# 2019 Crop Advantage Series

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# Proceedings

IOWA STATE UNIVERSITY
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A directory of Extension Field Agronomists appears on the back cover of this booklet.

Proceedings of the

# 2019 Crop Advantage Series

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# Lean and mean crop production for 2019

**Mark Licht,** assistant professor, Agronomy and Extension cropping systems specialist;
**Angie Rieck-Hinz,** Extension field agronomist; **Meaghan Anderson,** Extension field agronomist

## Objectives

- Identify aspects of total cost of production for potential cost saving.
- Develop strategies to effectively balance input costs and yield potential risk.
- Examine reactive verses proactive management through scouting to control input costs.

Several years of high corn and soybean production created large grain supplies; this, combined with trade tensions, has led to extremely tight corn and soybean production margins in Iowa and across the United States. This situation has prompted questions about what production practices have the highest return on investment and which practices can be discontinued or managed differently in an effort to keep farming operations afloat. These decisions are, without a doubt, specific to each individual farming operation.

The Iowa State University estimated costs of production for 2018 indicates land rent and machinery are the highest input costs for both corn and soybean production (Table 1). In some ways, these costs are locked in, although machinery upgrades can be postponed and land rent can be negotiated. Owned land and labor are important to include as costs of production because they are opportunity costs associated with crop production. That leaves the agronomic inputs of seed, fertilizer, and chemicals to be scrutinized.

## Seed selection

Seed selection is one of the most, if not the most, important management decision made. The biggest aspect of seed selection to focus on is yield potential and consistency. Use multi-location and multi-year data to select genetics that will perform well. Other seed characteristics such as herbicide and insect traits, disease ratings, and relative maturity are important to spread risk potential but also drive in-season management decisions.

Selecting extensive trait packages, high disease tolerance, and genetics with a range of relative maturities will lower risk potential and will require less in-season management.

This 'easy' management option comes with a cost. One must ask, "what do I need in a hybrid versus what do I want in a hybrid?" Seed selection options can be narrowed down if traits and genetic characteristics are not being used. It is worth noting that some cost savings may require added cost from in-season management.

**Table 1.** Selected estimated cost of production – 2018 (adapted from ISUEO FM 1712) for corn following corn (C/C), corn following soybean (S/C), and soybean following corn (C/S)

| | C/C | S/C | C/S |
|---|---|---|---|
| Seed | $ 114.20 | $ 114.20 | $ 52.00 |
| Nitrogen | $ 55.80 | $ 39.30 | - |
| Phosphorus, Potassium, Lime | $ 46.93 | $ 50.35 | $ 44.47 |
| Herbicide, Insecticide | $ 51.30 | $ 28.00 | $ 36.30 |
| Crop Insurance | $ 11.90 | $ 11.90 | $ 10.00 |
| Miscellaneous | $ 11.00 | $ 11.00 | $ 11.00 |
| Interest | $ 12.10 | $ 10.53 | $ 6.69 |
| Machinery | $ 139.83 | $ 137.50 | $ 69.29 |
| Labor | $ 39.20 | $ 35.70 | $ 30.80 |
| Land | $ 256.00 | $ 256.00 | $ 256.00 |
| Total Cost per Acre ($/ac) | $ 714.96 | $ 694.48 | $ 515.65 |
| Total Cost per Bushel ($/bu) | $ 3.86 | $ 3.47 | $ 9.38 |

Adapted from *Estimated Cost of Crop Production - 2018,* Iowa State University publication FM 1712

## Fertilizer applications

Fertilizer applications this fall were limited due to a late harvest, wet conditions, and frozen soil earlier than normal. This presents an opportunity to fine-tune the fertility program. Use the corn N rate calculator to adjust preseason N applications. Spring applications of N do not need N stabilizers. Keep an eye on April-June rainfall for the majority of the state; if more than 15.5 inches of rainfall is received, consider an additional in-season N application. In southeast Iowa, rainfall in excess of 17.8 inches in March-June warrants consideration for an additional in-season N application.

Phosphorus, potassium, and lime applications are just as important as N. This is a situation where spending money can provide big savings. Spend time and money on soil testing and variable rate application. Crop yield response is low when soil tests are in the very high and high testing categories. Liming can be avoided when the pH is above 6.5 for most soils and 6.0 for soils with calcareous subsoils. Use these field areas as an opportunity for cost savings with minimal to no impact on yield potential.

## Chemical decisions

Chemical decisions can be made on the go in-season. Have conversations with your retail agronomists to design a herbicide program that matches the weed pressure in your fields. This herbicide program should be field specific. An emphasis should be to make timely herbicide applications of residual products at full rates to avoid rescue applications.

Seed treatments are commonly used for both insect and disease protection in corn and soybean. Nearly all corn seed is treated, but soybean seed treatment is done locally which allows individualization. Assess field history for seedling issues, planting date, disease history, and early season insect pressure when making soybean seed treatment decisions. Consider using lower cost options where insect and disease risk is low. Some seed treatments, such as inoculants and biostimulants, have a lower yield response rate. Do not make prophylactic fungicide and insecticide treatments. Use genetics, weather conditions, and pest presence to make foliar insecticide and fungicide decisions. Time spent scouting to make decisions is a good investment.

## Crop insurance

Crop insurance is the ultimate risk management tool. Take advantage of the various federal crop insurance programs. Insure at the level of risk you are able to assume. Having said that, I'm often told that seeding rates are bumped up 5-10%, additional N is applied, starter fertilizers are used, and so on as a crop management practice insurance decisions. These crop management insurance decisions individually may only cost $1-5 per acre but they may be significantly reducing your return on investment through reduced yield potential or lack of additional yield gained. In times of tight margins, rely on federal crop insurance programs while reducing cost of production by eliminating crop management practice insurance decisions.

## Resources

**Iowa Crop Performance Tests**
www.croptesting.iastate.edu

**Corn N Rate Calculator**
cnrc.agron.iastate.edu

**A General Guide for Crop Nutrient and Limestone Recommendations in Iowa**
store.extension.iastate.edu/product/5232

**Estimated Costs of Crop Production in Iowa**
store.extension.iastate.edu/Product/1793



# Farming: It's a stressful occupation

**Chad Hart**, associate professor, Economics and Extension economist; **David Brown**, Program Specialist, Human Sciences Extension and Outreach; **Anthony Santiago**, College Projects Specialist, Human Sciences Extension and Outreach

## Objectives

- Explore the factors currently shaping crop markets.
- Discuss potential profitability and marketing opportunities.
- Learn about the signs and symptoms of chronic stress.
- Review strategies for coping with stress and learn about resources to help individuals under stress.

Farming is a high stress occupation due to many conditions not under the farmer's control, such as weather, commodity prices, machinery breakdowns or tariffs. The years 2009 to 2012 were characterized by strong crop prices, driven in the beginning by record building demand and at the end by a drought. The years 2013 to 2018 are characterized by strong crop production, a consistent string of large harvests that have been more than enough to meet and exceed demand. The outlook for 2019, based on the information we have today, suggests another challenging year is in front of us.

For corn, while the 2018 crop is smaller than its' predecessor, it is still a very large crop. This continues the string of large corn crops, with the last six U.S. corn crops being the six largest ever. Corn usage over the past six years has been robust as well, but, in general, usage has run just short of supplies. Corn stocks have built and corn prices have retreated. The wildcard is the export picture. In general, international corn demand has been growing over the past six years. But with greater competition of other corn producers worldwide and the threat from tariffs and trade disputes, export projections are tenuous at best.

For soybeans, 2018 is basically a continuation of the past two years, with record production and usage. But as with corn, supplies have generally exceeded usage. Soybean's demand structure had been relatively more supportive than corn's. But that has definitely changed with the trade dispute with China. It's hard to understate the importance of the Chinese market for soybeans. Soybean tariffs have greatly reduced trade between the U.S. and China. And that has lowered soybean prices significantly over the past several months.

Farm incomes have declined precipitously over the past few years. National net farm income has been cut in half. Working capital has been reduced for many producers and has disappeared for some. Maintaining adequate cash flow has been and continues to be a challenge. All of this leads to stress in farm country. Not only is there the stress of producing and marketing crops, but also the individual and societal stress that comes with hard times. Now is a good time to review ways to alleviate stress in farm country and help others (and maybe even ourselves) deal with difficult times. One crucial tool is communication. While farming can be seen as an individualized profession, we often rely on a team of advisors and companions to guide our decisions and/or serve as a sounding board for our thoughts on moving the farm business forward. In tougher times, those conversations with production and financial advisors are more important.

Farm production and financial stress can be fed back into individual, family, and community stress. And given the stress within the farm sector, now is a good time to review the signs and symptoms of stress (in ourselves and in others), strategies to cope with various stressors and resources to help. Stress is a natural part of life. It's our way to dealing with unexpected events and is a natural survival instinct. However, our inability to manage stress well can be damaging to both our physical and mental health. We'll review the physical, emotional, and societal impacts from stress.

When can we tell when stress has moved beyond normal levels and some form of care is needed? Concerns should be raised when stress significantly impacts the physical and mental state of a person. Individuals needing help often withdraw from friendships and social gatherings, have unusual and/or sudden changes in their physical appearance and emotional state, and display unexpected behaviors. Even without formal training, we can help individuals struggling with stress in a variety of ways. We can listen to them and provide support. We can acknowledge their distress, be direct and professional in our responses to them, and help connect them with resources to better manage the underlying issues. We can discuss approaches to relive or release stress: prayer, meditation, exercise, visualization, humor, etc. Stressful situations have many triggers and many solutions.

Sometimes the key to stress is planning for it. Farming is a hectic, but sporadic, profession. Some stressful events we can plan for, discussing plans and priorities (when the combine breaks down, who will run to town for the parts). With other events, we may need to let go, saying "No" to extra commitments. When stressed, it can be important to maintain our health and social connections. Get good sleep, eat balanced meals, and enjoy your personal relationships.

But sometimes the stress can be overwhelming and extra help is needed. There are many resources available to those going through stressful periods in their life. For example, during the 1980's farm crisis, Iowa State University Extension started the Iowa Concern Hotline (1-800-447-1985 or www.extension.iastate.edu/iowaconcern). This hotline has grown beyond just ag issues and is now available 24 hours of day, 7 days a week, to help people find quick connections to the resources and services available to those in need. Michigan State University and North Dakota State University have also created materials to directly related to managing stress on the farm and in farm families.

While we hope your stress levels stay near normal and your farm business flourishes, we also hope you find this information useful if you know someone who needs help. As Chad can speak from experience, the hardest conversation to have can also be the best conversation to have when you need some help. To end, allow us to quote that slightly known Canadian philosopher and TV show host, Red Green, "Remember, we're pulling for you. We're all in this together."

## Resources

**Ag Decision Maker**
www.extension.iastate.edu/agdm

**Iowa Concern Hotline**
1-800-447-1985

**Resources from Michigan State University**
www.canr.msu.edu/managing_farm_stress

**Resources from North Dakota State University**
www.ag.ndsu.edu/publications/kids-familyNDSI

# Stress on the farm: Strategies that help

**David N. Brown**, Human Sciences Specialist, Family Life. Reviewed by **Donna Donald**, Human Sciences Specialist, Field Operations; **Joy Rouse**, Human Sciences Specialist, Family Life; **Kristin Taylor**, Creative Projects Specialist

## Objectives

- Recognize the body's response to stress.
- Understand the behavioral, emotional and other farm related signs of stress.
- Learn strategies to help with stress.
- Know how to help others.
- Know where to find resources.

We know farming is dangerous. Farming ranks among the most hazardous of professions. Farmers are at very high risk for fatal and nonfatal injuries.

Farmers also have the highest mortality rate from stress-related illnesses. Individuals working in the farming, fishing, and forestry group also have one of the highest rates of suicide compared with other professions. This is primarily due to stressors, such as job-related isolation, stressful work environments and work-home imbalance. More importantly, stress is caused by those conditions beyond the farmer's control, such as weather, fluctuating commodity prices, variable crop yield and machinery breakdowns.

Stress is simply a response to a threatening event, such as receiving some type of bad news. Unfortunately, our brain and body do not know the difference between being threatened by a saber- toothed tiger, being late for work, or having a machinery breakdown during harvest. Our brain and body still respond by being prepared to either jump into a fight or run away quickly.

This response causes the body to produce stress related chemicals that make the heart beat faster, our muscles to tense, and the eyes to dilate. Blood is shunted away from the midsection (including stomach) and the mucous membranes dry up. All so you can fight harder, run faster, see better and breathe easier than you would without this response.

As stress is experienced over longer periods, our bodies may begin to experience high blood pressure, muscle tension, headaches, stomach upset, heartburn, ulcers, and diarrhea/constipation, which can eventually progress into issues that are more serious.

Serious wear and tear on the body can occur if the stress continues too long or becomes chronic. That is why chronic stress is a risk factor for heart attacks, weight gain, stroke, and diabetes. Individuals also become more prone

to severe viral infections, such as the flu or common cold. It is also a risk factor in depression, anxiety, addiction and suicide.

Other emotional responses can include isolation or withdrawal. For example, a person may frequently miss work or not go to school or church activities they once attended.

Individuals who are stressed might talk in a monotone voice or have a lack of expression on the face. You could observe bursts of anger or abrasive behavior towards children or others. Worry or fearfulness about the future could become a key topic of conversation. You may notice confusion, forgetfulness or difficulty concentrating.

