CropWatch No. 98-5, April 17, 1998

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Soilborne wheat mosaic is in full bloom. The Plant and Pest Diagnostic Clinic received two soilborne positive wheat samples last week — one from Red Willow County and the other from Lancaster County. The recent cool, wet weather conditions have been ideal for the expression of symptoms.

In the field, the disease appears as irregular patches of yellow or pale green wheat. The pattern may conform to low areas or drainage paths or just be generally distributed across the field. Infected plants are stunted and yield may be reduced 0% to 50%. Susceptible varieties will have the greatest yield losses. The following table lists those varieties rated as susceptible to soilborne wheat mosaic:

<table>
<thead>
<tr>
<th>Variety</th>
<th>Type</th>
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</thead>
<tbody>
<tr>
<td>Akron</td>
<td>Nekota</td>
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<tr>
<td>Alliance</td>
<td>Niobrara</td>
</tr>
<tr>
<td>Centura</td>
<td>Ogallala</td>
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<tr>
<td>Lamar</td>
<td>Pronghorn</td>
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<tr>
<td>Longhorn</td>
<td>Rawhide</td>
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</tbody>
</table>

Arapahoe is rated as moderately susceptible. Once the disease is established in the crop, there is nothing a grower can do to correct the problem, except to plan for next year. Preventive measures include proper planting time in the fall and growing resistant varieties. Those wheat varieties resistant to soilborne mosaic include:

<table>
<thead>
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<th>Variety</th>
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<td>Abiline</td>
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<td>Karl/Karl 92</td>
<td>Jagger</td>
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<td>Coronado</td>
<td>Big Dawg</td>
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<td>2163</td>
<td>Thunderbird</td>
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</tbody>
</table>

What's causing poor corn stands?

Keith Glewen, Extension educator in Saunders County, shared some producer concerns related to poor corn stands. Following are responses from several specialists.

Glewen: In recent years and especially last year we have seen some problems with poor stands in corn fields. In most cases it was no-till corn planted in soybean residue. In monitoring a field we would find cutworm evidence, but it usually couldn’t explain the entire stand reduction. The seed company blamed the herbicide and the chemical company representative blamed the seed. My conclusion was that it was a combination of all factors as a result of the below normal temperatures and the long duration of those temperatures.

At winter meetings Extension specialists recommended a preventative application of fungicide and insecticide with the planter. Some operators have had mixed results with seed box treatments or they don’t like working with the product and are listening closely to the other product information.

Dealers and growers are asking (Continued on page 47)
Paul Hay, Extension Educator in Gage County: Corn planting was started Tuesday in the Plymouth area. Wheat is looking pretty good but only 5-10% is fertilized and has weed control. Be safe, lots of work and tension coming.

Delroy Hemsath, Extension Educator, Frontier County: Army cutworms continue to be a problem in alfalfa and wheat fields in most of Frontier county. The number of worms per square foot range from 8 to 15. Damage to alfalfa is very noticeable but damage to wheat is not as evident. Most fields have been sprayed and the crops are getting ahead of the problem. Some wheat fields in eastern Frontier County are showing soil-borne mosaic and yellow dwarf disease symptoms. Pennycress populations are high in some fields and the survival rate on the plants has been good. Contrary to other areas of the state, we need some rain.

Gary Hall, Extension Educator in Phelps and Gosper counties: With warm dry conditions many farmers are applying fertilizer and preparing seedbeds. Planters have been field ready for some time and if the weather holds some will be in the fields this week. Some potatoes were planted last week in the Platte River Valley, but rains delayed further planting. Farmers are extremely busy trying to fit in as much work as possible. Good weather days have been at a premium and producers are trying to make the most of those days.

Andy Christiansen, Extension Educator in Hamilton County: We have an alfalfa field along the Platte River northeast of Phillips that has severe damage from army cutworms and bristly cutworms. About five acres of a 20-acre field has very little green showing. Cutworms ranging from .5 to 1 inch in length, most around .75 inch. There also have been reports of army cutworm damage near Palmer.

