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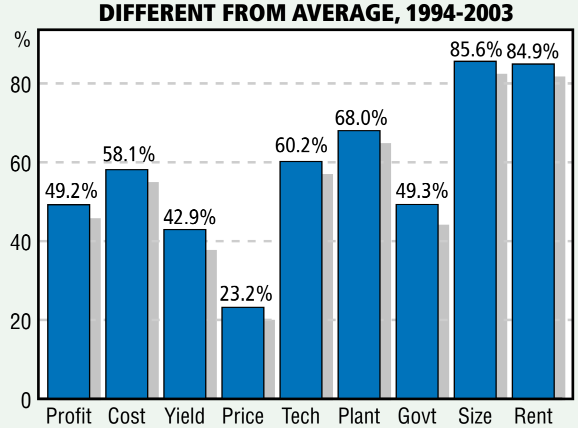
What Makes a Producer More Profitable?

A Kansas State University study produced evidence that farm operators who wish to improve profitability might do well to focus less on price and more on costs, planting intensity, technology and yields.

Using data collected from 1994 to 2003 by the Department of Agricultural Economics at Kansas State University, **Terry Kastens** and **Kevin Dhuyvetter** compared records of over 800 farms. They examined yield, input costs, technology, planting intensity, rent, government payments, farm size and risk. Their goal was to quantify "relative to their neighbors" the effect each management measure had on profitability and to establish a statistical model.

The first step was to determine how persistent each factor was for each farm. This was done by averaging each of the management measures' annual values for a farm and testing whether this measure was statistically different from the average farm. In the statistical model the average farm was normalized to equal 0 for all management traits.

PERSISTENCE OF MANAGEMENT TRAITS: PERCENT OF FARMS STATISTICALLY DIFFERENT FROM AVERAGE, 1994-2003



With 85 percent of the farms statistically different from 0 (the average), the relative percent of acres rented (Rent) is shown to be highly persistent among farmers. This was not unexpected as it simply means that producers tend to rent a consistently high or low percent of their crop acres.

The most persistent management measure is size. This, like Rent and government payments (Govt), is not highly manageable, at least not in the short run. Therefore, of the manageable traits, the most persistent measure, with 68% of the farms showing statistically different from 0, is planting intensity (Plant). Producers tend to have consistently low or high planting intensity year after year. Planting intensity was defined as the total harvested acres divided by the total tillable acres. Defined this way, Plant will be less than 1.0 with summer fallow and greater than 1.0 for double crop.

The second step was to determine the standard deviation of the management measures from 0 (average). **Table 1** reports the average value (0.00) and the value of one standard deviation for each measure. Being one standard deviation better (worse) than the average is roughly comparable to being in the best (worst) third of producers.

TABLE 1. VARIABILITY OF MANAGEMENT MEASURES

Measure	Average	Standard Deviation
Profit	0.00	77.3
Cost	0.00	26.7
Yield	0.00	15.0
Price	0.00	8.3
Less-till	0.00	50.6
Planting Intensity	0.00	22.5
% Crop Acres Rented	0.00	44.8
Government Payments	0.00	65.1
Size	0.00	77.5
Risk	0.00	65.9

The greater the standard deviation, the more that farms are different from each other due to management. For example, the typical farm in the low third of costs has costs that average 26.7 % below its neighbors. The standard deviation for crop yields is 15%, thus top managers (those in the top third) have 15% higher yields than the average farm.

Third, Kastens and Dhuyvetter wished to establish how much changing management might impact profitability ($ per acre relative to neighbors). They found that a 1% increase in yields resulted in farm profits rising by $0.23 per acre. Price was the only factor whose impact on profitability was not significantly different from 0. A producer who is in the best third for costs (i.e., a low-cost operator) would be expected to have per-acre profits $25.78 (26.7 x $0.96) better than the average producer. A producer in the top third of yields would only be expected to have $3.44 (15.0 x $0.23) higher profits than the average. Dhuyvetter and Kastens point out that machinery

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Revising Exam Performance Objectives

By Dr. Beth Guertal, Chair—ICCA Exam and Procedures Committee, Auburn University, Agronomy & Soils Dept.