Others may respond to stress by trying to screen out unpleasant circumstances in a variety of ways. For example, some people might deny their problems. They may blame others, such as banks or their spouses. Other times, people try to escape through eating or gambling binges, spending sprees or excessive use of alcohol or other drugs. Some may sleep too much or not enough. Most of these are maladaptive attempts to cope as a person tries to avoid dealing with the stress.

In farmers, a lack of social support, such as having few or no friends, is a predictor of depression. The person may not take care of their physical appearance or hygiene. A major concern would be if the farmer starts talking about shooting himself or herself or others. These are signs of hopelessness or depression.

You may be concerned about someone or a person's friend or family member, banker, veterinarian, FSA representative or elevator manager might ask you for a consultation. You could start a conversation with care and compassion by saying, "I've noticed you're feeling upset" or asking, "What's going on in your life?" Then let the person talk. Listen carefully, provide support and share personal experiences, if you feel that would be helpful. Give the person some time to express what is going on. When the person is finished and if you are concerned, be direct and ask, "Are you thinking about suicide?" If he or she says "Yes," get immediate help. Call 911 or take the individual to a hospital emergency room. If he or she says "No," ask, "What do you think might help?" or maybe "Where would you like to go for help?" Offer to make the contact together to a local resource found in a county resource directory, Iowa Concern, or the Suicide Prevention Lifeline, etc. by saying, "Why don't we make the call together?" It helps to have an awareness of or list of the resources available in your area.

Many things can minimize our natural stress response. Taking three slow and deep breaths, stopping to daydream or taking a short mental vacation for 10 minutes, or using repetitive prayer can help. A regular exercise program can provide break in the daily routine and is a constructive way to relieve stress. Having a strong network of friends, co-workers, and family can provide helpful support during difficult times.

Sometimes managing those items an individual ***does*** have control over can help to reduce stress, such as replacing worn parts during the off-season or setting some long-term goals. Before key seasons, discuss who can be available to run for parts or care for livestock. Set priorities about what has to be done today and what can wait. It is OK to say "No," especially to those commitments you do not have time for.

If stressed, first talk with someone you trust, such as friends, family or a trusted physician or minister. Taking your partner on a date helps to strengthen that very important relationship. Getting a good night's sleep, avoiding alcohol and drugs, and eating healthily help us to better manage our current stressors.

## Resources

### Iowa Concern Hotline

1-800-447-1985
www.extension.iastate.edu/iowaconcern
*Offers 24/7 free assistance and referral for stress counseling, legal education, and financial concerns.*

### National Suicide Prevention Lifeline

1-800-273-8255 (TALK)
www.suicidepreventionlifeline.org
*Provides 24/7 free and confidential support for people in distress, prevention and crisis resources for you or your loved ones, and best practices for professionals.*

# Tariffs: Past, present and future

**Kelvin Leibold**, Extension farm management field specialist

## Objectives

- Understand historical USA tariffs.
- Review current tariffs.
- Examine potential impacts of current tariffs.

The United States was formed as the result of a tariff. In May of 1773 the British imposed a tariff on tea, in part to pay for the cost of running the British government in the US, and in December the colonists responded with a protest later called the Boston Tea Party. After significant retaliation on both sides the colonist called the "First Continental Congress". Following more conflict the Revolutionary War started near Boston in 1775.

The United States did not have an income tax until 1861 to help fund the Civil War. It was revised in 1862. Prior to this the federal government relied heavily on tariffs to fund its activities. Tariffs were viewed as a tool to raise revenue, especially in war time, and to protect certain industries.

Tariffs peaked out after the passage of the 1930 Smoot-Hawley Tariff, which was originally proposed to help farmers after the end of World War I. But many other industries were added in and the rate peaked out at nearly 60%. The GATT agreement in 1947 drove tariffs down to historical lows of almost 1% by 2010.

On July 10th, 2018 the US announced that it would impose a 10 percent tariff on approximately $200 billion worth of Chinese products starting September 24, 2018. Starting January 1, 2019 the level would increase to 25 percent.

China responded by placing tariffs on US products. In a recent article Minghao, Zhang and Hart provide background on how China has responded to previous trade disputes. They state that China is inclined to target agricultural products with "proportional, restrained response," try to target products that are "substitutable," and try to "inflict economic and political costs". They further state that the Chinese government has long recognized the political significance of the U.S. agricultural industry, which partly explains why it targets U.S. agricultural exports in trade spats.

The impact of the tariffs are much more far reaching than just China. Tariffs or trade disputes have impacted many of our trading partners. Our trading partners are searching out new trading partners and are investing in infrastructure to build new trading partners and negotiating new trade deals.

Examples of this can be seen by looking to Brazil's soybean acreage for 2018/2019 marketing year which is expected to increase by 4% this year and an additional 8% for the 2019/2020 marketing year. Another example is the development of Mexican ports to handle commercial freight and improvement in railroads.

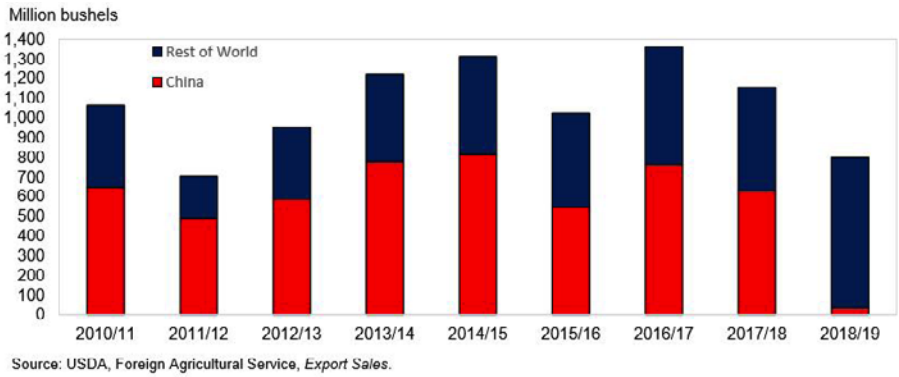



**Figure 1.** A lack of U.S. soybean sales to China by November 1 overwhelms an increase for other countries. Release: November 13, 2018 usda.mannlib.cornell.edu/usda/current/OCS/OCS-11-13-2018.pdf

## Resources

**CARD Policy Briefs**
www.card.iastate.edu/products/policy-briefs

**Center for China-US Agricultural Economics and Policy**
www.card.iastate.edu/china

**Trade Disruption Data**
www.card.iastate.edu/china/trade-war-data/

**Press release on China tariffs**
ustr.gov/about-us/policy-offices/press-office/press-releases/2018/september/ustr-finalizes-tariffs-200

# Winning the waterhemp war

**Bob Hartzler,** professor, Agronomy and Extension weed specialist

## Objectives

- Understand why waterhemp is ideally suited for our production system.
- Identify why current systems frequently fail.
- Design management systems that provide consistent control.

Our current production system relies on herbicides for weed management, and waterhemp is the weed best adapted to this approach. Traits that contribute to waterhemp's success include prolonged emergence, prolific seed production, and diversity within the population. Prolonged emergence complicates management since control efforts must be maintained from planting until full crop canopy. High seed production allows low numbers of escapes to sustain the weed seed bank, and in years when management fails the seed bank explodes in size. Finally, waterhemp is a dioecious plant, having separate male and female plants. Cross-pollination increases diversity within the population, creating biotypes suited to a wide range of conditions. Our management practices continually select the best adapted populations. When we change practices, the large seed bank is ready to supply a new biotype that is adapted to the new control tactics.

In order to successfully manage waterhemp, the objective for weed control must be to drive down the size of the seed bank. Waterhemp escapes that don't impact crop yields are able to replenish and increase the magnitude of the seed bank. The level of inputs required to achieve an acceptable level of control is directly related to the size of the seed bank. In addition, a large seed bank increases the likelihood of new herbicide resistant biotypes. Herbicide resistance is found at low frequencies within weed populations. Thus, if a field has a limited number of weed

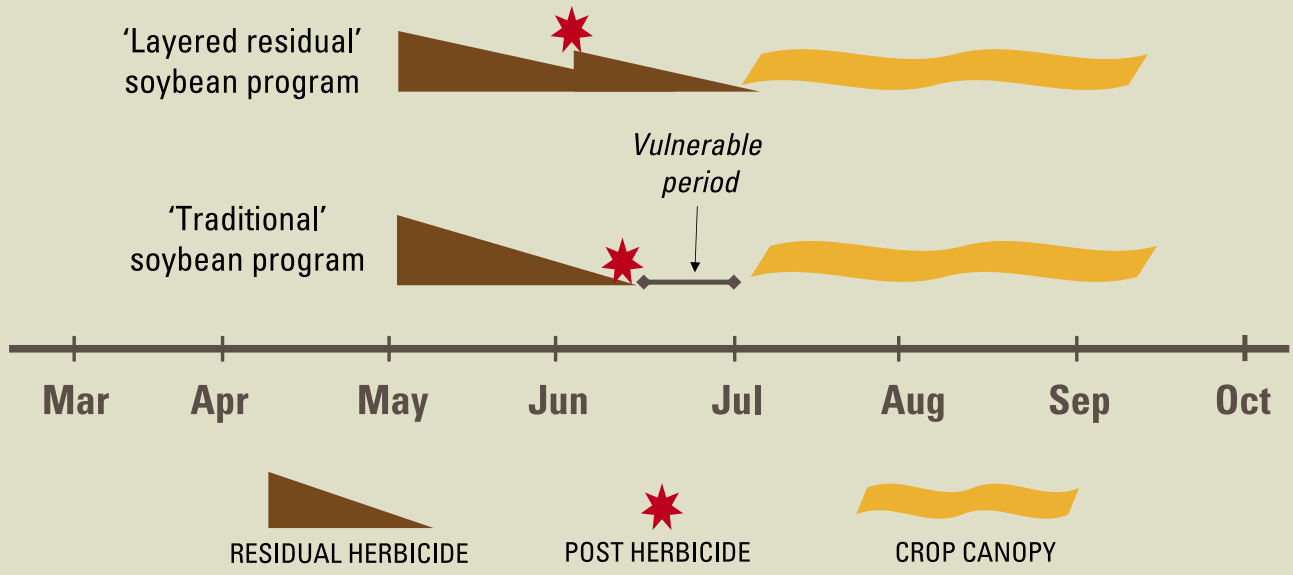



**Figure 1.** Using layered residual herbicides to achieve full-season weed control.

seeds in the seed bank, there is a low likelihood of a new resistant trait being found in the field. Thus, reducing the size of the seed bank makes weed control easier and decreases the likelihood of selecting herbicide resistant biotypes.

Reducing the size of the seed bank can only be achieved by achieving full-season weed control. In the majority of fields, a high percentage of waterhemp escapes are plants that escape after herbicides have lost their effectiveness. Preemergence (PRE) herbicides used in soybean are not persistent enough to provide full-season control. Delaying postemergence applications (POST) isn't a viable option since early emerging plants will have gotten too large for consistent control. The layered residual system provides the best opportunity to achieve full season control in soybean (Figure 1). This involves an at-planting application of a PRE followed by a POST that includes a HG 15 product for residual activity and a herbicide to control emerged weeds (HG 4, 9, 10 or 14). The POST should be applied relatively early (V2 to V4) while the initial PRE is still active. Waiting until significant numbers of weeds break through the PRE will reduce the consistency of the program.

In addition to achieving full-season control, programs need to be designed to reduce the selection of new resistant biotypes. Waterhemp has evolved resistance to Group 2, 4, 5, 9, 14, and 27 herbicides. Herbicide groups available for use in soybean that waterhemp hasn't 'broken' are limited to Groups 3, 10 and 15 – we are quickly running out of options. The use of multiple, effective herbicide groups is the best way to protect herbicides. This is more complicated than simply adding herbicides to the tank – how each product is used must be carefully evaluated. Determine if the rate of herbicide used and application timing is appropriate to provide an acceptable level of control. Cutting rates to reduce to costs or crop injury eliminates the benefit of this strategy in managing resistance.

Herbicides alone cannot win the battle with herbicide resistance. Critically evaluate your management practices to determine what is leading to waterhemp's success. In addition to modifying herbicide programs, look to see what can be done to increase the crop's competitiveness. Row spacing, planting populations and planting dates influence how well the crop is able to suppress weeds. Cultivation may be appropriate in 'problem' areas of fields where weed escapes are common. Cover crops can also supplement herbicide programs. Finally, weed control must be viewed as a long-term endeavor. Years when weather prevents timely management that results in failures are inevitable, but continuing to accept low numbers of escapes that don't affect yields will end up costing us in the long run.

## Resources

**Herbicide program development: Using multiple sites of action**
bit.ly/sitesofaction

**2019 Herbicide Guide for Iowa Corn and Soybean Production**
store.extension.iastate.edu/product/12150

# What's new in corn diseases?

**Alison Robertson,** professor, Plant Pathology and Microbiology and Extension crop plant pathologist

## Objectives

- Recognize the symptoms of tar spot.
- Understand what conditions favor tar spot.
- Provide an update on fungicides on corn.

## Tar spot

Tar spot, which is caused by the fungus *Phyllachora maydis*, was first identified in Iowa in 2016. In 2018, the disease was observed in 12 counties in eastern Iowa, and was widespread throughout the central Corn Belt (Figure 1). Yield losses amounting to 60 bu/A were reported from some fields in Michigan and Wisconsin.