Bob Wright, Extension Entomologist at the South Central Research and Extension Center, adds: This infestation in south central Nebraska is unusual because it is further east than is usually found for severe problems. It further demonstrates the degree of the problem with armyworms this year.

Jim Schild, Extension Educator in Scottsbluff County: I would estimate about 30% of our alfalfa acres are going to need treatment for cutworms in ScottsBluff County.

Donald W. Lydic, Extension Educator in Custer County: Farmers are cutting corn stalks, disking and applying anhydrous ammonia. I have received numerous calls from alfalfa growers wanting to know if they should spray for army cutworms. Farmers are preparing fields for spring alfalfa seeding.

Axiom labeled

Axiom, the new herbicide from Bayer, has recently been labeled. Axiom is a PPS, PPI, and PRE in corn and soybean. Axiom is a shoot inhibitor comprised of a 4:1 ratio of fluthiamide and metribuzin (Sencor) which provides control of many

(Continued on page 44)
Tips on using burndown herbicides in no-till

Preemergence herbicide treatments are commonly used for weed management in no-till corn, sorghum and soybean production. Many of these broad-spectrum treatments will control emerged small (2- to 3-inch) broadleaf weeds and may control grasses up to 1.5" tall. The weed response tables for burndown herbicides in the 1998 Herbicide Guide rate herbicides against emerged weeds. Larger emerged weeds require a postemergence herbicide and can be combined with the preemergence herbicide.

Herbicides useful for controlling emerged weeds prior to no-till planting include Gramoxone Extra, Banvel, Clarity, Roundup and Touchdown. Gramoxone Extra will control broadleaf weeds and grasses up to 4 inches tall. Roundup and Touchdown will control large emerged grasses and broadleaf weeds. There is no waiting period required before planting following a Gramoxone Extra, Roundup or Touchdown treatment.

Emerged broadleaf weeds can be controlled prior to planting with Banvel, Clarity and 2,4-D, however an interval between treatment and planting is required. Following 2,4-

D amine or ester at 0.5 lb ai/a, do not plant corn for seven days. Soybeans can be planted seven days after a 0.5 lb ai/a application of 2,4-D ester. Amine formulations of 2,4-D are not registered as preplant treatments for soybeans. Also 2,4-D is not registered as a preplant treatment for sorghum. The ester form of 2,4-D is usually used in preplant treatments because it is more active than the amine, particularly under cool conditions.

According to the labels corn can be planted immediately after a 1 pt/acre application of Banvel or Clarity on fine textured soils with greater than 2% organic matter and a 0.5 pt/acre application on coarse textured soils. We suggest waiting five days after treatment before planting.

Alex Martin
Extension Weeds Specialist

Corn planting starts in southeast

This year’s spring offers a variety of situations for farmers, from fields too wet to get in to to apply fertilizer, to fields too dry and needing moisture for the soil profile. Corn planting has started in southeast Nebraska. Across the state planting usually starts when the average daily soil temperature reaches 50°F — warm enough to initiate germination and sustain seedling growth. However, the calendar, not soil temperature, should guide corn planting.

On average, about 30% of the state’s corn is planted before May 4. Research from North Dakota shows that for each day planting is delayed after May 15, producers can expect approximately one bushel per day loss in potential grain yield.

Producers planting early in the season should be aware that:
— The rate of seedling emergence is lower in cold soils, so increase plant populations 10-15%.
— Late-season frost shouldn’t affect seedlings, since the plant’s growing point remains below ground for two to three weeks after emergence. If early emerging leaves are damaged by frost, it’s unlikely to have serious effects on grain yields.

Lenis Nelson
Extension Specialist

Field safety is paramount when weather delays lead to rushing

With field activities being delayed in some parts of the state, producers should recall 1993 when many activities were squeezed into a fairly tight window of opportunity in the spring. Unfortunately, the rush to get field work done likely contributed to increased accidental farm deaths that year — including eight in a five-week period from April 24 to May 31. Most of the accidents involved tractors overturning or running over people.

