honorarium.

Agronomic Service Award

The award recognizes development of agronomic service programs, practices, and products for acceptance by the public. The focus is on agronomic service with associated educational, public relations, and administrative contributions of industrial agronomists, governmental or university administrators, and others. The award consists of a certificate and $1,000 honorarium.

CCA of the Year Award

This award recognizes a CCA who delivers exceptional customer service, is highly innovative a leader in his/her field, and has contributed substantially to the exchange of ideas and the transfer of agronomic knowledge within the agricultural industry. The award consists of hotel and travel expenses for two to the ASA Annual Meeting, $500 in cash, a commemorative plaque, and a one-year membership in ASA.

Irrometer Professional Leadership Award

The award recognizes an outstanding individual in the soil science profession who has demonstrated adherence to the certification goals and personal growth and has had an impact on associates and the public at large. Service involving consulting, cooperation with industry, community development, and/or public extension and research programs is strongly solicited. The award consists of a certificate and $500 honorarium plus up to $400 in travel expenses to attend the SSSA Annual Meeting.

Francis Pierce, 2010 President of the American Society of Agronomy (ASA), presents Alan Blaylock, CPSS and Manager of Agronomy for Agrium Advanced Technologies, with the Agronomic Industry Award in November 2010 during the ASA Annual Meeting in Long Beach, CA.

Industry and Professional Leadership Award

The award recognizes outstanding contributions to soil, environment, natural resource, agricultural, and related sciences by a practicing professional in the private sector. It also is given for outstanding service in promoting programs, practices, technology, or products that enhance soil science. The award consists of a certificate and $1,000 honorarium.

For more information on submission and eligibility requirements, go to www.agronomy.org/awards or www.soils.org/awards. Nominations open in January and are due Mar. 29, 2011. Questions can be directed to Leann Malison (608-268-4949 or lmalison@sciencesocieties.org).
Parasitic nematodes: a hidden culprit in cornfields

Corn yields not up to what your client expected? Nematodes could be to blame. Many nematologists across the United States believe that there has been increased pressure caused by plant-parasitic nematodes in corn. In this article, Dr. Tamra Jackson, Extension Corn Specialist at the University of Nebraska–Lincoln, discusses the problem of corn nematodes and what can be done to prevent them from occurring in your fields.

By Laura Lipps
Crops & Soils magazine contributing writer

Plant-parasitic soil nematodes are frequently overlooked culprits of yield loss or decreased crop health in cornfields, where growers often focus instead on more obvious ways to optimize production. But increasing awareness of the yield-robbing parasitic nematodes is now coinciding with a potential increase in nematode pressure on the U.S. landscape.

“Many of us nematologists across the country believe that we’re seeing, or will be seeing, increased pressure caused by plant-parasitic nematodes in corn,” says Dr. Tamra Jackson, Extension Corn Specialist at the University of Nebraska–Lincoln. There are a vast variety of nematode types in the soil, she explains, including many beneficial one. But dozens of species of plant-parasitic nematodes feed on corn and cause harm to the plant and to farmers’ profits.

The increase in corn nematode pressure may be due partly to changes in crop production practices over the last several decades. “Although we’re growing bigger and better corn than ever, unfortunately some of the things we’ve changed may actually be favoring nematodes,” Jackson explains.

One change has been a shift in the insecticide chemistries most commonly used. “For a lot of years, producers were using soil insecticides that were carbamates and organophosphates,” Jackson notes. “Those products had secondary nematocidal activity. So whether growers realized it or not, they might have been controlling their nematode problems by using those products. In more recent years, we’ve switched more to pyrethroid insecticides. And although those products do a really great job controlling insects, they’re actually not effective against nematodes.”

Recent trends away from rotation towards more corn-on-corn may also be contributing to increased nematode pressure. “Corn is a favored host for most of these nematodes, so just by simply going back to corn-on-corn, we are favoring nematode reproduction,” Jackson says.

A third factor that might be affecting nematodes is the trend towards reduced-tillage systems. “We don’t have much data on that,” Jackson says. “But we know at least one or two types of nematodes are sensitive to soil disturbance. So by not tilling, we might be favoring some of those.”

How big of a problem are corn nematodes?
Corn nematodes may be a more common problem than previously
realized. Jackson cites the results of a recent survey of nematodes that she and colleagues undertook in 16 different Midwestern states. “One of the things that really surprised us was that we found root-lesion nematodes in almost every field,” she says. “It wasn’t a big problem in every field, but they were at least present. In Nebraska, over 93% of the fields we sampled—over 450 fields—had root-lesion nematodes.” This species has also been found in high abundance in other Midwestern states.