Each year the Exam and Procedures Committee revises one section of the CCA Performance Objectives (POs). This year the Nutrient Management POs were revised. The other three competency areas, (1) Soil and Water Management, (2) Pest Management and (3) Crop Management, will be reviewed in future years.

Jim Vorst and his staff at Purdue University formed a committee consisting of university professors, practicing CCAs, industry technical people, National Resource Conservation Service (NRCS) staff and other professionals. The committee represents expertise from the U.S. and Canada.

Dr. Beth Guertal

Over a two-day period the POs are dissected, discussed, edited and revised. Topics that you didn't need to know three or four years ago are discussed and may be added. Recent additions have included Comprehensive Nutrient Management Planning, reporting improperly handled effluent discharge, the advantages of GPS/GIS to monitor pest infestation and the definition of genetically modified (GM).

I often hear, "Is this something a practicing CCA needs to know?" This question helps the committee keep its focus on the goal, which is to identify things practicing CCAs should know, regardless of where they live or what crops they work with.

Comments frequently made are "That's too regional" and "My growers don't do that." They underline the importance of inviting committee members from varied geographies and cropping backgrounds. What matters to an Alabama cotton farmer may not matter at all to a North Dakota sugar beet producer.

Once the committee has revised the POs, they are examined and discussed by representative CCAs, who provide further input. The Exam and Procedures Committee meets, discusses the revisions and votes on the proposed POs.

Questions for the new POs are solicited from experts and entered into a database with existing exam questions. Once an exam has been assembled, the Exam and Procedures Committee meets again, and each question and its potential answers are discussed.

This long process and hundreds of volunteer hours are all focused on ensuring a relevant and accurate International CCA Exam. It enables your CCA program to maintain high standards and integrity in the agricultural marketplace.

CCA Program Corner

Florida Celebrates 10th Anniversary

By Mary Hartney, President, Florida Fertilizer & AgriChemical Association

One of the neat ways the Florida CCA Board of Directors is commemorating the 10th anniversary of our first class of CCAs is a new effort with *Florida Grower* to highlight the benefits CCAs provide. The first feature highlighted the expertise of **Donnie Rou,** CCA, a Williston-based senior sales consultant for **Agriliance**, and his weed management work with **Gene Waldron**, a green peanut grower in Citra, FL.

Florida CCA Agent Mary Hartney and Florida Farm Bureau Federation President Carl B. Loop, Jr., congratulate Mark Maffett (center) as he received the 2004 Florida Excellence in Crop Advising Award.

Future quarterly articles will feature the CCA/grower dynamic with a focus on pest control, nutrient management and soil/water management. We're looking for volunteers to be interviewed for these articles — contact **Mary Hartney,** *mhartney@ffaa.org*.

OTHER 10TH ANNIVERSARY EVENTS INCLUDE:

- Honoring the achievements of Florida's 212 CCAs on Oct. 12 at the Indian River Research and Education Center in Ft. Pierce, coordinated by the University of Florida's Institute of Food and Agricultural Sciences.
- Partnering with the Florida Farm Bureau Federation to fund the $500 cash prize for the 2005 Florida Excellence in Crop Advising Award.

Mark Maffett, CCA, with **Growers Fertilizer Corp.** in Lake Alfred, was the 2004 winner of the Florida Excellence in Crop Advising. The Pasco County Farm Bureau Board of Directors singled out many of the qualities that make the CCA designation so prestigious.

"Through freezes, floods, pestilence and drought, Mark has encouraged when needed, researched what he was unsure of and promoted new and better practices," Pasco County Farm Bureau President **Wilton Simpson** said in the nomination. "He has never wavered from his desire to save the producer money by offering the best crop advice possible."

This fall, Florida Farm Bureau and the Florida CCA Program will once again recognize a CCA for outstanding service to Farm Bureau members with a plaque and $500 cash award. Candidates must be CCAs and nominated by farmers, ranchers or County Farm Bureau presidents.