Following these tips can help you have a safer spring:
• Don’t haul more than one fertilizer tank at a time and stay below 25 miles per hour — the wheel and tires on these trailers are not designed for highway speeds.
• Tanks should have safety chains and a locking drawbar pin.
• Don’t haul more equipment than you can safely stop.
• Be sure reflectors and warning lights are clean and easily visible. If you’re working in muddy conditions, clean off signs, lights and windows before returning to the road.
• Make sure the flush water supply is replaced daily. Use goggles, rubber gloves, and appropriate protective clothing.
• Take care of yourself by getting plenty of rest, eating nutritious meals, and taking breaks during the day. Don’t overuse caffeine or alcohol.
• When a tractor becomes mired in mud, get another vehicle to pull it out. Use chains or cables with enough capacity for the job.

When you’re in the field, don’t take shortcuts that might cost you your health. Farm safely, stay alert to watch for others, and tell others what you’re doing.

Dave Morgan
Extension Safety Engineer
How to select the right seed-to-soil attachment for your planter

Some producers have problems establishing seed-to-soil contact and closing the seed furrow when planting in less than ideal conditions. Others report problems with sidewall compaction when opening a seed furrow in wet soil conditions. Industry has responded with a wide and sometimes confusing variety of attachments to improve planter performance. Before buying any attachment, determine how it functions, is it needed, and will it create other problems with the planting process.

Small diameter (5- to 7-inch) seed press wheels are available to press the seed into the bottom of the seed furrow, providing good seed-to-soil contact and a uniform planting depth. These wheels, however, do nothing to close the seed furrow and can increase sidewall compaction. They were designed for use in dry soils to provide the extra seed-to-soil contact needed to get moisture to move to the seed. In wet soils, particularly when loose soil is in the seed furrow, the small diameter wheel may pick up the seed, knocking it out of the seed furrow or affecting planting depth. Most manufacturers recommend removing this wheel or locking it up in wet conditions.

Another small diameter wheel is available from one manufacturer to "score" the soil to aid in closing the seed furrow. This sharp-edged furrow closing wheel operates approximately 3/4 inch to the side of the seed furrow, at a 3/4 inch angle, about 3/4 inch deep. This provides some loose soil for the press wheels to cover the seed and establish seed-to-soil contact with. With this loose soil, the press wheels can be operated with less downpressure, reducing overpacking of the seed furrow. When planting in wet soils, the loose soil moved into the seed furrow reduces the chance of the seed furrow opening back up as the soil dries and shrinks. However, the wet soil loosened by this wheel may stick to the press wheels and a scraper may be needed to keep the press wheel clean.

Larger diameter (10-inch or more) seed press wheels are used on some planters and are popular on many no-till drills to provide seed-to-soil contact in the bottom of the seed furrow. The larger diameter wheels, particularly with soft rubber tires that flex, are less likely to pick up the seed in wet conditions. With a small diameter, the wheel's point of contact on the seed moves almost straight up as the wheel leaves the seed. The point of contact on a larger wheel leaves the seed in a more tangential direction, leaving the seed in the furrow. A set of covering disks and/or a harrow are used behind the seed press wheel to close the seed furrow.

Spiked, curved-tine, or lugged closing wheels can be used to "till" the seed furrow closed. The downpressure on the closing wheels has to be reduced so as not to till the seed out of the seed furrow. While effective at closing the seed furrow and tilling in the sidewall, these attachments often do not provide sufficient seed-to-soil contact and should be used in conjunction with a seed firmer. The tillage may leave the soil loose above the seed, allowing the seed zone to dry out. A wide press wheel or drag chain behind the closing wheels can be used to firm the soil to reduce soil drying.

A plastic device is available from a couple of manufacturers to help place all the seeds in the bottom of the seed furrow at a uniform depth. These devices usually attach to the seed tube and do nothing to close the seed furrow. They may pay for themselves by providing a more uniform crop emergence, particularly if seed bounce is a problem in rough fields or at higher planting speeds. One of the devices provides seed-to-soil contact by pressing the seed into the bottom of the seed furrow as well. If too much downpressure is applied to either one, the device may drag seeds in the seed furrow, particularly if the soil is wet and sticky. Closing the seed furrow is accomplished with a separate device.