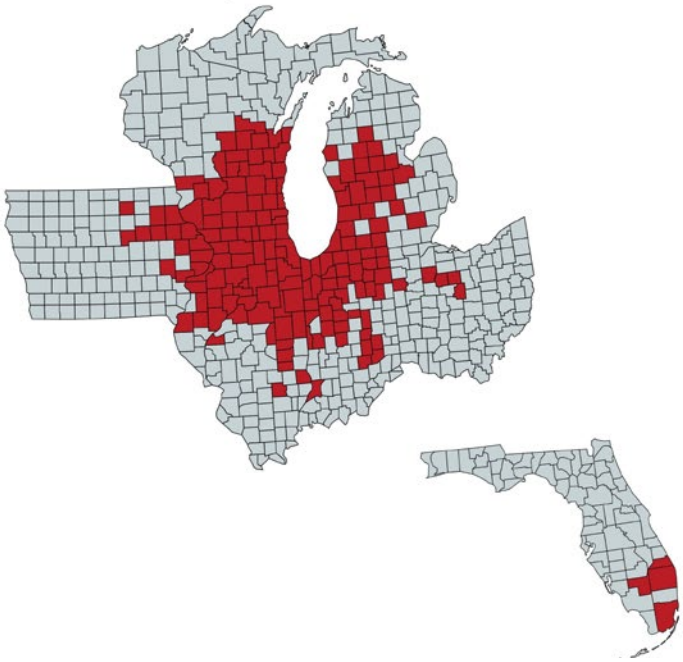


**Figure 1.** Map showing the counties in the U.S. within which tar spot was observed in the 2018 growing season. Courtesy of cropprotectionnetwork.org

**Figure 2.** Tar spot is recognized as small, irregular shaped, raised lesions scattered across the leaf. Photo by Adam Sisson.

Tar spot is recognized as small, irregular-shaped, raised spots scattered across the surface of corn leaves, husks and occasionally stalks (Figure 2). Severe infections result in premature dry down of corn plants that easily lodge. Although corn is susceptible at all stages of crop development, thus far the disease has been only observed during grain fill in Iowa.

Tar spot is an important disease of corn in Central America. The disease is usually found at higher altitudes (4000 to 7000 feet above sea level) and is favored by cool temperatures (63 to 70F), high relative humidity, and at least 7 hours of leaf wetness.

The fungus is believed to survive in infested corn residue, thus fields with a history of the disease should be rotated to a non-host crop such as soybean. Although hybrids grown in the U.S. vary in their susceptibility to tar spot, all hybrids are susceptible. Fungicide applications will likely be used to manage tar spot in the U.S., but timing of application will be crucial. Not all fungicides are labelled for tar spot management.

If you observe tar spot in your fields in 2019, please contact Alison Robertson (alisonr@iastate.edu) or the ISU Plant Disease and Insect Diagnostic Clinic (pdic@iastate.edu). We would like to visit fields and collect symptomatic leaf samples to contribute to tar spot research efforts in the Midwest.

## Fungicides on corn

In 2018, we evaluated fungicides from several companies applied at V6, V12 or tasseling for their efficacy in controlling corn foliar disease and protecting yield at 6 locations in Iowa. Gray leaf spot (GLS) was the most prevalent disease observed in the trials. No tar spot was observed. Applications of fungicide at tasseling provided the best control of GLS followed by applications at V12 (Figure 3). Applications at V6 had little effect on GLS development. The greatest yield response was associated with those fungicide applications that reduced GLS severity the most.

## Resources

**Integrated Crop Management - Crop Diseases**
crops.extension.iastate.edu/pests/diseases

**Crop Protection Network**
www.cropprotectionnetwork.org

**Alison Robertson on Twitter**
@alisonrISU

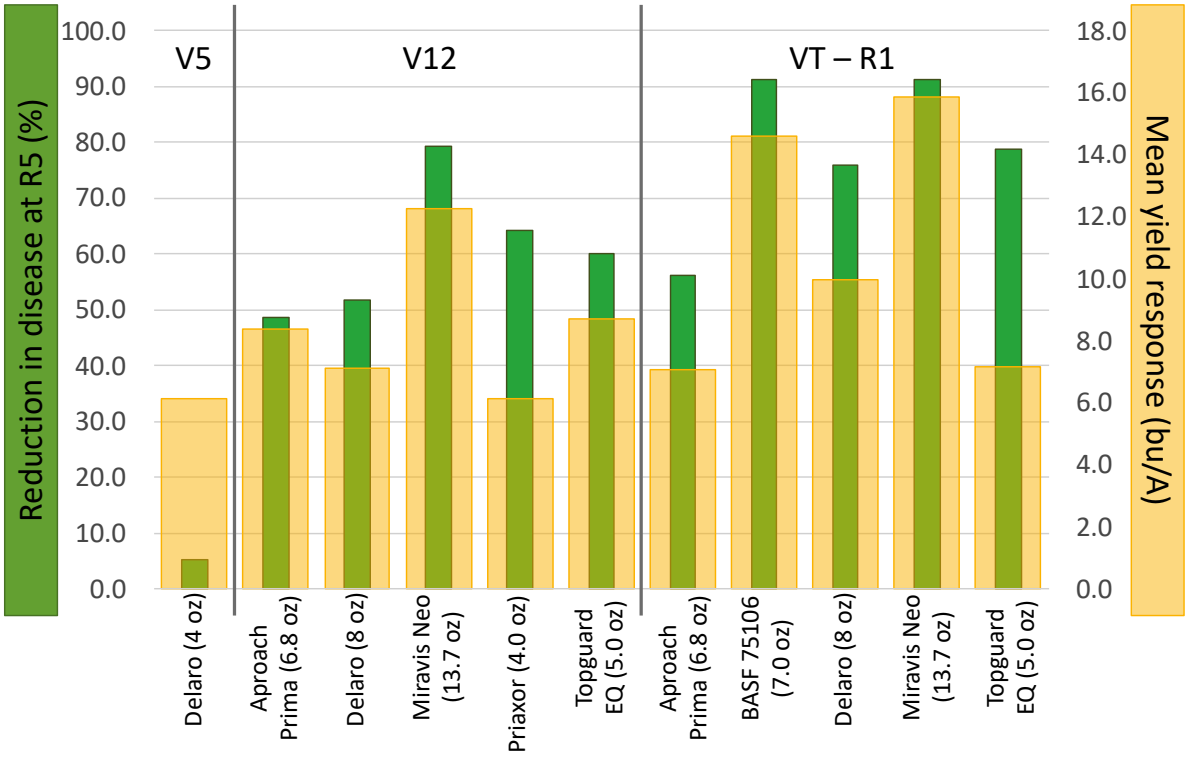



**Figure 3.** Percent reduction in disease and yield response of corn to various fungicides applied at either V6, V12 or tasselling at the ISU Northeast, Northwest and Southeast Research Farms in 2018.

# On the lookout for a new soybean pest

**Erin Hodgson**, associate professor, Entomology and Extension entomologist

## Objectives

- Raise awareness of soybean gall midge in Iowa.
- Provide an update on 2018 field observations.
- Offer scouting and identification tips for 2019.

Soybean gall midge have been observed in isolated fields in northwestern Iowa since 2015, but spread in intensity and distribution in 2018. Infested fields can be associated with hail damage or fungal pathogens, but sometimes plants are completely healthy. In 2018, 65 counties in Iowa, Minnesota, Nebraska, and South Dakota reported soybean gall midge activity. Significant yield loss was reported in many of the midge-infested fields this growing season.

## Scouting and plant injury

Some of the fields surveyed in 2018 had significant levels damage with a high frequency of dead plants at the edge that dissipated with distance from the edge (Figure 1). Infested fields had heavily damaged plants next to a field planted to soybean the previous year. In addition, plant death was greatest next to waterways and ditches with dense vegetation. Such observations suggest that gall midge can survive Iowa's winters and may be overwintering in soybean fields.

Live soybean in damaged areas of the field had dark discolorations at the soil surface that extended to the unifoliate node. These plants easily snapped off at the soil surface. Damage to the phloem and xylem of the plant is likely to result in yield reductions for surviving soybean gall midge infested plants. Additional losses are also anticipated due to the lack of stem strength, predisposing plants to increased risk of lodging if crop harvest is delayed. Many larvae can be feeding within a plant at the same time. Eventually, infested plants become brittle and break off, resulting in plant death.

**Figure 1.** Plant injury from soybean gall midge is concentrated around the perimeter. Photo by Adam Bierbaum.


**Figure 2.** Soybean gall midge larvae; note young larvae and older larvae are present. Photo by Erin Hodgson.

## Pest description

Soybean gall midge is a new species in the genus *Resseliella* (55 species worldwide with 15 of those in North America), and have named it *Resseliella maxima*. Midges are flies (Diptera: Cecidomyiidae) with complete metamorphosis (e.g., egg, larva, pupa and adult). Gall midges are long-legged flies with hairy wings and long antennae. Adults are fragile and known to be weak fliers. Eggs and larvae were observed inside soybean stems. Young larvae were small and translucent, but mature larvae were larger and orange (Figure 2).

## Resources

**Integrated Crop Management News - Insects**
crops.extension.iastate.edu/pests/insects

**Iowa State University Soybean Entomology Research**
www.ent.iastate.edu/soybeanresearch/content/extension

# Drainage research update

**Matthew Helmers**, professor, Agricultural and Biosystems Engineering and Extension agricultural engineer; **Kapil Arora**, Extension agricultural engineering field specialist; **Kristina TeBockhorst**, Extension agricultural engineering field specialist

## Objectives

- Observe the high level of drainage research that has been conducted by ISU in the past nearly 30 years.
- Understand the impacts of land use, nutrient management, manure, tillage, and drainage system design on drainage water quality.
- Understand the agronomic impacts of tile drainage.

Tile drainage has been an integral part of agriculture throughout the Midwest Corn Belt. Iowa State University has been studying the agronomic and water quality impacts of drainage for nearly 30 years. This research becomes especially important with current tight profit margins and a high level of concern for Iowa's downstream impact on water quality. ISU is conducting this research at five primary sites across the state.

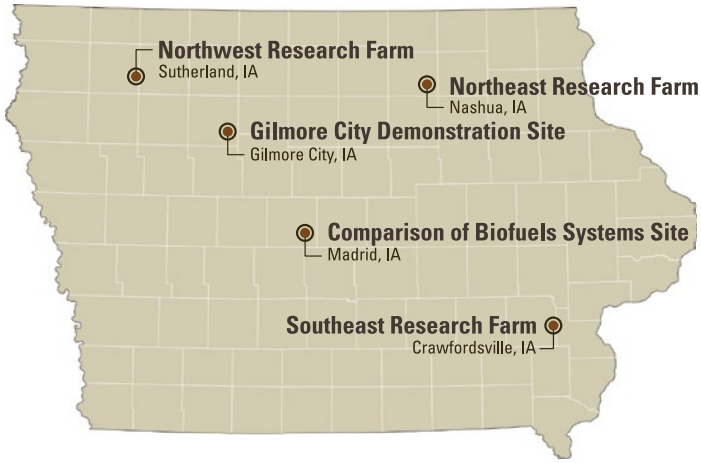



**Figure 1.** Location of drainage research facilities

## Main findings

### *Ag Drainage Research Site, Gilmore City, IA*

When N-fertilizer is applied at economic N-rates, the average concentration of nitrate-N in tile drainage ranged from 12 to 16 mg/L (drinking water standard is 10 mg/L).

For a corn-soybean rotation with no N-fertilizer applied, there was 15-20 lb-N/acre lost through tile drains at nitrate-N concentrations of 6-8 mg/L.

In general, concentration of nitrate in the tile drainage was similar for the corn and soybean phases of the corn-soybean rotation.

Use of a cover crop has the potential to reduce nitrate-N concentration in drainage water. Cover crops did not significantly impact drainage volume but reduced nitrate-N load.

In the corn phase, the flow-weighted nitrate-N concentration was lower in the side-dress N-application treatment compared to the fall application treatment. Averaged over both the corn and soybean phases, however, flow-weighted concentrations in the fall application, spring, and side-dress treatments were similar.

### *Comparison of Biofuel Systems Site, Madrid, IA*

Flow-weighted nitrate-N concentrations over seven years were 0.1, 0.6, 9.3, 10.4, 13.1, and 13.2 mg/L for prairie, fertilized prairie, continuous corn with cover crop, corn, soybeans, and continuous corn, respectively.

Despite a higher nitrogen fertilizer application rate in the continuous corn with cover crop treatment, the nitrate-N loss was less than under the continuous corn with no cover crop.

Bioenergy-based mixed prairie systems with annual above ground biomass harvest after senescence substantially limited nitrate-N losses to subsurface drainage, even when synthetic fertilizer was applied.

### *Northeast Research Farm, Nashua, IA*

Continuous corn systems required higher input of N fertilizers and resulted in significantly higher nitrate-N leaching losses compared to corn-soybean rotations fertilized with manure or urea ammonium nitrate (UAN).

Total nitrate-N losses averaged over the years 2008-2015 ranged from 13.6 lb/acre/yr from a corn-soybean no-till rye cover crop treatment with spring application of urea ammonium nitrate to 34.4 lb/acre/yr from annual swine manure applied to continuous corn.

Cereal rye cover crops significantly reduced nitrate-N concentrations in drainage water compared to a similar treatment without a cover crop.

Minimal differences in dissolved P concentrations in drainage water were observed from six different management systems over an eight-year period, with total losses less than 0.03 lb/acre/yr from all systems studied.

### *Northwest Research Farm, Sutherland, IA*

In 2015 and 2016, the annual flow-weighted nitrate-N concentration in corn plots with no N-fertilizer application was significantly lower or similar to corn plots with N-application.