Root-lesion nematodes are a relatively small variety of nematodes that live inside corn roots as an endoparasite. They are not as well known as some of the larger types. “We also learned through the survey that the root-lesion nematode didn’t seem to have a preference for soil textures,” Jackson adds. These nematodes were found not only in sandy soils, but also in clay and loam soils. Jackson explains that because these nematodes are small, they are able to move easily through the smaller pore spaces of clay and loam soils as well as sandy soils. The lesson here is that farmers should not rule out the possibility of nematode infestation just because their field is not on a sandy soil.

The case of root-lesion nematodes contrasts to two more familiar plant-parasitic nematodes, sting and needle nematodes, that also are known to infect corn in Nebraska and other Midwestern states. According to Jackson, they are larger in size, so they require the looser sandy soils to move around in. They cause severe damage in localized areas, often causing dead spots (or almost dead spots) in fields. If you see these diagnostic dead patches, which happen in severe cases of infestation, sampling for nematodes each season is a good idea. But where you sample is important, according to Jackson. “You don’t want to sample in the center of that spot because the nematodes need living root tissue, and there’s none left in the middle. They will have moved out. You’ll get your best numbers on the edges of a severely affected patch.”

But dramatic dead or dying patches are rare. It is much more common to have subtle symptoms of nematode damage, such as yields that are lower than expected. Because nematode feeding on roots often reduces plant health without killing the plant, growers might see signs of injury and stunting, general unthriftiness, short plants, or yellowing leaves. Below-ground, root clubbing may occur with certain nematode species.

But the challenge to recognizing symptoms of nematode damage is the diversity of plant-parasitic nematode types out there. “There are at least a dozen different genera, not even species, of nematodes that can feed on corn. And they all feed differently, so they have different symptoms associated with them,” Jackson says. When multiple parasitic nematode species are present, as is common, diagnosis becomes even more complex.

Another challenge to identifying nematode damage is that the symptoms can also mimic other types of problems in the field, such as nutrient deficiencies. “The symptoms that nematodes cause look like a lot of other problems that producers and crop consultants see every day,” she says. Soil compaction, insect injury, and even some herbicides will cause root-clubbing symptoms that may look similar to some types of nematode injury. Nutrient deficiencies may cause symptoms similar to the aboveground signs of nematodes.

Sting nematode damage to a cornfield (right) and corn roots (above). Photo courtesy of Clemson University-USDA Cooperative Extension Slide Series, Bugwood.org.
Jackson says the big question she gets is when people should sample: “Everybody knows that you’ll have more nematodes at the end of the season than at the beginning, and I agree with that. However, at least in Nebraska, I recommend that people sample early in the season, approximately four to six weeks after planting, so that the plants are still small and the roots are still in the upper eight inches or so of the soil. That’s because that’s where the nematodes have to be too, if they’re feeding.”

Some of the larger nematodes, like sting and needle, will move deeper in the soil later in the season. “They might be missed if you’re sampling only later in the season… That four- to six-week window after planting gets the best likelihood of catching at least some representative of all the genera.”

Focus your sampling on a representative area of the field in question and follow the lab’s recommended sampling protocol. After sampling, take care to minimize your handling of the samples, and keep them away from heat, since some nematode species are sensitive to disturbance. It is usually best to ship samples as soon as possible to the lab.

Nematode prevention

If a grower discovers nematode problems, there’s not much that can be done during that growing season. But changes to management practices can help control their impact in future years. “One of the things that people don’t often think about is crop rotation,” Jackson says. “Not all nematodes can be controlled with crop rotation, but rotation certainly does a better job of it than monoculturing. So if people are able, I recommend crop rotation.”

However, the success of a rotational strategy depends largely on the species of nematodes present in a field. Take the difference between needle and sting nematodes, for example. “They have very different host ranges,” Jackson explains. “The host range for needle nematode is very narrow. It likes grassy species like corn and probably even some weeds.

“Crop rotation can actually control needle nematode. For example, it likes corn, but it does not prefer soybeans. So a rotation will help control that nematode.” However, Jackson cautions that even with needle nematodes, you only have “some mortality” with rotation. “It doesn’t completely get rid of all of them.”

In contrast, though, the sting nematode has a very wide host range that includes “practically every major crop we grow in the Midwest, except alfalfa,” Jackson says. Though it favors corn, “the nematode can still survive quite well on soybean and some of the other crops. So crop rotation is not going to be the most effective strategy.”