For a nomination form, contact **Mary Hartney** at 863/287-8668, *mhartney@ffaa.org*. The deadline is Sept. 9.

Chairman's Corner — It's Been Fun

By Steve Dlugosz, CCA
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I was asked to share some thoughts as my term as board chair comes to an end. I believe the best part of being CCA chair is that you will soon be past chair! Seriously, it has been a great experience.

I've met a lot of great people from the U.S. and Canada. Even though we are from diverse areas and cropping systems, we seem to have much in common. It appears that farmers are very much the same all over North America, and the challenges of interacting with them are similar.

A highlight both professionally and personally was testifying before a congressional subcommittee on Asian rust. It was exhilarating yet humbling to know I was speaking for nearly 14,000 CCAs across the continent. The CCA Program is becoming widely recognized in Washington, DC, and this opportunity took us up to the next level. We hope to be further involved as a new farm bill is developed for 2007.

I have also enjoyed the time spent with a great group of individuals who serve as our Board of Directors. They represent a variety of agricultural professions, all with a common goal of wanting to contribute to the growth of our profession and the CCA Program. We only meet twice a year (we all have real jobs that actually pay the bills), but we work hard to address the needs and challenges of CCAs and set a course for the future.

I've also enjoyed working with Executive Director Luther Smith and the ASA staff. Luther is a dedicated and hard-working leader who believes in the mission of CCA.

I would encourage you to get involved with the CCA Program at the state, region or provincial level. Many programs are looking for energetic volunteers to serve on local boards, committees, etc. We're always looking for good people to serve on the ICCA Board or committees. Give Luther or me a call.

For those who are called to simply grind it out day after day — work hard, serve well and do what's right — that's what defines a professional crop adviser. All the best!

What Makes a Producer More Profitable? *(continued from page 35)*

costs are the biggest area where producers can differentiate themselves from others.

A more meaningful measure of management impact would be "being in the best third," that is, one standard deviation away from one's neighbors. The results of the right panel in **Table 2** confirm that farm operators who wish to improve profitability by improving management might do well to focus less on price and more on costs, planting intensity, technology adoption (less tillage) and yields. The researchers were especially surprised to see that the percent of crop acres rented had that much impact on profit. However, it is important to note that capital gains on land were not considered in this analysis of farming operation profits. This does not mean that land is a poor investment, only that operators who rely more on rented land than their neighbors tend to be more profitable. It should be remembered that farming more land (Size) or relying more on rented land (Rent) are long-run strategies to improving profitability.

Conclusions: Short-run management strategies should focus on (1) reducing costs, (2) increasing planting intensity (more crops per year per acre of land), (3) adoption of new technologies, (4) increasing crop yields and (5) trying to get higher crop prices. Long-run strategies should focus on increasing farm size, particularly by renting land.

The full report and a feedback link to KSU are at *www.agmanager.info/farmmgt/finance/management.*

TABLE 2. IMPACT ON PROFIT PER ACRE OF MANAGEMENT TRAITS

MARGINAL		ONE STANDARD DEVIATION CHANGE	
This 1% change	Results in this $ change in profit/acre	This 1% change	Results in this $ change in profit/acre
A 1% decrease in costs	$0.96*	A 26.7% decrease in costs	$25.78
A 1% increase in yields	$0.23*	A 15.0% increase in yields	$3.44
A 1% increase in prices	$0.09	An 8.3% increase in prices	$0.77
A 1% increase in the % herbicide is of herbicide plus machinery costs	$0.16*	A 50.6% increase in the % herbicide is of herbicide plus machinery costs	$7.97
A 1% increase in planting intensity	$0.72*	A 22.5% increase in planting intensity	$16.06
A 1% increase in percent of acres rented	$0.44*	A 44.8% increase in percent of acres rented	$19.92
A 1% increase in government payments	$0.07*	A 65.1% increase in government payments	$4.79
A 1% increase in farm size above average	$0.14*	A 77.5% increase in size	$10.72
A 1% increase in farm income variability	$0.56*	A 65.9% increase in farm income variability	$36.70

** denotes significantly different than 0 at the 90% confidence level*

Continuing Education Self-Study Course

Soil and Water Management

Nitrate Leaching to Subsurface Drains as Affected by Drain Spacing and Changes in Crop Production System

By E. J. Kladivko, J. R. Frankenberger, D. B. Jaynes, D. W. Meek, B. J. Jenkinson, and N. R. Fausey

EARN ONE CEU!