For 2015 and 2016, in both crop phases, the nitrate-N concentration was statistically the same for plots with no N-fertilizer and with split N-application.

There were no significant differences in total-P and total-reactive-P concentrations in drainage found between the four treatments.

***Southeast Research Farm, Crawfordsville, IA***

***Tile drainage spacing study (2000-2009)***

A drainage spacing study on Kalona and Taintor soils demonstrated a yield loss with tile spacings at and greater than 90 ft with tiles installed 4 ft deep.

Closer tile spacings give a slightly quicker rate of water table drawdown, though all spacings (30 ft, 45 ft, 60 ft, and 75 ft) dropped the water table below 1.5 ft in less than 24 hours.

***Drainage water management study (2007-2016)***

Drainage improved corn yields by 12.4 bu/acre and soybean yields by 4.8 bu/acre. Tile drainage volume and annual nitrate-N loss was reduced by 52 and 55 percent with controlled drainage and by 53 and 43 percent with shallow drainage, respectively, compared to the conventional drainage system.

There were no significant differences in the time that the water table was within one foot of the ground surface between the conventional, controlled, and shallow drainage treatments, even though the controlled and shallow treatments generally had a higher water table than the conventional drainage treatment.

## Resources

**Agricultural Drainage Research and Demonstration Site – Gilmore City**
store.extension.iastate.edu/product/15147

**Comparison of Biofuels Site**
store.extension.iastate.edu/product/15148

**Northeast Research and Demonstration Farm**
store.extension.iastate.edu/product/15149

**Northwest Research and Demonstration Farm**
store.extension.iastate.edu/product/15140

**Southeast Research and Demonstration Farm**
store.extension.iastate.edu/product/15151

# Nitrogen management in variable environments

**John E. Sawyer,** professor, Agronomy and Extension soil fertility specialist

## Objectives

- This talk will discuss how high yield environments do not mean high N fertilization rate requirements.
- Attendees will recognize nitrogen application increases, not decrease corn yield variability.
- Based on research studies, you will recognize that recommended N rates provide adequate N in the majority of environments.
- Producers will be able to recognize the need for additional N application based on evaluating springtime precipitation.

We all recognize that growing seasons are different. Does this mean nitrogen (N) management has to change every year? Or are N management systems within current corn production resilient enough to work well across varying environments? The short answer to the second question is yes, with understanding that the infrequent extremes of very low and high N need years are the environments that need to be considered for adjustment.

Figure 1 is an example that shows the variability in corn yield response to N across multiple years at two contrasting research sites in Iowa. The graphs give the yield with no N applied, the highest rate in the study (240 lb N/acre), the yield at the economic optimum rate each year (Y-EONR), and the yield with the current MRTN rate for each location (Y-MRTN). The Ames site is a Clarion loam soil. The Crawfordsville site is a Kalona silty clay loam soil. Nitrogen was applied either spring preplant or early sidedress urea or UAN solution. These graphs allow comparison of what a "uniform" rate like the MRTN can do for corn production versus the best possible (the yearly EONR). At the Ames site, only in one year was the yield with the MRTN rate less than the yearly optimal rate; at the Crawfordsville site, lower yield three years. The Crawfordsville site soil is more poorly drained and receives more rainfall each year; therefore, more years where more than the MRTN rate was needed. What this example comparison does not show are the years where the MRTN rate was more than required, but yields would be "protected" in those cases.

How can we adjust for those extreme high N-fertilization need years? What we have promoted in the last few years is using the rainfall total from March 1 to end of June in Southeast Iowa (17.8 inches) or April 1 to end of June in the Main area of Iowa (15.5 inches) as a trigger point. If rainfall exceeds those amounts, then more than the MRTN rate is suggested. Why not just apply a high N rate every year? That would take care of any yield loss in high N rate need years, but across time would result in too much N most years, lower economic return, and more N for loss in drainage water.

In-season (mid-to-late vegetative) N applications are options for adjusting to the season, but does not always improve N management compared to preplant N. Late applied N can put corn yield at risk, for example due to lack of precipitation before/after the application. An example of a large positive response to late N was a field-length trial (2005) where split N (UAN surface-dribbled) was applied at the V13 corn growth stage (60 lb N/acre had been applied early sidedress), rained 2+ inches after the V13 application – a 32 bu/acre yield increase. An example of a large negative response to late N was a trial at the Northwest Research Farm water quality site in 2017 where split N (urea surface-dribbled) was applied at the V10 stage (40 lb N/acre had been applied as starter N), a dry summer and with no or small rain events for a considerable time after the V10 application – a 22 bu/acre lower yield compared to preplant. These are examples of how precipitation variation can enhance or detract from attempted improved management in rainfed corn production.

We have to supply adequate N to build the corn "yield" factory, so adequate N supply early in the season is important (70% or more of total N is taken up by silking). This can be accomplished by all preplant N application or split-sidedress. In either application system, excessively wet springtime conditions can cause loss of soil and fertilizer derived nitrate - thus a high N responsive year. Managing N by using recommended rates and adjusting for early-season excess moisture is a viable way to deal with variable environments.

## Resources

**Nitrogen Use in Iowa Corn Production**
store.extension.iastate.edu/product/14281

**Corn Nitrogen Rate Calculator**
cnrc.agron.iastate.edu

**Use of the Late-Spring Soil Nitrate Test in Iowa Corn Production**
store.extension.iastate.edu/Product/5259

**Soil fertility information from Iowa State University**
www.agronext.iastate.edu/soilfertility

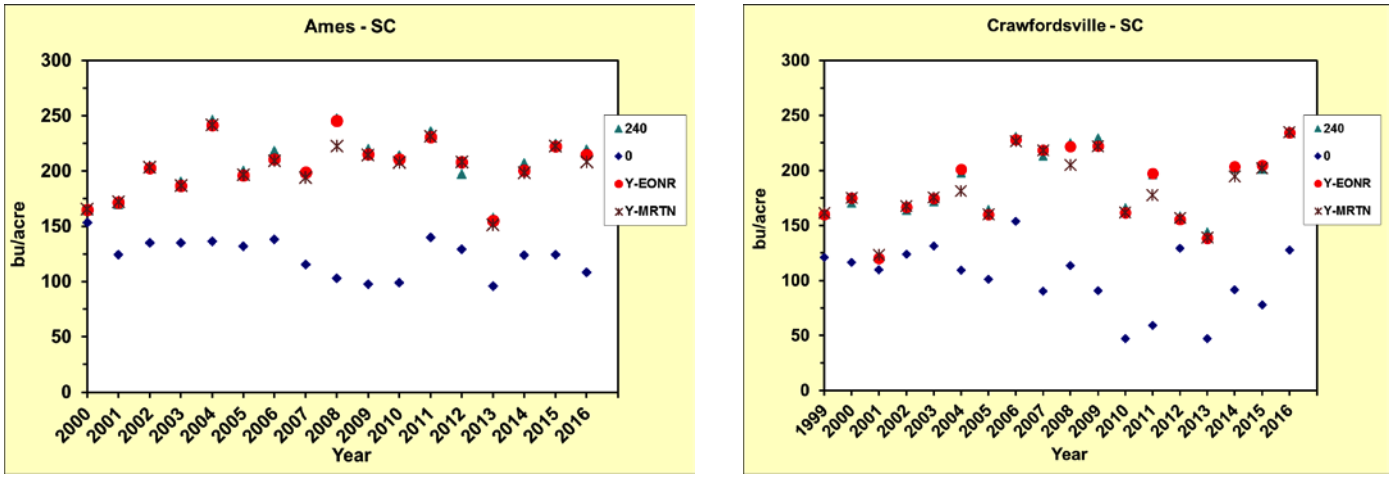



**Figure 1.** Examples of corn yield at two sites with no N applied, 240 lb N/acre (max in the study), at the yearly optimum EONR (Y-EONR), and with a constant MRTN (Y-MRTN) rate each year (MRTN of 140 lb N/acre at Ames and 153 lb N/acre at Crawfordsville, corn following soybean). If the "star" symbol is below the dot, then the yield with the MRTN rate was less than the yield with that year-specific EONR rate.

# Soil pH and liming research update and management strategies with low crop prices

**Antonio Mallarino,** professor, Agronomy and Extension soil fertility specialist

## Key points

- Soil pH should be used to determine if a soil requires liming but the Buffer-pH test is needed to determine the amount of lime to apply to increase pH to a certain value.
- Corn and soybean have similar optimum pH and lime requirements, and yield increases are not likely with pH 6.0 or higher in Iowa regions with soils having calcareous subsoil and with pH 6.5 or higher in other areas.
- A 6-inch soil sampling depth should be used in fields managed with tillage. In fields managed with no-tillage or established forages used for grazing or hay, a sampling depth of 2 to 3 inches is recommended because in these fields lime seldom changes pH in deeper depths.
- Liming materials should be applied based on the effective calcium carbonate equivalent (ECCE) analysis, which considers both the material chemical properties and particle fineness. Research has shown no consistent or large yield differences between sources when the application is based on ECCE, and both the material and delivery costs determine the convenience of using a specific material.

Soil pH should be used to determine whether a soil is too acidic and requires liming and the buffer-pH soil test is used to determine the amount of lime needed to increase soil pH to a desirable level. Liming products should be applied based on the effective calcium carbonate equivalent (ECCE) analysis, which considers the materials chemical properties and fineness since both affect acid neutralization capacity.

Results of an on-farm study with corn-soybean rotations conducted from 2007 to 2012 in 14 Iowa fields encompassing ten counties confirmed the adequacy of guidelines in Iowa State University Extension (ISUE) publications for soil sampling (CROP 3108) and interpretations of results (PM 1688). Treatments for each 4-year strip trial were an unlimed control and aglime at 3 ton ECCE/acre. Dense grid sampling, yield monitors, GPS, and GIS were used to assess crop responses for different parts of each field. There was no statistical difference between corn or soybean responses to lime. The optimum pH for both crops was higher (pH 6.5) in soils with acidic subsoil than in soils with calcareous (high pH) subsoil (pH 6.0). Figure 1 shows averages across both crops for soils with or without high-pH subsoil. Iowa State University Extension publication PM 1688 includes a map indicating regions with soils having calcareous subsoil (mainly in central, northern, and western Iowa).

The pH results of the on-farm study confirmed that lime application to no-till fields does not significantly increase pH below a depth of about 3 inches. Figure 2 shows

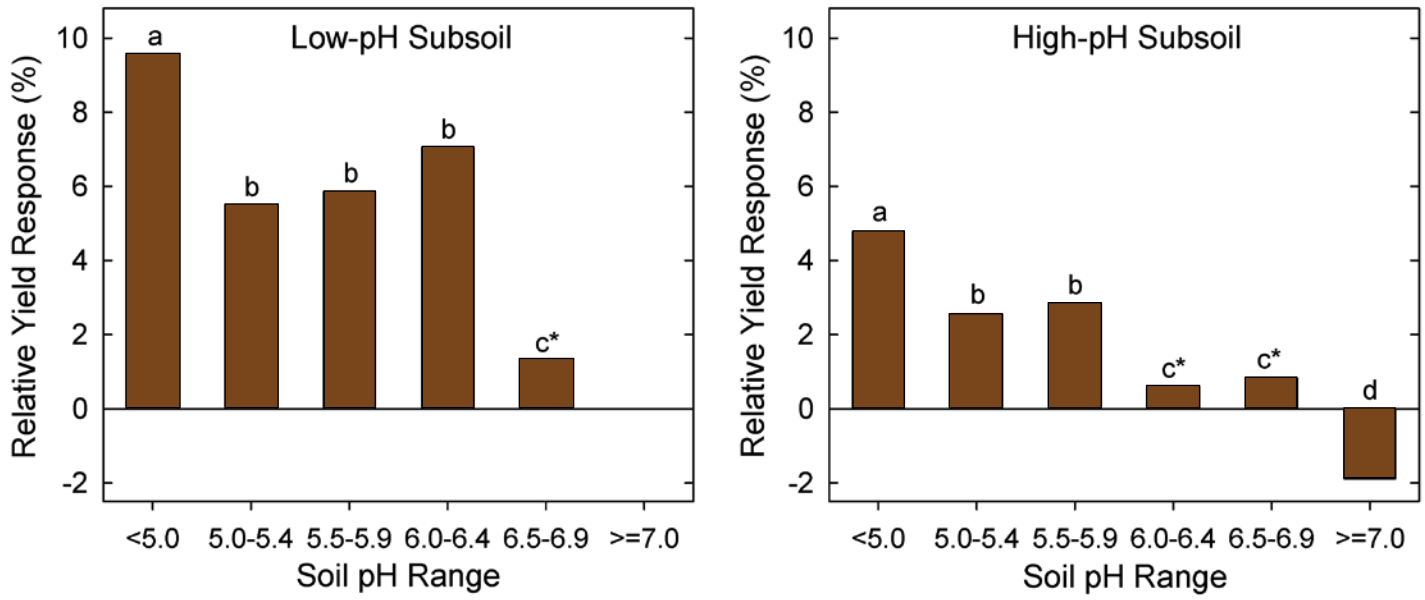



**Figure 1.** Relative grain yield response to lime across corn and soybean crops as affected by soil pH and subsoil pH (different letters indicate statistical differences between pH ranges and asterisks indicate no difference from zero).

average results across the four fields that were managed with no-till. For this reason, ISUE publications PM 1688 and CROP 3108 suggest a 6-inch sampling depth for tilled fields but 2 to 3 inches for no-till and established forages. Sampling to a 6-inch depth in these cases is tempting because this is the best sampling depth for nutrients. Unless the lime recommendation for a 6-inch depth is reduced to about one half, however, excess lime will be applied that will not increase yield compared with a lower rate and may even decrease yield.