With any planter, the units need to be leveled or operated slightly tail-down to provide seed-to-soil contact. Sufficient weight must be on the press wheels to ensure firming of the seed into the soil. Wet soil is easily compacted and care must be taken not to overpack the soil, making it difficult for seedling roots to penetrate. In dry soil conditions, extra closing force may be needed. The key is to evaluate seed-to-soil contact, not the top of the seed furrow. Closing the seed furrow may be a separate step, even with something as simple as a harrow, a common practice on drills.

Paul Jasa
Extension Engineer

Axiom

(Continued from page 42)
anual grasses and some broadleaf weeds. This is a dry flowable formulation that must be mixed in water or sprayable fluid fertilizer. Application rates are 13–23 oz/acre in corn and 7–13 oz/acre in soybeans depending on soil texture and organic matter. Axiom may be tank-mixed with certain herbicides to improve broadleaf control.

Alex Martin
Extension Weeds Specialist
You’ve heard the commercial talk, now learn what it means

Creating a genetically engineered crop

Corn and soybean seeds from bags labeled “Roundup Ready,” “Liberty Link,” “Bt” or a combination of these are being planted this spring on record acreage in Nebraska. The seed from these bags looks normal, but its unique value will be apparent later in the season as producers capitalize on the genetically endowed ability of these crops to resist damage from “Roundup” or “Liberty” herbicide or to ward off corn borers. How are these genetically engineered crops developed? The process is a result of a new partnership between genetic engineers and plant breeders.

Careful crossing and selection by the plant breeder in the past has resulted in successful genetic improvement in crop varieties and hybrids. Plant breeding remains a critical component to the development of genetically engineered crops. However, genetically engineered crops are different because of their starting point. Plant breeders were once limited to searching for desirable traits in plants that could be crossed with the crop variety and produce fertile offspring. Now the genes controlling these traits can originate from any organism. The genetic engineer orchestrates the transfer of these genes into the crop plant. Then the breeder takes over to insure that the new genes are passed onto lines with the elite genetic makeup for overall agronomic performance.

There is a common process which the genetic engineer follows to introduce new genes into crops.

**Step 1: Discovering genes**

The traits of every organism are controlled by its genes. The first step in developing a genetically altered crop is discovering an organism that has the trait you want in your crop plant. Bacteria were the source of “Roundup”, “Liberty” and “Bt”. While bacteria will not be the source of all genetically engineered traits in crop plants, these first products illustrate that the normal barriers of sexual crossing are broken with the tools of genetic engineering.

(Continued on page 46)
Genetically altering crops (Continued from page 45)

The Bt gene

Bt corn has its beginning with a common soil bacteria called Bacillus thuringiensis (Bt). Many years ago, it was discovered that strains of this bacteria had a toxic effect on insect larvae in the lepadoptera family. Further investigation revealed that a crystalline protein made and stored in the bacteria was responsible for this toxicity. These Cry proteins would break down into endoxins when ingested by the larvae, bind to the midgut and cause rapid death.

How does the Bt bacteria make these toxic Cry proteins? The bacteria has the genes to do it. Genes control traits by encoding proteins. Genes are made of a molecule called DNA. The DNA sequence of a gene provides codes for the amino acid sequence of a protein. DNA is inherently stable. It can be removed from the bacteria, moved into other living cells and maintain its coding ability.

Step 2: Transformation — putting new genes into the plant

The method of reading the coded information in a gene is universal. The gene information from the Bt bacteria will be read the same way by the corn plant. This fact makes genetic engineering possible. If the gene can be placed inside the plant cell and become a permanent part of the cell’s genetic information, the plant can then read the instructions to make the corn borer-toxic protein.