All CCAs may earn up to 20 Continuing Education Units (CEUs) per two-year cycle as board-approved self-study articles which will include CCA Advantage articles. The CCA CEU logo (above) marks all pre-approved material, with the CEU value indicated by the number in the middle. To receive one CEU in soil and water management, read this article, fill out the attached exam and mail the tear-out form, along with $10, to the American Society of Agronomy.

Subsurface drainage (often called "tile" drainage) is a common water management practice in agricultural regions with seasonally high water tables. It provides many agronomic and environmental benefits, including greater water infiltration, lower surface runoff and erosion, and improved crop growth and yield compared with similar agricultural soils without subsurface drainage. Subsurface drains have been found to reduce losses of sediment and phosphorus from agricultural fields but to increase losses of nitrate N through the enhanced leaching.

An appropriate balance between increasing drainage intensity (narrower spacing) to improve drainage and decreasing drainage intensity to reduce nitrate N losses needs to be found for different climatic and soil regions. Recent concerns about the hypoxic zone in the Gulf of Mexico and similar problems worldwide have caused a renewed interest in tile drain studies. Because tile drainflow contributes significant amounts of water and nitrate to ditches and streams during some months of the year, drainage studies provide valuable data for estimating nitrate loads in agricultural watersheds.

Nitrate concentrations and mass losses in subsurface tile drains vary with soil organic matter level, yearly weather variations, fertilizer N rates and timing, drain spacing, cover crop growth, cash crop yield and water table control practices. Noncontrollable factors such as precipitation and the mineralization of soil organic matter have a great impact on drainage volumes and nitrate loads. Our 15-year study provides an important data set for assessments of nitrate leaching in the Mississippi River basin. Our site is on a low organic matter, loess-derived silt loam soil in southeastern Indiana, which contrasts with the high organic matter soils of most of the drainage studies in Iowa, Minnesota and Illinois. By comparing results from different soils and climatic zones within the Midwest, scientists and policymakers will hopefully gain greater understanding of the challenges to reducing nitrate loads to subsurface drains.

The objectives of our study were to (1) evaluate the effect of three different drain spacings on water flow and nitrate leaching into subsurface drains over a 15-year period and (2) measure changes in nitrate leaching that would result from first converting from conventional monoculture corn with high N fertilizer rates to the same cropping system with lower N rates, and then to a no-till corn-soybean rotation with lower fertilizer N rates and a winter "trap crop."

MATERIALS AND METHODS

A subsurface drainage research facility was established in 1983 at the Southeastern Purdue Agricultural Center (SEPAC) in southeastern Indiana. The site has drains (10-cm diameter) installed at spacings of 5, 10 and 20 m at an average depth of 75 cm and a slope of 0.4%. Three drain lines (225-m length) were installed at each spacing, with the outside drain lines on each spacing acting as common drains between treatments. Each spacing was replicated in two blocks separated by a 40-m distance.

Corn was planted each year from 1984 through 1993, using conventional tillage. In 1994 a no-till, soybean-corn rotation was begun, with the addition of a winter wheat cover crop after corn as a "trap crop" for N in the soil profile. Fertilizer N rates were gradually reduced during the course of the experiment as fertilizer rate "philosophy" changed within the Purdue extension recommendations. Preplant fertilizer N rates were 285 kg N ha^{-1} for the first 5 years of monoculture corn, 228 kg N ha^{-1} for the last 5 years of monoculture corn, 200 kg N ha^{-1} in 1995 and 177 kg N ha^{-1} in 1997 and 1999, all preplant-applied as anhydrous ammonia. The nitrification inhibitor nitrapyrin was used at a rate of 0.56 kg a.i. ha^{-1} with the anhydrous ammonia applications from 1984 through 1995. A small amount of "starter" fertilizer N was also applied during corn planting.