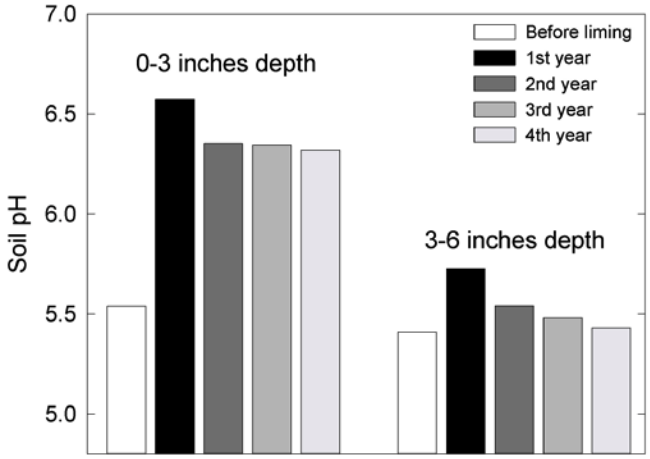



**Figure 2.** Average effect of 3 ton/acre of effective calcium carbonate equivalent (ECCE) on soil pH across four fields managed with no-tillage and corn-soybean rotations.

Another project studied the efficiency of pelleted lime because the supply of pelleted lime in Iowa has increased, but many farmers are doubtful of its value and ISU had not evaluated it until recently. Six 2-year trials were established in 2015 to compare pure calcium carbonate, aglime, and pelleted lime for corn and soybean in soils with pH 4.9 to 5.6. All materials were spread and incorporated into the soil by disking in the fall prior to planting corn and no-till soybean was grown the second year.

The pure calcium carbonate and the pelleted lime had similar effects on pH and maximized soil pH 4.5 months after the application, but with aglime maximum pH was reached 12 months after liming. However, there were no yield differences between the sources. Liming increased corn grain yield in three fields and soybean yield in four fields. Figure 3 shows the average crop responses across responsive sites. Rates of 2.9 and 1.2 ton ECCE/acre maximized corn and soybean yield, respectively. Therefore, for application methods and rates used in this study, the costs of the materials and delivery will determine the most cost-effective lime source.

## Resources

**General guide for crop nutrient recommendations in Iowa**
store.extension.iastate.edu/Product/5232

**Take a good soil sample to help make good fertilization decisions**
store.extension.iastate.edu/Product/3915

**Lime and soil pH topic. Soil fertility website, Iowa State University Extension**
www.agronext.iastate.edu/soilfertility/limesoilph.html

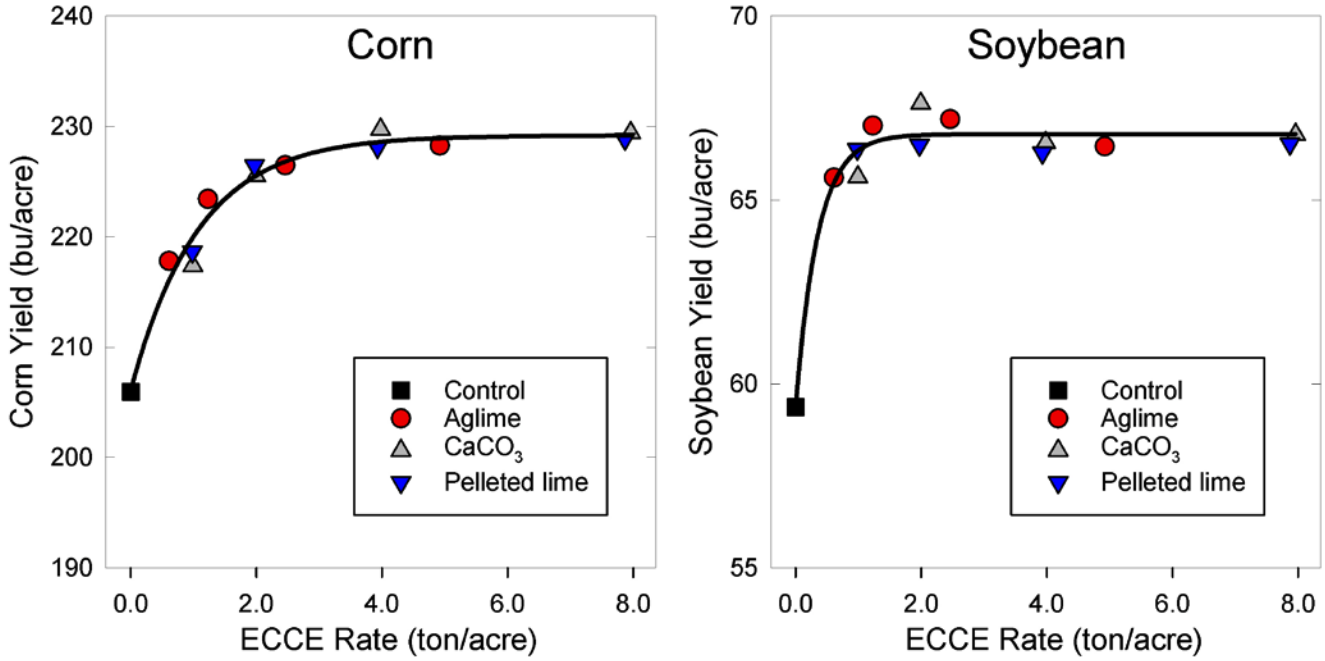



**Figure 3.** Effect of calcium carbonate, calcitic aglime, and pelleted lime on grain yield of corn and soybean (averages across responsive sites).

# Iowa Nutrient Reduction Strategy: Scaling up, measuring progress and lower risk opportunities for reaching the N and P goals

**Jamie Benning,** Water Quality Program Manager

## Objectives

- Review the Iowa Nutrient Reduction Strategy and the identified nitrate and phosphorus reduction practice options.
- Understand the Logic Model approach to measuring progress of the Iowa Nutrient Reduction Strategy, progress made to date and the need to increase practice implementation to meet the INRS goals.
- Review and discuss opportunities for scaling up to meet the INRS goals including lower risk practices such as establishing cover crops and no-till systems ahead of soybeans.

## Iowa Nutrient Reduction Strategy

The Iowa Nutrient Reduction Strategy (INRS) is a science and technology-based framework developed to assess and reduce nutrient loss to Iowa's local water bodies and the Gulf of Mexico. The strategy addresses methods and practices to reduce total loads of N and P from both municipal and industrial point sources and agricultural nonpoint sources by a combined 45% (INRSSA, 2013). The approach was developed in response to the 2008 Gulf Hypoxia Action Plan that calls for Iowa and other states in the Mississippi River watershed to develop strategies to reduce nutrient loadings to the Gulf of Mexico and ultimately reduce the size of the gulf hypoxic zone.

The INRS Science Assessment outlines the conservation and water quality practices that reduce nonpoint source nitrate-N and phosphorus loss from agricultural land. There are currently 21 practices that have been identified to effectively reduce nitrate-N loss and 15 practices identified for P reduction. The practices address three major areas in the agricultural system where nutrient reduction can be influenced; within the field, at the edge-of-field, and through land use change. Nutrient loss can be reduced in-field through modifications in fertilizer and manure application, using reduced or no-tillage practices, and through use of cover crops. Edge-of-field structural practices reduce nitrate-N in water moving through subsurface drain tile by denitrification or by capturing or filtering P moving with sediment. Land-use changes, including long-term rotations or converting row crop acres to perennial systems, provide vegetative surface cover to minimize soil and P loss and living roots to take up nitrate-N.

## Practice implementation and scale up

The Iowa Water Quality Initiative (WQI) program, funded and administered by the Iowa Department of Agriculture and Land Stewardship (IDALS), is currently providing funding and technical support for 16 watershed-based demonstration and implementation projects (Figure 1) within priority hydrologic unit code (HUC) 8 watersheds. The demonstration and implementation projects aim to conduct education and outreach to increase awareness and engagement and provide financial and technical assistance to farmers and landowners to increase adoption of nutrient reduction practices.

Farmers and landowners that own or operate farms outside of the WQI project watershed boundaries also have opportunities to participate in the program. Cost share funding for priority in-field practices including cover crops, no-till, strip-till, nitrapyrin nitrification inhibitor has been available on a statewide basis since 2013. In 2017, 2,600 farmers participated in the program, utilizing $4.8 million in state cost share funds and matching approximately $8.7 million of their own funds to implement the four practices.

## Tracking progress

To evaluate progress of the INRS, the INRS Annual Report documents change indicators in four major categories, inputs, human, land, and water each year. Changes in financial and technical assistance inputs, INRS knowledge, practices implemented on the landscape, and measured nitrogen and phosphorus loads in water at small and large scales are evaluated. Approximately 760,000 acres of cover crops were established in 2017 with 329,000 acres implemented with state and federal cost-share programs and the remaining 431,000 estimated to be established by landowner, farmer and other private investment (INRS, 2018). Implementation of edge-of-field practices that reduce nitrate loss including saturated buffers, nitrate removal wetlands and bioreactors, has also increased. According to available cost-share practice data, there are currently 86 nitrate removal wetlands installed in the state that are removing nitrate from 104,000 acres of tile drained crop land and 27 bioreactors and saturated buffers treating approximately 1,450 acres (INRS, 2018). Water and sediment control basins, grade stabilization structures and terraces constructed between 2011 and 2017 are reducing sediment and phosphorus loss from approximately 290,000 acres (INRS, 2018). Approximately 1.8 million

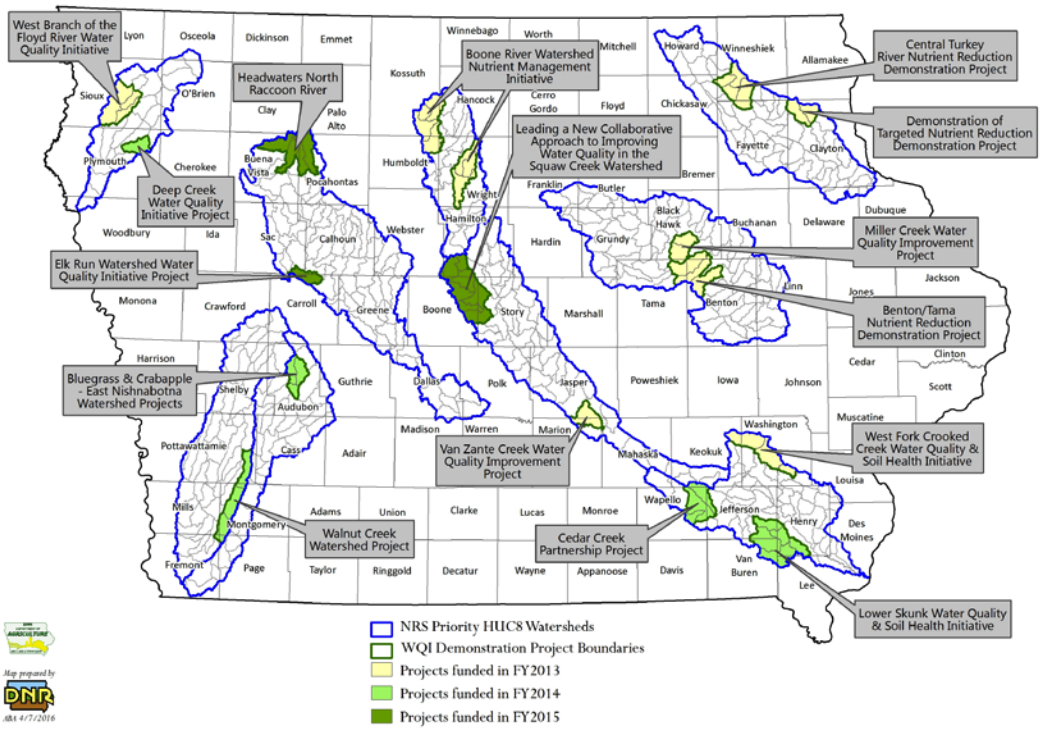



**Figure 1.** Iowa Water Quality Initiative watershed projects.

acres are currently enrolled in the Conservation Reserve Program, a slight increase from the 1.4 million acres in 2016.

## New financial resources

Early in the 2018 legislative session, the Iowa Legislature passed and Governor Reynolds signed legislation that increased funding for water quality improvement. Approximately $2 million in additional funding became available in fiscal year 2019 to support IDALS nonpoint source water quality efforts. An additional $2 million will be dedicated to these efforts next year and approximately $15 million each year from fiscal year 2021 to 2029. The legislation also dedicated funds to the Iowa Finance Authority to be used to reduce point source nutrients through community wastewater treatment facility upgrades. In total, over $270 million will be dedicated to reducing nutrient loss from agricultural nonpoint sources and municipal point sources over the next 11 years.

## Low risk opportunities for scale-up

Increases in practices that reduce nitrate-N and P loss are encouraging, however, acres and numbers of practices currently on the landscape fall far short of what's needed to reach the INRS nonpoint source goals. One potential scenario that will meet the INRS goals outlines that approximately 11 million acres of no-till, 12 million acres of cover crops, 7,600 nutrient removal wetlands, and 120,000 bioreactors and saturated buffers will be needed.