The new gene introduced into the plant (the transgene) needs to reside in every cell of the plant so that the gene can be read by all cells that need to make the new protein. This also insures that the new gene is passed on to offspring in a predictable manner. It would not be possible to accomplish this by working with seeds. They consist of thousands of cells and it would not be feasible to introduce the gene into each cell. Plants consist of millions of cells and also would be a difficult place to start the genetic engineering process.

The genetic engineer has discovered methods to introduce genes into individual plant cells. The transgene must be inserted into the plant’s chromosome where it will be replicated along with the rest of the chromosome as the cell divides. The insertion of the transgene into a cell is called an event. Once plant cells with the new genes are produced, plant cloning is performed.

Step 3: Cloning transgenic plants with a new gene

While animal cloning has made recent headlines, plant cloning is not new. The cloning process used in crop genetic engineering is referred to as tissue culture. Masses of undifferentiated plant cells can be grown in artificial media and induced to develop into entire plants. If the cells have a transgene introduced into their chromosomes, they will pass this new gene onto daughter cells (the genetically identical cells made when cell division occurs). Plants derived from these transformed cells will be transgenic; they contain the new gene or genes in every cell. The genetic engineer’s role in the process is complete when a transgenic plant is put into the hands of the plant breeder.

Plant breeding — combining traits through crossing

From this point, the development of genetically engineered crops proceeds through the same plant breeding steps as non-genetically engineered crops. The new gene is brought into the elite lines of the plant breeding program as rapidly as possible. Normally this involves crossing the transgenic plant with an elite line, selecting offspring with the transgene and then crossing these progeny to the parent.

This pattern of backcrossing is repeated until the breeder has a line with the transgene and the desirable genes for high yield and adaptation to the growing environment. Year round nurseries and intensified selection methods can speed the process of bringing transgenic lines into the mainstream of a plant breeding program.

Why can’t genetic engineers simply place genes into the best elite lines to begin with? One reason is because the tissue culture process lends itself to small but not all lines in a crop species. Furthermore, the genetic engineering process is time, space and labor intensive. This prevents the genetic engineer from creating transgenics of every line of a plant breeding program.

Different traits, similar process

Roundup Ready. The gene encoding the protein that gives plants Roundup resistance came from a special strain of Agrobacteria, a soil bacteria that can be a plant pathogen. This gene encodes a protein called 5-enolpyruvyl-shikimate or EPSPS. EPSPS is an enzyme that catalyzes a reaction in plant and bacteria cells that is necessary for the synthesis of some amino acids. The Roundup herbicide can bind to the EPSPS made in plants and block its ability to work. This causes the plant to run out of amino acids, which halts growth and development. The plant eventually dies. The version of EPSPS made in the special strain of Agrobacteria has a slightly altered shape. This alteration prevents (Continued on page 47)
questions about the effectiveness of smart boxes. I have growers specifically asking what fungicides and insecticides should be used to provide protection from seed/seedling insects and diseases. They are looking for a planter application of a broad spectrum insecticide and fungicide. Any thoughts and or suggestions?

Keith Jarvi, Extension Assistant, Northeast Research and Extension Center, Norfolk, responded: I believe you are correct that the recent cool springs have been the major contributors to poor stands. I have seen herbicide, insect, and disease problems alone and in combination, all affected by the cool weather.

From the insect side of it, the cool soil temperatures have delayed germination and allowed seed feeding insects like wireworms to reach the seed. Several farmers remarked to me last year that they could see a difference in areas of fields where they tilled. The tilled areas were much better because they got a jump start. Every field will have a population of wireworms; under most conditions the populations are usually low enough that plants will outgrow damage with minimal loss. Still, a seed treatment is a good investment. Most seed treatments are a combination of fungicide(s) and insecticide(s).

Something like Kernel Guard or Agrox DL Plus (both 15% captan + 15% diazinon and 25% lindane) are relatively inexpensive, about $1.00/ a depending on seeding rate. Most data I have seen indicate that these products will perform as well as the more expensive soil insecticides if applied properly. A Smartbox is just a closed delivery system. It is very accurate once calibrated but what we’re discussing here does not warrant anyone going out to get one.