RESULTS AND DISCUSSION

Hydrology. Annual rainfall ranged from a low of 800 mm for 1987 to a high of 1,370 mm in 1995, with the average nearly equal to the 30-year "normal." Drainflow per unit area decreased as drain spacing became wider, as expected. Drainflow varied from a low of 6.7 cm (8% of annual rainfall) for the 20-m spacing in 1987, the driest year, to a high of 32.5 cm (26% of annual rainfall) for the 5-m spacing in 1985.

Drainflow as a percent of annual rainfall ("drainage efficiency") was calculated for each year and each drain and averaged over the periods of interest. Averaged over the 15-year period, drainage efficiencies were 20.6%, 14.9% and 12.1% for the 5-, 10- and 20-m spacings, respectively. A comparison was then made between the two different cropping systems used in different time periods of the study, namely continuous corn with chisel tillage in 1985-1993 vs. the 1994-1999 soybean–corn rotation with no-till and a winter wheat cover crop after corn. Average annual drainage efficiencies were 20.4%, 13.7% and 11.2% for the 5-, 10- and 20-m spacings, respectively, for the 1985-1993 continuous corn years and 20.8%, 16.5% and 13.2%, respectively, during the 1994-1999 soybean–corn years. The data suggest drainage efficiency did not change over time for the 5-m spacing, but that the 10- and 20-m spacings showed an increased efficiency during the later time period. This increased efficiency for the wider spacings may reflect a maturation of the drainage system over time, with flow paths to the drains developing from greater distances over the years after drain tiles were installed. Because the 5-m spacing showed no evidence for a change in drainage efficiency with time, it suggests that the changes for the 10- and 20-m plots were not due to evapotranspiration differences resulting from the new cropping system. Within the six years of soybean–corn rotation, there were no apparent trends in drainflow or drainage efficiency between the corn years and the soybean years.

Nitrate Nitrogen Concentrations. Nitrate N concentrations in drainflow decreased considerably over the 15-year period. Concentrations were consistently in the 20 to 30 mg L^{-1} range in the 1985 to 1988 period and in the 7 to 10 mg L^{-1} range in the 1996 to 1999 period. Concentrations did not vary with block or drain spacing.

The 71% decrease in nitrate N concentrations from the 1986 to 1988 period to the 1997 to 1999 period is probably a result of a combination of the management practice effects along with yearly weather and crop yield variations. Reduction of fertilizer N rates and the growth of a winter "trap crop" after corn have both been shown to reduce nitrate N concentration in drainage and are probably the major factors in our study. A corn-soybean rotation compared with continuous corn or the soybean phase compared with the corn phase of a corn-soybean rotation have sometimes shown lower nitrate N concentrations and may also be a factor at our site. Conversion from spring chisel tillage to no-till probably had minor influence on nitrate leaching, since most of the annual drainage in the "tilled" years occurred before tillage was performed.

In addition to management practice changes, the weather and resulting crop yields had an impact on year-to-year variations in nitrate N concentrations (and load, as discussed later). During the first 5 years of the drainage study, preplant fertilizer N rates were 285 kg ha^{-1}, the recommended rate at that time for a yield goal of 12.5 Mg ha^{-1}. Several years of poor crop yields probably resulted in high residual soil N and contributed to the increasing trend in concentrations over the 1985 to 1989 period. Preplant fertilizer N rates were reduced from 285 to 228 kg N ha^{-1} in the 5-year period from 1989 to 1993, and concentrations started to show a decrease in 1990, in the first "flow season" after the reduction in fertilizer application. A rise in concentrations in 1992 probably reflects the poor crop yield in 1991, but concentrations decreased again in 1993 following a high crop yield in 1992. The 1994 change to a soybean–corn rotation and lower fertilizer N rates for the corn did not result in an immediate decrease in concentration, but by 1996 the concentrations had declined again. The lower concentrations are probably a result of both the winter wheat "trap crop" after the corn and the lower fertilizer N rates.