Implementing cover crops and no-till practices ahead of soybeans in the corn-soybean rotation is an opportunity to make progress toward the INRS goals and improve soil health while minimizing risk of yield and profit loss. A 9-year field-scale study by Iowa Learning Farms and Practical Farmers of Iowa found that cereal rye had no impact on soybean yield in most years and increased yield on eight sites by an average of eight bushels per acre. In the same study, cereal rye reduced soil loss by 30-80%. In a ten year study by Mahdi Al-Kaisi, there was no soybean yield response to tillage in most locations when comparing no-till, strip till, chisel plow, deep rip, and moldboard plow corn-soybean systems. Profit was also 17% greater in the no-till and strip till systems compared to chisel plow, deep rip, and moldboard plow. On average, no-till had a lower input cost and greater economic return compared to the conventional systems. Cover crops reduce nitrate-N loss by an average of 31% and P loss by an average of 29%. No-till reduces P loss by an average of 90% when compared to chisel plowing. With just under 10 million acres of soybeans planted in Iowa each year, there is great potential to make progress toward the INRS goals when focusing on applying cover crops and no-till ahead of soybeans.

## Resources

**Reducing Nutrient Loss: Science Shows What Works**
store.extension.iastate.edu/product/13960

**Iowa State University Extension and Outreach Water Quality information**
www.extension.iastate.edu/waterquality

**Iowa Water Quality Initiative**
cleanwateriowa.org

# Cover crop impact on crop yield and water quality: Comparing single species to mixtures

**Elizabeth Juchems**, Extension conservation outreach specialist, Iowa Learning Farms

## Objectives

- Nitrate concentrations in pore water were significantly reduced with cover crops.
- Rye and oats provide the best reduction in nitrate concentration.
- Corn and soybean yields were unaffected by the presence of a cover crop - adjusting planter settings to manage additional residue will minimize yield risk.
- Rye and oats provide the best biomass return on seed investment! Single species are the way to go in Iowa.

## Introduction

Iowa landowners and farmers are seeing the value of single species cover crops. In theory, cover crop mixtures have similar advantages as diverse species ecosystems like prairies. The most important advantage would be greater and more stable total plant growth. The goal was to evaluate management techniques that improve environmental benefits of different cover crop species in improving soil health and reducing nutrient losses.

## Study design

This study was conducted at six ISU research farms with single and mix species cover crops (Figure 1). The study period was 2013 to 2017 and all sites were in no-tillage, corn and soybean rotations. The plots compared three treatments: single species, mixture, and no cover crop, and each treatment is replicated four times in a randomized block design. There are 24 plots at each farm and they range from six to twelve rows wide and all are 50 feet in length.


**Figure 1.** There are six ISU research farms involved in this cover crop mixtures project.

**Figure 2.** Spring cereal rye growth at Northern Research Farm, Kanawha, March 27, 2017.

Before corn: single species is oats and mixture is oats, hairy vetch, and radish. Before soybean: single species is rye and mixture is rye, rapeseed, and radish. The seeding rates were designed to be one million seeds per acre.

For all project sites, spring and fall cover crop biomass and cash crop yield data were collected. To evaluate impacts on water quality, suction lysimeters were installed at 5 sites. Lysimeter pore water samples were taken and analyzed for nitrate-N once every two weeks over the growing season. There were no lysimeters installed at Sutherland and lysimeters were removed from Chariton and Lewis in 2015 and 2016, respectively. There are a total of 22 site-years for yield data and 17 site-years for water quality.

## Results

### *Water quality*

Iowa soils are highly vulnerable to nitrate losses between April and June when natural nitrate production exceeds the cash crop demands. Spring (April to June) had the highest nitrate concentrations during the study. The presence of a cover crop (mix or single species) statistically reduced annual lysimeter nitrate concentration significantly when averaged over all sites. In the soybean mixtures, rye significantly decreased nitrate concentration compared to the cover crop mixture. During cover crop growth (planting in August to termination in May), all treatments had lysimeter readings average below 10 mg/L, including the no cover plots (Table 1).

**Table 1.** Suction lysimeter nitrate-N values in mg/L averaged over all years. Values within the same row sharing a letter are not statistically different (p=0.05).

| Time frame | Site | Crop | No Cover | Mix | Single |
|---|---|---|---|---|---|
| | | | | *mg/L* | |
| Annual 2014-2017 | All | Corn | 13.1a | 10.8b | 10.5b |
| Annual 2014-2017 | All | Soybeans | 7.0a | 4.3b | 3.2c |
| Spring | All | Corn | 15.9a | 12.8b | 12.2b |
| Spring | All | Soybeans | 9.6a | 5b | 3.7c |
| Cover crop growth (Aug-May) | All | Oats (radish, hairy vetch) | 5.6a | 3.9ab | 3.4b |
| Cover crop growth (Aug-May) | All | Rye (rapeseed, radish) | 8.0a | 4.8b | 3.4c |

### *Cash crop yield*

There were no significant yield reductions from cover crop treatments when averaged over all sites for corn or soybeans (Table 2). It should be noted that planter settings are important to handle the additional residue associated with cover crops.

**Table 2.** Corn and soybean yields averaged over all years. Values within the same row sharing a letter are not statistically different (p=0.05).

| Site | Crop | No Cover | Mix | Single |
|---|---|---|---|---|
| | | | *lb/ac* | |
| All | Corn | 209a | 211a | 211a |
| All | Soybeans | 66a | 65a | 64a |

**Figure 3.** Liz Juchems collecting suction lysimeter water samples at the Northeast Research Farm site, November 19, 2015.

### *Cover crop biomass*

Single species treatments produced more cover crop biomass in the fall. Most of the fall mixture consisted of the single species (oats and rye) and regardless of mixture, the non-cereal grain was generally a small amount of total biomass. In the spring, rye consistently survived over winter in every plot.

## Conclusions

This study was one of the first of its kind to evaluate single species vs mixed species cover crops. Corn and soybean yields were unaffected by the presence of a cover crop. Nitrate-N concentrations in pore water were significantly reduced with cover crops. Rye and oats provide the best reduction in nitrate-N concentration, improving water quality. In the observed growing conditions, the mixtures did not provide biomass or water quality benefits compared to single species. Since the mixtures would have greater cost, rye and oats provide the best return on seed investment for environmental services.

## Acknowledgements

This project was a collaboration of Iowa Learning Farms, Iowa State University Extension and Outreach, and Practical Farmers of Iowa. Funding was provided by NRCS Conservation Innovation Grant 69-3A75-13-230 and Leopold Center for Sustainable Agriculture.

## Resources

**Iowa Learning Farms cover crops resources**
www.iowalearningfarms.org/covercrops

**Iowa Learning Farms blog**
iowalearningfarms.wordpress.com

**Iowa Learning Farms on Twitter**
@ialearningfarms

# Long-term tillage and crop rotation effects on yield, economic return and soil organic carbon in Iowa

**Mahdi Al-Kaisi,** professor, Agronomy and Extension soil and water specialist

## Objectives

- Understand the effect of tillage and crop rotation on yield.
- Evaluate system effects on economic return.
- Determine long-term tillage and crop rotation effects on soil organic matter.

## Introduction

The economic returns of corn and soybean with different tillage systems and crop rotations are highly influenced by regional soil and climate conditions. Factors including different tillage systems affect corn and soybean yields through changes in the soil organic carbon and soil water availability. In a long-term study across the state we evaluated yield, economic return of corn and soybean, and soil carbon change from 2002 to 2013 using five tillage systems: no-till, strip-till, chisel plow, deep rip, and moldboard plow. Three crop rotations were used: corn-soybean, corn-corn-soybean, and continuous corn.

## Tillage and crop rotation effects on yield and economic return

The corn-soybean rotation showed the greatest advantage for yield and economic returns corn across all tillage systems, followed by the corn-corn-soybean rotation and continuous corn (Figure 1). Corn yield and economic return penalties with no-till were greater than conventional tillage, especially in the northern locations with poorly-drained soils as compared to the southern locations with well-drained soils. In this study we found corn yield penalty associated with continuous corn rotation was location-specific and varied from 11 to 28% across the state. Also, the corn production input cost for the conventional tillage systems (chisel plow, deep rip and moldboard plow) was greater than that associated with no-till and strip-till by 7.5 and 5.7%, respectively. Soybean yields show no significant response to different tillage systems at different locations and the economic return with no-till ($509/acre) exceeded that with conventional tillage ($502/acre). Input cost associated with soybean with no-till was lower ($187/acre) than that with conventional tillage ($207/acre). The corn-corn-soybean rotation resulted in greater soybean yields (9%) and economic returns (11%) than those with the corn-soybean rotation in five out of the seven locations across Iowa. Rotation effect on soybean yield was greater than the effect of tillage on soybean yield where differences in soybean yields were not significant.

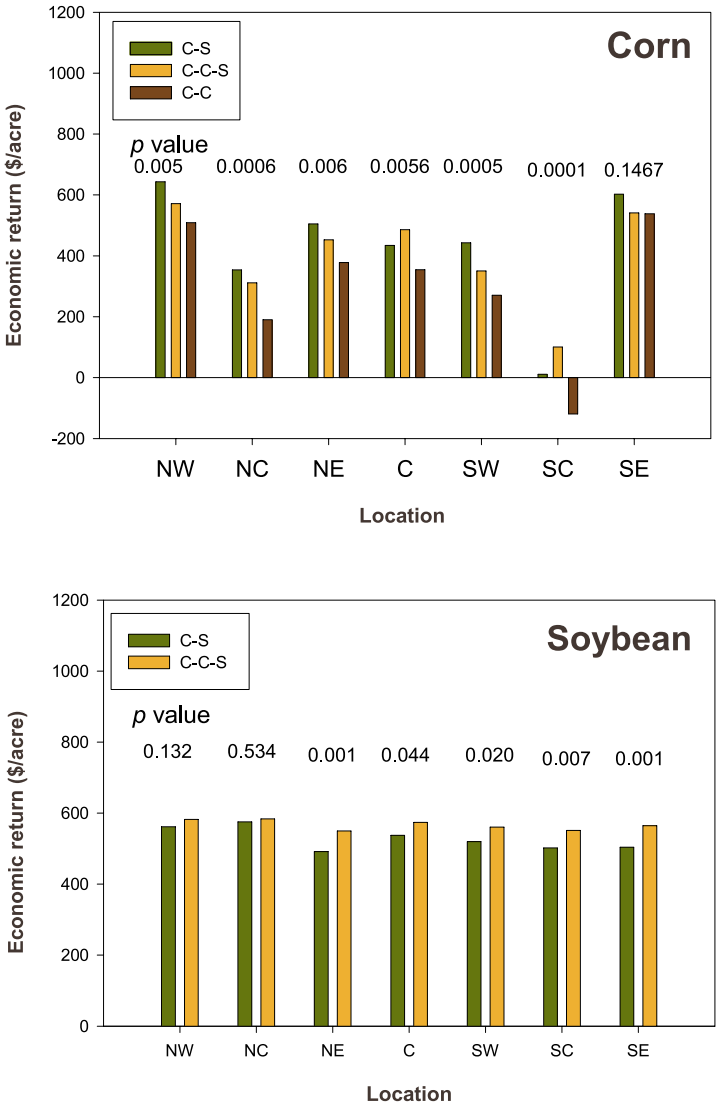



**Figure 1.** Corn and soybean economic return as affected by tillage and crop rotation across seven Iowa locations. Crop rotations: corn-soybean (C-S), corn-corn-soybean (C-C-S) and continuous corn (C-C). Locations: northwest (NW), north central (NC), northeast (NE), central (C), southwest (SW), south central (SC) and southeast (SE).

## Tillage and crop rotation effects on soil organic carbon

The effects of the five different tillage systems on soil organic carbon changes (gain or loss) in 0-24 inch depth for Sutherland, Kanawha, and Crawfordsville within each crop rotation are summarized in Figure 2. The rates of soil organic carbon gain with no-till and strip-till across the three crop rotations studied was 0.26 and 0.20 ton/acre/year at Sutherland; 0.20 and 0.15 ton/acre/year at Kanwaha; and 0.24 and 0.16 ton/acre/year at Crawfordsville, respectively. Alternatively, the rates of soil organic carbon loss across three crop rotations with chisel plow, deep rip and moldboard plow at Sutherland, Kanawha, and Crawfordsville was -0.29, -0.19, and -0.31 ton/acre/year; -0.23, -0.16, and -0.27 ton/acre/year; and -0.32, -0.28, and -0. 34 ton/acre/year, respectively. Generally, the average gain in soil organic carbon with no-till and strip-till across all crop rotations and sites over 14 years was 0.23 and 0.17 ton/acre/year, respectively. The average soil organic carbon loss with chisel plow, deep rip and moldboard plow across the same rotations and sites was -0.28, -0.21, and -0.31 ton/acre/year, respectively. The results showed that soil organic carbon gain or loss is highly affected by tillage intensity.