Seed treatments must be thoroughly mixed in the seed box before application. You are right. Some farmers hate to use them. They are a very fine dust and can be very irritating and can interfere with some monitoring equipment. Under hot conditions, these products themselves can cause germination problems. Other farmers think they are great. Seed treatments will not prevent cutworm damage.

Registered seed treatments are listed in the insecticide tables on the Entomology web site at ianr.wwu.unl.edu/ianr/entomol/ fldcrops/fldcrops.htm This summer we will be testing several seed treatments still under development.

Bob Wright, Extension entomologist at the South Central Research and Extension Center, agreed with Jarvi, adding: Monitor corn regularly starting at emergence. If cutworms are a concern, the most cost-effective approach is to use a postemergence spray where needed, not a planter box treatment or a planting time insecticide treatment over the entire field. Regarding treatment for seed/seedling insects and diseases, yes, the most cost-effective treatment would be a planter box treatment, with the caveats Keith mentioned.

Genetically altered (Continued from page 46)

Roundup from binding, but still allows the resistant EPSPS to catalyze the amino acid synthesis reaction. Plants with the bacterial EPSPS can be sprayed with Roundup and take it up in their cells. They have a backup enzyme, however, that gives them the ability to keep making amino acids.

Liberty Link. Some crop plants have been genetically engineered for resistance to the broad spectrum herbicide, Liberty. The story is similar to Roundup Ready. A bacteria gene was discovered (the pat or bar gene) that encoded a protein called phosphinothricin (PAT). PAT is an enzyme that controls resistance by detoxifying the Liberty herbicide molecule (glufosinate-ammonium). Genetically engineered plants can make

This is the first of several articles to address the development of genetically altered crops.

the PAT enzyme and breakdown Liberty before it can bind to an enzyme called glutamine synthetase. This enzyme allows plants to make certain amino acids and recycle ammonium. Liberty resistance comes from a transgene that provides an additional enzymatic function rather than a backup enzyme as with Roundup Ready.

With both the Roundup Ready and Liberty Link traits the genetic engineers follow the same process as with Bt to introduce the gene to the plant and continue with the breeding process.

Current technology allows for the introduction of only one or two genes at a time. The initial impact of genetic engineering will be on plant traits that are under relatively simple genetic control. Because the same genetic engineering procedures can be used for all genes, the success rate of the genetic engineer is constantly improving. More genes with the potential to control important traits in crop plants such as pest resistance, herbicide tolerance, and improved end-use quality are discovered daily. It’s likely that there will be a steady stream of transgenic plants with new traits contributing to the development of new varieties and hybrids.

Don Lee, Associate Professor
UNL Department of Agronomy
Average soil temperatures hint at planting date

Wet fields and cool soil temperatures across the eastern two-thirds of the state have seriously limited normal field activities. Oat seeding is 50% behind the five-year average, while fertilizer applications across central and eastern Nebraska have been delayed or stopped.

There has been a persistent pattern of above normal precipitation since the early March snowstorm. Although periods of above normal rainfall are common in spring, the frequency and strength of these storms have been unusual. Instead of receiving 0.25 to 0.50 inch of precipitation with each storm, 1- to 2-inch amounts have been typical.

Soil temperatures have been averaging 5-10°F below normal since the beginning of April. There has been little opportunity for drying between storm systems and soil temperatures at the four-inch depth have not been over 50°F for any significant time.

Using soil temperature data from High Plains Climate Center Automated Weather Data Network sites across Nebraska, averages were developed for the 1987-1996 period for the dates of April 15, April 30, and May 15. Average soil temperatures at the 4-inch depth under bare soil can be viewed in the maps (right).

For the 10-year period, soil temperatures south of the Platte River averaged 50°F or more by April 15. Except for extreme northeast Nebraska, soil temperatures will average at least 50°F — the threshold for corn planting — by April 30. By May 15, soil temperatures average 60°F or greater across the entire state. The 60°F threshold is critical for adequate germination of soybean and sorghum.