The precise fertilizer N rate and crop management system needed for optimal crop growth and environmental quality is region specific and varies from year to year, and this remains a major challenge for agriculturalists worldwide. Results of all these types of studies underscore the necessity for long-term field experiments in different regions and on different soils, to understand the impacts of yearly weather variations, long-term climate, soils and management on nitrate N leaching.

Nitrate Nitrogen Load. Annual nitrate N loads to drainage water decreased significantly over the 15-year period, due to the large decrease in nitrate N concentrations over the same period. Annual nitrate N loads averaged 38 kg N ha^{-1} in the 1986 to 1988 period and 15 kg N ha^{-1} in the 1997 to 1999 period. This 60% reduction in load occurred even though drainflow was 29% greater in the 1997 to 1999 period than in the 1986 to 1988 period. The 71% decrease in concentrations resulted in a large decrease in loads even with a moderate increase in flow.

In addition to the long-term trends in nitrate N loads, year-to-year variations in loads occurred as a result of variation in weather and crop yields. Loads were particularly high in 1989 after the low corn yields in the 1988 drought year. The higher residual nitrate that was probably remaining in the soil profile in autumn 1988, coupled with high drainflow volumes in 1989, led to the highest nitrate N loads of the 15-year study. Other Midwest studies also found greater N losses to drains in years following a drought due to greater residual N in the soil profile.

Nitrate N mass loads per unit area varied similarly to drainflow volumes, with a tendency for greater losses from the narrower spacings. Annual nitrate N losses were 50, 37 and 27 kg ha^{-1} for the 5-, 10- and 20-m spacings, respectively, in the 1986-1988 period and 16, 16 and 13 kg ha^{-1} in the 1997-1999 period. Differences in loads between spacings were significant in some but not all years.

As can be expected, differences in loads were larger in years with overall higher loads, and statistically significant differences were more prevalent in those years. Significant differences occurred almost exclusively in the time period with continuous corn, higher N fertilizer rates and no winter cover crop (1985-1993), whereas both absolute loads and the differences in loads between drains were smaller in the period with the winter cover crop, lower fertilizer N rates and soybean–corn rotation (1994-1999). The total 15-year nitrate N load was 559, 298 and 232 kg ha^{-1} for the 5-, 10- and 20-m east drains, respectively, and 675, 587 and 463 kg ha^{-1} for the 5-, 10- and 20-m west drains. The greater total loads from the narrower spacings compared with the wider spacings are consistent with the annual differences in loads discussed previously.

Seasonal Effects on Drainflow, Loads and Concentrations. Loads to the drains exhibit a clear seasonal cycle related to the timing of drainflow in this system. The majority of drainflow and nitrate N loads occurs in the fallow season of November through March. Rainfall is relatively uniformly distributed throughout the year, but drainflow varies much more over the year, due to higher evapotranspiration in the growing season. Drains typically begin to flow in November or December at this site, after the soil profile has rewetted following the growing season. Drainflow at the site continues through the winter in most years, and flow usually ceases in May or early June. In climates where the soil does not freeze all winter, most of the drainage and nitrogen loss occurs in late fall, winter and early spring. Differences in seasonal distribution of flow must be considered when comparing studies from different regions and when designing and evaluating management strategies for decreasing nitrate loads to drainage water.

Visual observation of the data from individual drains did not reveal a strong seasonal pattern in monthly nitrate N concentrations for the 15-year period. The close correspondence of percent of annual flow and load in each month also indicates a relatively stable concentration throughout the year.