## Resources

**Iowa Soil Health Management Manual**

store.extension.iastate.edu/product/14682

**Soil Management and Environment**

www.extension.iastate.edu/soilmgt

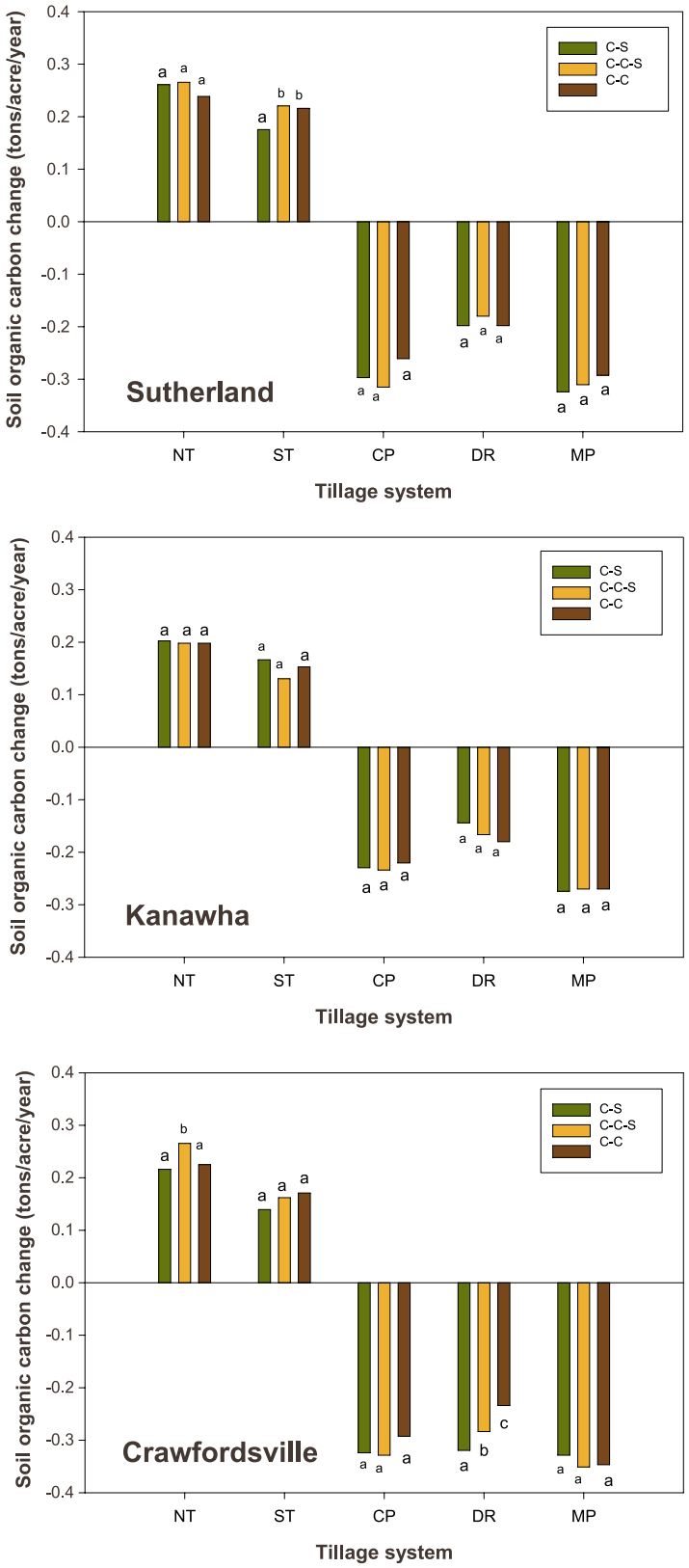



**Figure 2.** Effect of five tillage systems and three crop rotations on soil organic carbon gain or loss in the 0 to 24 inch soil depth over 14 years at Sutherland, Kanawha, and Crawfordsville, Iowa. Tillage systems: no-till (NT), strip-till (ST), chisel plow (CP), deep rip (DR), and moldboard plow (MP). Crop rotations: corn-soybean (C-S), corn-corn-soybean (C-C-S) and continuous corn (C-C).

# Finding opportunity areas for wildlife habitat on the farm

**Adam Janke,** assistant professor, Natural Resources and Ecology Management and Extension wildlife specialist

## Objectives

- Describe the basic elements of quality wildlife habitat.
- Recognize unique opportunity areas for wildlife habitat on working farms.
- Understand how to layer wildlife habitat with soil and water conservation practices on the farm.

Wildlife are an essential and welcome element of Iowa's farms where they survive in a wide variety of habitats. There, wildlife help with pest control of weed seeds, aerial insects, and herbivores, enrich aesthetics, and provide for opportunities for family and friends to enjoy the outdoors through hunting or careful observation. This presentation introduces the basics of on-farm habitat conservation and points interested producers to resources to help make wildlife habitat improvements on the farm in opportunity areas that can in many cases improve profitability.

Just like humans, wildlife need places to live, and management and creation of these areas is the essence of wildlife conservation in Iowa. Also like humans, wildlife need more than just one element in their habitats. Imagine for example if we offered humans access only to building materials for their homes, but no plumbing to bring water or take away waste? Or what if we placed all the grocery stores in the neighboring county, with only buildings and water in our own? These fundamental characters of a quality place to live are what comprise the essential elements of wildlife habitat, and without food, water, shelter, and considerations for their size and arrangement relative to on another ("space") we cannot make the most of our farms for wildlife (Figure 1).


**Figure 1.** The key features of wildlife habitat on any farm.

Equipped with a basic understanding of what makes wildlife habitat work, we can then set out on our farms to find places where wildlife habitat already exists, or could be created or enhanced. I call these areas "opportunity areas" because they represent areas on the farm where improvements for wildlife can improve the efficiency, aesthetic, soil health, or water quality on the farm – a win-win for wildlife, farmers, and everyone who depends on our lands. We can find these opportunity areas in four areas.

**Existing patches of habitat** like forested areas, along drainages or waterways, old fields, or patches enrolled in federal programs like Conservation Reserve Program or Wetlands Reserve Program can often be improved for wildlife. Common practices for improving existing habitat patches include light disturbances like grazing and fire that promote growth of a diversity of native flowering plants or strategic cutting in forests to favor certain trees or control invasive species. Consultation with a professional wildlife biologist or forester (like those indexed on the contact feature linked in the Resources section) can help identify these areas and practices, and often reveal cost share available to help implement habitat improvements.

The second opportunity area for wildlife habitat on the farm is to create new habitats in **underperforming or profit loss areas** in crop fields. Many traditional crop fields have areas that year-after-year fail to produce enough to offset the costs of the inputs used there. In these areas 'precision conservation' can improve the balance sheet and also create new wildlife habitats, often with the help of cost share programs. Areas to look include wet spots within fields, flood-prone areas adjacent to streams or ditches, highly eroded or erodible hill sides or tops, and along field edges where years of compaction and/or competition from adjacent trees inhibit crop growth. Finding these areas by paying close attention to the view from the combine or interpretation of yield maps can allow producers to remove high-input low-return parcels from the balance sheet and focus on the best areas within the field. (Figure 2)

Another opportunity area for creating wildlife habitat on the farm is to focus on **existing idle areas** that can be left to grow up into wildlife habitat or converted into diverse prairies. How do you find these areas? Look anywhere you currently mow and ask whether those mowed areas are necessary? Could those mowed areas be converted to prairies or left to grow up into grasses and flowers? Could you reduce the size of your yard? Or drive equipment


**Figure 2.** Wet, highly erodible, and compacted areas along field margins are opportunity areas for strategic integration of wildlife habitat onto working farms.

across prairie rather than mowing areas only used once or twice a year? Perhaps the greatest lost opportunity for wildlife habitat on our modern farms and in our modern cities are all the acres that are maintained in mowed grass only because we do not have any better ideas for their use. Make these areas wildlife habitat, save time and money, and help the birds and butterflies all at once!

The final and perhaps most promising opportunity area for wildlife habitat on the farm is in concert with any and all improvements in **water quality and soil conservation practices** planned or already implemented. Edge-of-field water and soil conservation practices almost exclusively target marginal areas on farms or existing areas already out of production and can create layered multi-functional benefits that improve soil, water, wildlife, and even the aesthetics of our landscape all at once. Practices like wetland restoration, nutrient reduction wetlands, wind breaks, prairie strips, and saturated buffers all help improve land and water while also creating wildlife habitat and attractive features on the land. A win-win-win for land, people, and wildlife.

Many of these practices have cost share available to help. You can learn more about most programs through the Natural Resources Conservation Service office in your county. In addition to the more common programs like CRP, be sure to ask about wildlife habitat practices under Environmental Quality Incentives Program (EQIP) or the Conservation Stewardship Program (CSP). The Iowa DNR also has people and programs, like the Prairie Partners Program (that provides cost-share to buy native prairie seed), to help. And other organizations like watershed groups, the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife program, Pheasants Forever, and The Nature Conservancy can all help in many places throughout Iowa. Learn more and find these people in the resources section and start your plan for improving opportunity areas for wildlife on your farm today.

## Resources

**Iowa State University Wildlife Extension and Outreach**
www.nrem.iastate.edu/wildlife

**Contact information for professional wildlife biologists**
www.nrem.iastate.edu/wildlife/contacts/Wildlife-Habitat-Programs-and-Consultation

**Native Prairie Planting Guides and other NRCS publications**
www.nrcs.usda.gov/wps/portal/nrcs/ia/newsroom/factsheets

# Cutting through the confusion: Online decision support tools for monitoring climate and weather

**Justin Glisan**, State Climatologist of Iowa, Iowa Department of Agriculture and Land Stewardship

## Objectives

- Identify the best resources for localized agricultural decision support.
- Understand how online decision-support tools help stakeholders make better long-term choices.
- Understand how to use meteorological observations for agricultural guidance.

Weather and climate data provide farmers and stakeholders in the agricultural sector vital information and guidance, especially throughout the growing season. These data are particularly useful when they deliver real-time, quality observations as well as short-term and long term climate outlooks. Obtaining this data can be a challenge since farmers are inundated with websites, expensive proprietary products and technologies that can be used to gather this type of information.

Quality meteorological observations are an integral part of monitoring current conditions and should be stored and made available after the fact. This is important in terms of constructing a long-term observation record, as location dependent trends are invaluable for numerous reasons, including drought and wetness monitoring. High frequency observations are also helpful in situations that may have legal implications, such as pesticide spraying and drift. There are numerous smart phone apps available that have GPS services and thus "this is where you are and these are the current conditions" capabilities. Many Midwestern states use high frequency observations to monitor low-level temperature inversions in real-time. These inversions can suspend pesticide droplets and cause secondary drift and crop/vegetation damage. Online graphical tools are available to stakeholders that alert them whether or not to spray given a location, current conditions and inversion probability.

Along with observations, climate outlooks are also a great asset for decision making. The Climate Prediction Center (CPC), a branch of the National Oceanic and Atmospheric Administration (NOAA) creates the main outlook information for the United States. These outlooks are based on the probability that temperature and precipitation will be above or below the 30-year climatology. The most useful of these outlooks tend to be the short-term 6-10 and 8-14 day products. These outlooks provide good guidance in terms of shorter-term precipitation and temperature

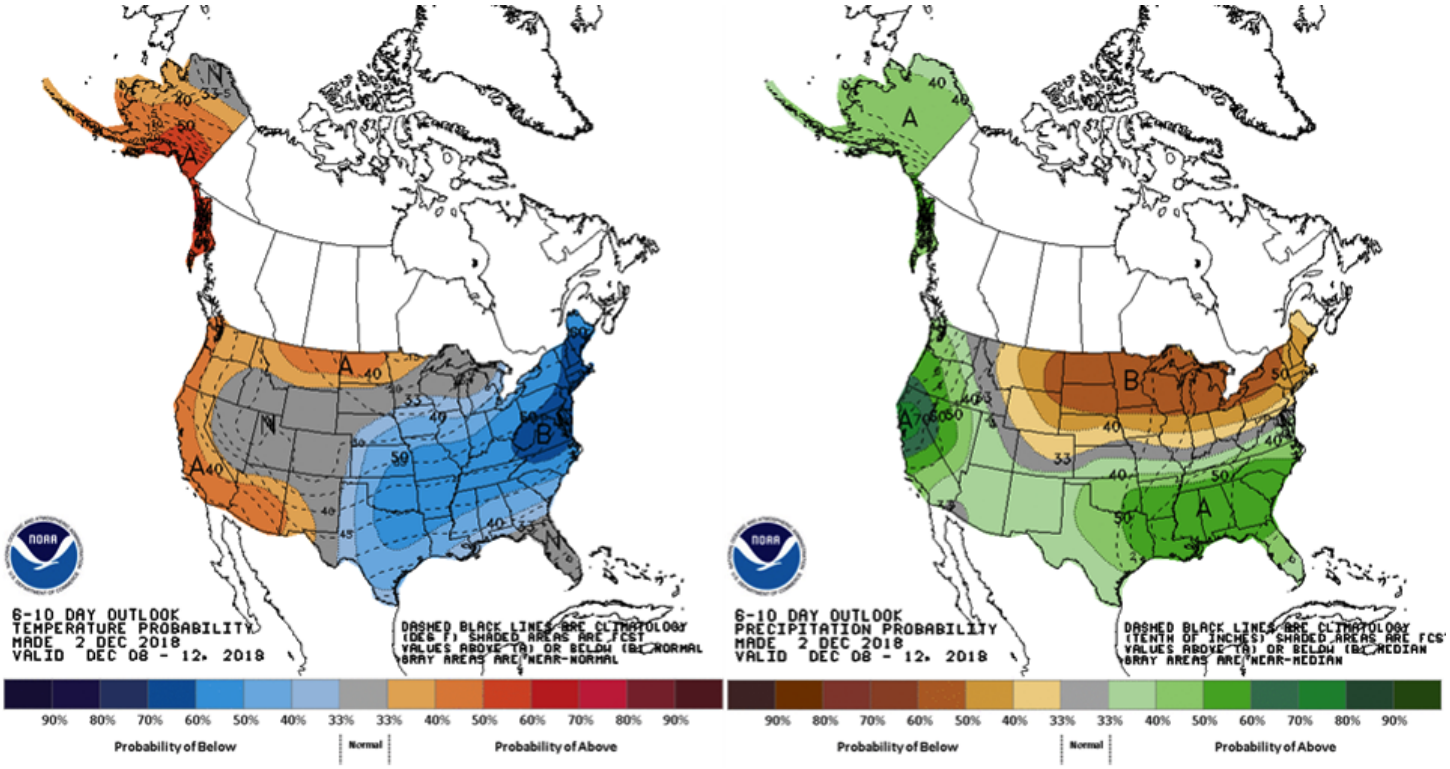



**Figure 1.** Climate Prediction Center 6-10 day (left) temperature and (right) precipitation outlooks.

behavior using an easy to understand graphical mapping. For example, precipitation outlooks use a color scale from brown to green; the darker the brown (green) the higher the probability, and hence confidence, that a location will be drier (wetter) than climatological expectation. These products are updated daily around 2:00 PM ET. Many private companies also create more specific outlooks. These outlooks can add some value, though their methodologies may diverge, where CPC uses a suite of tools for a consistent product.