Producers should remember that these temperatures are measured under bare soil that has not been disturbed. Tillage operations at, or immediately prior to, planting can reduce soil temperatures in the planting zone by at least 5°F. During the spring, soil

(Continued on page 49)
Herbicide resistance: Are you at risk?

The scenario

You have been using a trusted herbicide for several years in your corn field and have liked how well it's worked. Last year you noticed that a certain weed had more escapes than usual. You blamed those escapes on your son or the commercial applicator. This year you sprayed the same herbicide, but instead of a few escapes, your whole field is infested with the weed. Something is definitely wrong because you are no longer dealing with an escape, you are dealing with an epidemic. Barring a mixing or application error, you could be a victim of herbicide resistant weeds.

What is herbicide resistance and how did it get here?

Herbicide resistance occurs when a weed in a certain species, such as waterhemp, is typically killed by a herbicide (such as Pursuit) is no longer controlled by that herbicide. The resistant weeds are referred to as a “biotype,” which means that resistance is due to a change at the genetic level. Scientists believe that a very small portion (one in a million or one in a billion) of Pursuit-resistant waterhemp always existed in the field. If a farmer sprays Pursuit several years in a row, all of the susceptible waterhemp plants are eventually eliminated from the field, leaving the resistant biotype to prosper. The resistant biotype produces resistant offspring and within a few years the field becomes full of resistant waterhemp.

Does herbicide failure always mean herbicide resistance?

Herbicide failure alone is not a definite indicator of resistance. There can be many reasons for herbicide failure. Many years the environment can play tricks on how well a herbicide controls a weed. If factors such as temperature, moisture, humidity, weed growth stage, and weed growth rate are not ideal, weed control may not be ideal. This makes identifying resistance more of a challenge.

Previous research has shown that resistance can develop in fields where the same herbicide or the same mode of action is applied for more than three years in a row. If weed escapes are coupled with repeated use of a herbicide, the likelihood of those escapes being herbicide-resistant is greater.

How do I prevent resistance?

Since resistance typically occurs in fields where the same herbicide or mode of action has been applied for several years in a row, rotating modes of action may prevent resistance. The mode of action refers to how a herbicide kills a plant. For example, Pursuit is called an ALS-inhibitor and kills a plant the same way as Exceed, Beacon, and Accent. Rotating from Pursuit to Beacon does not help prevent resistance. The Nebraska Herbicide Guide has a glossary of herbicides and an outline of their modes of action. It is a good reference that provides the information necessary for identifying effective herbicides and rotating modes of action. It is available from Extension offices.

In addition to rotating modes of action, several other approaches can help combat herbicide resistance. Crop rotation challenges the weeds in a field with different types of competition and may allow you to select from a different arsenal of herbicides. Providing an environment that enhances crop growth and allows for weed suppression is another method of reducing the potential for resistance development. One such practice is planting crops in narrow rows to give crops a competitive advantage over weeds. Tillage and mechanical removal of weeds reduces the amount of weeds exposed to herbicides and reduces the potential for resistance.

Finally, watch your fields closely. If you believe you may have a resistance problem based on escapes and field histories contact your extension agent.

Chad Lee
Weed Science Research Assistant
Alex Martin
Extension Weeds Specialist

A brief list of herbicide resistant weeds occurring in surrounding states.

<table>
<thead>
<tr>
<th>Herbicide resistant species</th>
<th>Mode of action to which resistance developed</th>
<th>Location</th>
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<tbody>
<tr>
<td>Cocklebur</td>
<td>ALS</td>
<td>Missouri, Kansas, South Dakota</td>
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<tr>
<td>Foxtail</td>
<td>ALS</td>
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<td>Foxtail</td>
<td>ACCase</td>
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<td>Kochia</td>
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<td>Waterhemp</td>
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</tbody>
</table>

Soil temperatures

(Continued from page 46)

Temperatures in a one-foot profile can vary more than 10°F and tillage will bring colder soil from deeper in the profile to the surface. It may be beneficial to have four-inch soil temperatures of at least 55°F to compensate for this effect.