At our site, the tendency for slightly higher nitrate concentrations in May–June–July has minimal impact when considering total nitrate loads for the year. Nearly 80% of the annual drainflow and annual nitrate load occurs in the winter and early spring before fertilization for the next crop. These results underscore the potential importance of cropping systems that would use some of the nitrogen and water during late fall or early spring, such as winter cover crops or perennials that grow later in the fall and earlier in the spring than the typical corn-soybean rotation. Winter cover crops may be able to provide some of the benefits of perennials in the midst of an annual cropping system, if sufficient growth of the cover crop can be obtained under the cool conditions of the Midwest.

Concentrations vs. Flow Rates. Graphical analysis of concentration and flow data revealed some periods where concentration declined rapidly as the flow increased rapidly. This is opposite to the typical preferential flow behavior of pesticides or newly applied tracers, which tend to move with the water in the preferential flow paths and have higher concentrations as the hydrograph rises. Nitrate and other chemicals that are well distributed in the soil matrix tend to move more by matrix flow, however, and therefore drain concentrations are diluted by the relatively clean water flowing in the preferential pathways. This behavior does not occur consistently in our drains, and we do not know why it occurs sometimes but not always.

CONCLUSIONS

Subsurface drainage is an important water management practice in many humid regions of the world, but it also has potential negative effects of increased nitrate leaching through soils. Our 15-year study on a loess-derived soil in southeastern Indiana provides an important data set for assessments of nitrate leaching into tile drains in the Mississippi River basin. The primary findings from our site are:

- Nitrate N concentrations and mass losses were significantly decreased over the period of study by a combination of reductions in N fertilizer rates, change in rotation and tillage, and growth of a winter cover crop as a "trap crop" after corn. Nitrate N concentrations and loads decreased from 28 mg L^{-1} and 38 kg ha^{-1} yr^{-1}, respectively, in the 1986-1988 period to 8 mg L^{-1} and 15 kg ha^{-1} yr^{-1} in the 1997-1999 period, while drainflow was 29% higher in the latter period.
- Both drainflow volumes and nitrate N leaching losses were greater with more intensive drain spacing. Spacing affected drainflow throughout the study, but differences in nitrate N loads with spacing occurred primarily in years with continuous corn, high fertilizer N rates and no cover crop.
- The majority of the drainflow occurs in the fallow season. About 64% of the annual drainflow occurs in November through March, and 81% in November through April.
- The majority of the N loads occur in the fallow season. About 63% of the annual N load occurs in November through March, and 78% in November through April.
- Concentrations did not vary greatly by month within a year, but loads did vary due to seasonal drainflow distributions.

Concerns about hypoxia in the Gulf of Mexico have focused attention on nitrate N loads from tile-drained soils of the U.S. Midwest. As researchers and policymakers explore options for reducing the loads, studies from different Midwest locations should be carefully compared and contrasted. Some key points from our current study that should be kept in context when comparing results across the region are highlighted here:

- The relatively shallow (0.75 m) drain depth at our site may affect concentrations and drainflow volumes, compared with sites where drains are installed at deeper depths.
- The low organic matter content of this soil (approximately 1.3%) contrasts with the Mollisols of much of the upper Midwest. The nitrate N concentrations of less than 10 mg L^{-1} achieved in the last four years of our soybean–corn rotation with winter cover crop after the corn may not be achievable on high organic matter soils growing the same rotation, due to higher mineralization rates.
- Drainage occurs all winter (usually) at our site. But at many Midwest drainage research sites (Minnesota, Iowa) drainflow ceases in January, February and part of March.
- Fertilizer N is applied as spring preplant anhydrous ammonia, in the second half of April. This contrasts with sites receiving fall N applications or nitrate-containing fertilizers.

Additional research comparing the low organic matter soils represented here and the high organic matter soils of much of the U.S. Midwest is essential for understanding the system and designing appropriate management practices for each region.