Another strategy is weed management. Weeds are hosts for many nematodes and may be reservoirs for the next season’s nematode population as well. For example, because needle nematodes like grassy weeds, Jackson says control of grassy species might help control their spread.

A third management strategy is to optimize plant health. “Some studies suggest that maintaining good health of the crop early in the season, when the nematodes are most active, is important,” Jackson says. “Make sure your nutrient, especially nitrogen, levels are adequate, so that the plant can overcome the stress. You’re not controlling the nematode, but you may be able to help the plant overcome some of the damage that they do.”

Finally, chemical control may help. There are only a few nematicides labeled for corn, including carbofuran (Furadan), ethoprop (Mocap), and terbufos (Counter), and efficacies vary. Nematicides may not be economically feasible except in severe cases.

Several new seed treatments are coming down the pike and generating interest. Syngenta’s new seed treatment nematicide, Avicta, was labeled for corn in 2009. Another brand new seed treatment from Bayer CropScience, VOTiVO, will be available this year. It is a biological product: a bacterium that protects young roots from nematode feeding.

If you suspect nematode problems, Jackson says strip trials with either of these products might help. “Crop consultants and farmers are some of the best scientists, and to get the best answers in their own environment, strip trials are a terrific idea. If you can get some treated seed with Avicta and some without Avicta, of the same hybrid and seed lot, you can run treated and non-treated strips across your own fields to see if you get the effect that you’d like…. If you can put VOTiVO trials side by side with your Avicta trials, that would be even better.

“If you have a bad problem, it might be to your benefit to use a combination of management practices to get the best effect, whether it’s crop rotation plus the use of a nematicide or weed management for alternate hosts or managing the health of the plant.” Getting good nematode samples will help diagnose which species are present and their abundance as well as suggest management strategies.
Scholars + Mentors = Golden Opportunity

“One’s mind, once stretched by a new idea never regains its original dimension.” — Oliver Wendall Holmes

Extraordinary Opportunity

The Golden Opportunity Scholars Institute, a program of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, matches undergraduates with scientist-mentors during the ASA-CSSA-SSSA International Annual Meetings. The program encourages talented students to enter the agronomy, crop, and soil sciences, cultivate networks, and succeed in their careers.

Extraordinary Support

You can help support young scientists with a monetary gift to the Golden Opportunity Scholars Institute. In 2010, the program will become global with our first International scholar/mentor tandem being invited to Long Beach, CA.

To contribute, please contact:
Alexander Barton
608-273-8095
abarton@sciencesocieties.org

www.goldenopportunityscholars.org
### Stevens Hydra Probe Soil Sensor

**Your solution for quality soil data**

#### All-in-One Multi-Parameter Sensor
- Soil Moisture (WFV %)
- Soil Temperature
- Soil Electrical Conductivity
- Real Dielectric Permittivity
- Imaginary Dielectric Permittivity
- Raw Voltage Outputs
- and many more!

#### Features of the Stevens Hydra Probe
- Excellent precision and accuracy
- Over 10 years of field use
- Temperature corrected measurements
- Smart Sensor technology
- No calibration required for most soils
- SDI-12 or RS-485 signal output
- Measure temperature down to -10° F
- (-30° F probe option also available)

The most robust and consistent soil sensor ... **Guaranteed 5 year performance warranty**

Over 100 universities, government agencies (USDA, USGS, NOAA, DOD, NASA), farms, vineyards and other companies rely on the Hydra Probe for quality data collection and analysis!

---

### Other Soil Measurement Solutions from Stevens Water

**The POGO Portable Soil Sensor:**

*Just poke and go!*

The POGO enables manual soil readings to be taken quickly and easily. Simple insert the probe into the soil and select “Sample” on the PDA's screen. Soil measurements are instantly displayed on the screen and logged to the PDA for further analysis.

**Stevens Agricultural Monitoring (SAM)**

Improve crop quality and yield using Stevens Agricultural Monitoring (SAM) System. Combining a weather system with Hydra Probes monitoring multiple soil variables, the SAM System delivers complete and quality data in a cost-effective package that enhances the user's knowledge to make informed crop management decisions.

---

**Data Loggers**

Tel: 800.452.5272
503.445.8000
Web: www.stevenswater.com

**Monitoring the Earth’s Water Resources Since 1911**

[Stevens Water Monitoring Systems, Inc.]