Soil temperatures will probably remain cool for the next week as the persistent rainy pattern continues. A longterm forecast shows this storm series to be about over.

Al Dutcher, State Climatologist
Agricultural Meteorology

April 17, 1998
Consider long-term effects for soil and crops when negotiating contract for animal manure

As livestock producers become more specialized and increase herd size, more crop producers may be asked for long-term commitments for land application of animal manure. Following are some factors to consider when contracting to take manure over several years.

1. **Know the soil resource.** A comprehensive soil sampling of each field is sound agronomic practice regardless of whether manure is to be applied. Soil sampling is necessary to determine nutrient needs and provides a baseline to determine changes due to manure additions. When working with manure, an estimate of soil salts is important background information. Analysis for soils should include calcium, magnesium, sodium, potassium and electrical conductivity (EC).

2. **Know the manure.** The manure should be regularly sampled and analyzed and the analysis should be tracked in a table or graph. Sample the manure as it is being spread so losses due to storage are indicated. Sample results should be reported in an 'as is' state so that total application rates can be calculated once the gallons per acre or tons per acre applied are known.

3. **Incorporate manure application into your cropping plans.** The nutrients in the manure should be credited toward crop needs. There are many publications and resources that help calculate credit for nitrogen and other nutrients. Nitrogen is the most difficult to credit because of its slow availability and its multi-year release. Planning is essential to making the most of the manure.

   Consider cropping rotations and planned tillage in your plans. Make efficient use of a tillage operation by applying enough manure to supply phosphorus for two or three years. Generally, this won't overload the soil nutrient needs. Legumes generally fix their own nitrogen, but can scavenge nitrogen very effectively. If excess manure is available and the phosphorus is needed, manure can fill the phosphorus needs.

4. **Use best management practices to spread manure.** Applicators need to be calibrated. Spreading pattern needs to be observed and adjusted to avoid serious distribution problems.

5. **Regularly monitor soil for phosphorus and salt buildup.** Generally there is no plant toxicity with high phosphorus levels. Manure is wasted if soil levels are too high.

   In states that have maximum soil phosphorus levels (Bray #1) they are in the range of 150 ppm. This is at least five times higher than suggested maximum agronomic levels. The reason for the 150 ppm level is that when the soil gets that high, soluble phosphorus concentration in the runoff water approaches the level where it causes problems in surface water.

   The other problem is salt accumulation. With adequate rainfall and good quality irrigation water (EC < 1.0), salt buildup is not usually a problem. However, it is possible to have very salty manure and under low rainfall, dryland conditions salt accumulation can occur. Corn grown on soils with electrical conductivity (EC) under 1.7 mmhos/cm should not have problems. When soil EC reaches 2.5, expect a 10% yield decrease in corn. Soybeans are less sensitive with zero reduction in yield up to a soil EC of 5.0 and a 10% reduction in yield at 5.5 soil EC. If soils show increasing levels of EC, change the application quantity and management. (Thorp, R.M. 1984. Editor. Ortho Agronomy Handbook. Chevron Chemical Company. p. 435.)

6. **Negotiate financial arrangements and write them down.** The question of manure value frequently is raised when discussing the use of manure on cropland. Manure is a "bundled" product that cannot be separated into its component parts. This causes a problem since the total value of the nutrients in manure may be higher than needed for a specific field. The crop producer considers the value to be what it would cost to achieve comparable yields with commercial fertilizer. The livestock producer wants full value for the nutrients in the manure. While it is difficult to assign a dollar value, there are benefits to soil physical properties from using manure which may increase yields in some years. These should not be forgotten during negotiations. Also, remember that nitrogen may be lost after spreading and becomes available over a three-year period, therefore, the nitrogen value may be less than the total applied. In addition to the nutrient value there is the added cost of labor and equipment for hauling and spreading. Both sides need to be flexible and understand the benefits both will receive from the manure. When manure is used as a soil amendment and applied at agronomic rates, everyone is a winner.

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