Editor's note: *Content was adapted from the paper "Nitrate Leaching to Subsurface Drains as Affected by Drain Spacing and Changes in Crop Production System," which was published in the Journal of Environmental Quality, Vol. 33, September-October 2004, and is courtesy of the authors E. J. Kladivko, J. R. Frankenberger, D. B. Jaynes, D. W. Meek, B. J. Jenkinson, and N. R. Fausey.*

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7. An electronic version of this test is also available at *www.AgProfessional.com*. Go to the Certified Crop Advisers section (lefthand column) and access the "CCA Advantage" link.

Nitrate Leaching to Subsurface Drains as Affected by Drain Spacing and Changes in Crop Production System

September Self-Study Examination

DETACH HERE

1. Benefits of subsurface tile drainage include all of the following EXCEPT

[ ] a. greater water infiltration.
[ ] b. decreased losses of nitrate N.
[ ] c. improved crop growth and yield.
[ ] d. reduced surface runoff.

2. A management factor that can increase nitrate leaching losses is

[ ] a. wider tile spacings.
[ ] b. cover crops in the rotation.
[ ] c. high crop yields.
[ ] d. continuous corn.

3. A reason why researchers are interested in studying tile flow and nitrate nitrogen loads in tile drains is

[ ] a. water turbidity caused by underground drains.
[ ] b. hypoxia zones such as that in the Gulf of Mexico.
[ ] c. new national standards dictating nitrate levels in soils.
[ ] d. chemical contamination of fish in rivers and streams.

4. Drainage efficiency for tile drains can increase over time from

[ ] a. the natural development of flow paths to tiles.
[ ] b. normal degradation and deterioration of plastic tile.
[ ] c. decreasing soil organic matter in cultivated soils.
[ ] d. the settling of soil over drains.

5. Even in years with more tile flow, a significant decrease in annual nitrate N loads to drainage water could occur if

[ ] a. tiles are closely spaced.
[ ] b. conventional tillage is used.
[ ] c. tile trenches are backfilled with gravel.
[ ] d. the nitrate N concentration in drain water is lower.

6. Reasons why nitrate N concentrations in drainflow decreased during the 15-year test period included changes in

[ ] a. crop management practices.
[ ] b. forms of nitrogen used.
[ ] c. hybrid genetics.
[ ] d. soil texture that occurred as a result of drainage.

7. High nitrate loads in tile drains might be expected when

[ ] a. following successive high-yielding crops.
[ ] b. winter cover crops are used.
[ ] c. a wet year follows a drought.
[ ] d. applying animal manure during the winter.

8. One of the reasons for this research studying subsurface tile drainage and nutrient loads was to

[ ] a. help determine the correct tile spacing to maximize drainage benefits while minimizing nitrate losses.
[ ] b. measure the reductions in stream nitrate loads by reducing tile flow during certain times of the year.
[ ] c. calculate crop yield improvements possible through subirrigation of crops.
[ ] d. determine the effects on crop diseases in improving soil drainage.

Over

9. This study showed that the majority of drainflow and nitrate N loads occurs during
[ ] a. November through March.
[ ] b. April through June.
[ ] c. July and August.
[ ] d. September and October.

10. A reason why results from this Indiana site need to be interpreted before they are directly applied to other drainage sites includes the
[ ] a. ceasing of tile flow in January, February and March.
[ ] b. high organic matter content of the soils.
[ ] c. relatively shallow drain depth as compared to other drainage sites.
[ ] d. practice of applying fall nitrogen.

SELF-STUDY EXAM REGISTRATION FORM

Name: ______________________________

Address: ______________________________

City: ______________ State/Province: ____________ Zip: ____________

CCA Certification #: ______________________________

Credit Card #: ______________ Type of Card: Visa ❑ Mastercard ❑ Discovery ❑ Am Express ❑

Expiration Date ______________ Name on Card: ______________

Enclose a $10 check payable to American Society of Agronomy.

X ______________________________

Signature of Registrant as it appears on Code of Ethics

I certify that I alone completed this self-study course and recognize that an ethics violation may revoke my CCA status.

This exam issued September 2005 expires September 2008.

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SELF-STUDY EXAM 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 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: ______________________________