The Midwestern Regional Climate Center (MRCC) provides a suite of decision-support tools to help stakeholders and producers make better long-term decisions. The Useful to Useable (U2U) suite has a Corn GDD tool that tracks "real-time and historical GDD accumulations, assess spring and fall frost risk and guide decisions related to planting, harvest and seed selection." This tool integrates the stages of corn development with location-specific weather and climate data for decision-support specifically tailored to production.

## Resources

**Climate Prediction Center Outlooks**
www.cpc.ncep.noaa.gov

**Midwestern Regional Climate Center - Useful to Usable**
mrcc.illinois.edu/U2U

**Iowa Environmental Mesonet**
mesonet.agron.iastate.edu

**Climatology Bureau, Iowa Department of Agriculture and Land Stewardship**
www.iowaagriculture.gov/climatology.asp

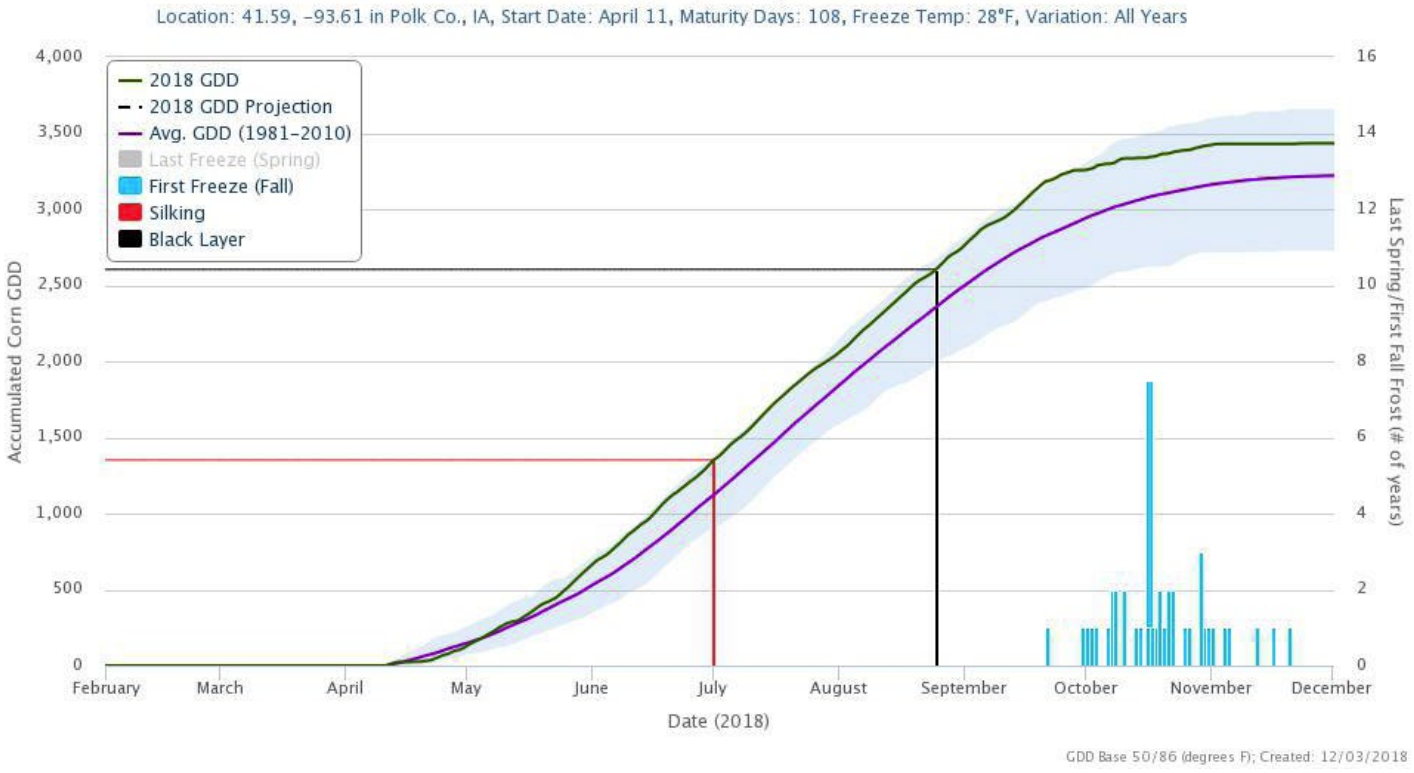



**Figure 2.** MRCC Useful to Usable Corn Growing Degree Day tool.

# Farmland leasing: Trends and strategies

**Melissa R. O'Rourke,** Extension farm management field specialist

## Objectives

- Explore categories of information shared between farmland owners and producer tenants.
- Understand the nature of methodology of fixed cash rent farm leasing.
- Analyze methods to apply flexible methods to determine cash rents.
- Identify resources available to assist farmland owners and producers to reach fair cash rent arrangements.

In some Iowa counties, as much as 70 percent of the land is farmed by producers who do not own it. Throughout farm country, there is a steady and increasing number of farmland owner and producer relationships.

There are two particularly common categories of farmland owners. First, there are owners who actively farmed the land in past years, have now retired and are leasing the acres to farm producers. In these relationships, a key consideration is the length of time since the owner was an active farmer. The more years that have lapsed since the owner was involved in active farm production, the more important it is to engage in ongoing communication and education regarding the latest crop technology, production costs and related trends.

Second, there is a growing number of farmland owners who have never been personally involved in farm production. Such owners may have inherited the land (or purchased it as an investment) and now lease it to active farmers. Some of these owners may have never lived on or near the farmland that they now own; in fact, some may have never seen the farmland. These farmland owners have a high learning curve, with much information to absorb regarding farming practices and the economics of crop production. At the same time, tenants must take on increased responsibility for anticipating questions and providing information to the landlord.

Communication is a key challenge for all farmland owners and producers. Farmland owners commonly express frustration that they do not know how their land is being farmed and what it is producing. Tenants may not understand that farmland owners often have a deep desire to learn how the farmland is being cultivated and cared for by producers. It is to the benefit of both owners and tenants to build relationships and communicate with one another.

Commonly, a farmland leasing agreement may include a provision requiring the operator to provide an annual report to the owner. See for example paragraph 7(e) of the Iowa Farm Lease Form (AgDM File C2-12). See also paragraph 10 of the Iowa Cash Rent Farm Lease (Short Form) (AgDM File C2-16).

The purpose of the annual report form is to enhance communication. This report form is intended to provide farm tenants and landowners with a guide for sharing crop information for farmland rental agreements and to aid in communication. It is not intended to take the place of legal advice pertaining to contractual relationships between the parties. The parties can certainly revise or design their own form if changes are desired. However, by using this form, the parties will have a consistent format to share information. Separate forms can be used for each parcel in a manner that is convenient for the parties.

If a form such as this has not been used in the past, the farmland owner and the producer should discuss the purpose of the reporting process. The parties should agree

### Landlord-tenant communication is a two-way street

Farmland **owners** need to be receptive to learning about current farming challenges, conditions, and costs of productions. **Producers** need to be receptive to the interests and goals of the farmland owners and be willing to share operational information about inputs, yields, and crop plans.

### The facts

- ➔ Up to 70% of the land in some counties is under a form of rental agreement.
- ➔ Statewide, 53% of Iowa land is rented:
  - 68% cash rent
  - 14% flexible cash rent
  - 17% crop share
- ➔ 34% of Iowa land is owned by individuals with no farming background. Much of this is inherited.
- ➔ 23% is owned by farmers that are retired or not actively farming.

upon the confidential nature of the information shared on this form. A landlord must understand that the farm tenant does not want this proprietary business information shared with others who have no right to this data. Likewise, the tenant should understand that the landlord has a right to know how the farmland is being utilized for crop production. Conversations based on the reported information should help the owner and producer to grow in understanding their relationship, to the mutual benefit of both parties.

Farmland cash rent agreements can result in a fixed (per acre) rental rate, or a flexible methodology can be used. Fixed cash rent lease agreements are popular because both parties know exactly what the rent will be, and the owner is relieved of risk involvement because the risk and returns from changing prices, yields, and costs are all borne by the tenant.

Several methods for computing cropland rental rates are outlined in AgDM File C2-10 – the annual Cash Rental Rates for Iowa Survey. It is important to remember that determining a farmland rental rate is not a simple matter of just looking at this annual opinion survey and finding numbers for the county in which the land is located. Rather, estimating fair cash rental rates for cropland can be based on a variety of perspectives including: What others are charging/paying; average yields; corn suitability ratings (CSR2 index); share of gross crop value; return on investment/value; crop share equivalent and tenant's residual methods.

Flexible cropland cash rents have even more possibilities for determining the rents – and approximately 18 percent of all Iowa cash rent leases use some type of flexible methodology. Some of these can be found in the AgDM File C2-21 Flexible Farm Lease Arrangements; and AgDM File C2-22 Flexible Cash Rent Lease Examples. These flexible methods help to take into account fluctuating markets and uncertain yields, and allow the rent to be determined after the crop is harvested, when the final rental rate is based on actual prices and/or yields. Flexible leases have the advantage of sharing both risk and profit opportunities between the land owner and the farm tenant. At the same time, the owner is paid in cash and does not have to be involved in decisions about crop inputs or grain marketing.

## Resources

**Ag Decision Maker—Farmland Leasing Resources**
www.extension.iastate.edu/agdm/wdleasing.html

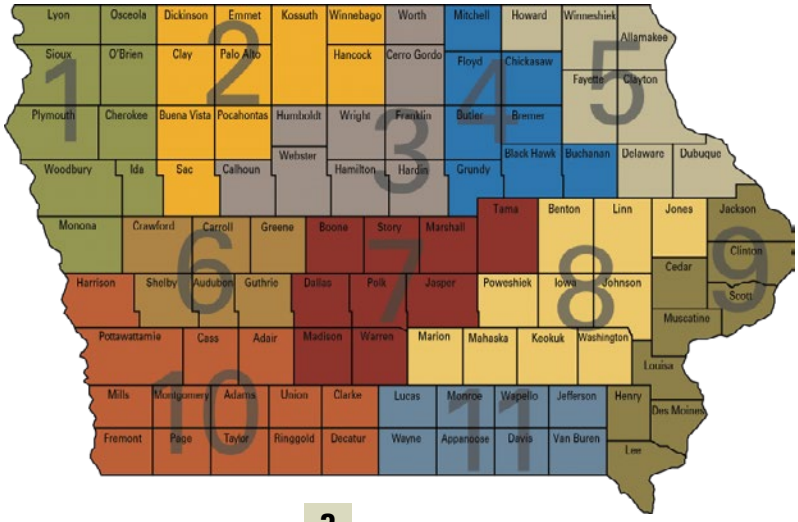
**Farmland Lease Annual Report**
www.extension.iastate.edu/agdm/wholefarm/html/c2-06.html

**Computing a Cropland Cash Rental Rate**
www.extension.iastate.edu/agdm/wholefarm/html/c2-20.html

# IOWA STATE UNIVERSITY
Extension and Outreach

## Field Agronomists

Iowa State University Extension and Outreach Field Agronomists are located throughout Iowa to assist farmers with current crop production and protection information. They serve as a vital link in delivering current, relevant and research-based information to the citizens of Iowa.

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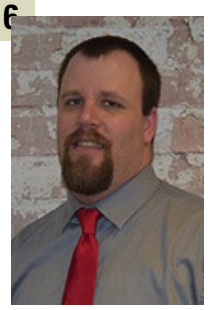

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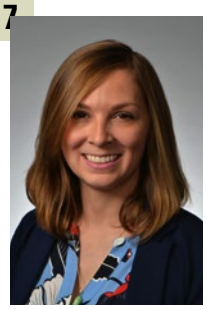

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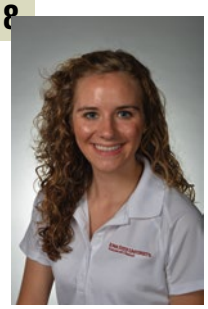

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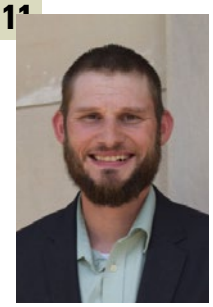

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