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Managing the new herbicide-resistant crops

Never before has there been such a wide array of crop varieties. With the recent flood of herbicide-resistant crops, many producers find themselves reevaluating production strategies. This new technology may allow more flexibility for many producers, but those benefitting most will be paying attention to details and have a well-organized strategy.

Although herbicide-resistant crops may not seem very different from conventional crops, they can be more difficult to manage. There is a tendency for management strategies to focus on an all-postemergence program. Although residual preemergence herbicides can complement the postemergence program (see Crop Watch 98-3), many producers may opt for a total postemergence program. Unfortunately, timely postemergence applications may not always be made, resulting in heavy weed competition for a short period. In addition, this increase in postemergence applications may increase demand for custom applications during a shorter time.

Many producers may opt for herbicide-resistant crops for the flexibility they provide the producer. They do lengthen the time when herbicides can be applied. Remember, however, that while the crop may tolerate later applications, they are still as susceptible to weed competition as conventional crops. The herbicide application should be timed to the appropriate weed growth stage to get maximum control.

The development of herbicide-resistant weeds is of some concern with this new technology. Due to the flexibility offered with these crops, some producers may be tempted to use the same resistant crop varieties and herbicides over several consecutive years.

Although it has been generally thought that the use of herbicides such as Roundup will not result in weed resistance, repetitive use of the same mode-of-action may cause species shift. Using herbicides as part of an integrated weed management program will help avert problems.

In the past, drift was only a concern with nearby sites with different crops such as corn and soybeans. With the use of herbicide-resistant crops, drift from non-selective herbicides will be of much more concern. If Liberty were to drift onto a variety with no resistance, crop damage is likely. Paying attention to wind and humidity will minimize these problems. Commercial applicators may have particular concerns. A herbicide-resistant field cannot be identified by sight.

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Special focus: Corn

Nebraska ranks third nationally in corn for grain production, with 1.15 billion bushels produced in 1997. This week get the latest on early season insect control, how to manage the new hybrids, planting tips, and what to consider when debating between dryland sorghum or corn.
Noel Mues, Extension Educator in Furnas County: We are seeing strong evidence of soil-borne wheat mosaic virus in southwest Nebraska (Cambridge, Bartley, Indianola area). Several samples have been sent to the plant diagnostic clinic for diagnosis and we are waiting for the results. Symptoms (mild green to yellow coloration and moderate stunting) are occurring in localized patches in several fields. We could see yield reductions in infested areas. Resistant or tolerant varieties are the only method of control.

Paul Hay, Extension Educator in Gage County: Wet weather has field work at a standstill. The first need when the weather allows is to get wheat sprayed and fertilized. Oat planting is non-existent. We will be pressed to get alfalfa planted in the recommended planting window. (See tips in Bruce Anderson's story at right.) Calf losses are three times greater than normal. The cloudy, cool, damp weather has created a battle with scours and respiratory infections.

Ralph Kulm, Extension Educator in Holt County: Crop producers are getting very nervous about weather conditions. After receiving anywhere from 8-20 inches of snow this past week fields are still quite wet. We need some sunny 70°F days with a little wind. Crop producers in the Boyd and Knox county areas are not as concerned except those that are wishing to plant small grain.

Correction

If you're planning to take the Nebraska Weed Tour, note that the starting time for the tour on Tuesday, June 23, has changed to 9 a.m. Also, the first two days of the tour are June 17-18. There will be more information about the tour in a future Crop Watch.
Corn vs. sorghum: Which is best when

With the increased soil moisture this spring, some producers are considering switching from sorghum to corn on their dryland acres. Before deciding, producers should consider rotation, expected prices, production costs and the long-term plan for their farm.

Charles Yamoah, a visiting scientist at UNL, worked on a statistical evaluation of the two crops and their yields based on several long-term rotation trials in eastern Nebraska. The experiments were done by Gary Varvel, associate professor of agronomy, and others with the Agricultural Research Service, USDA, and Max Clegg, associate professor of agronomy, at the Agricultural Research and Development Center near Mead.

Dr. Yamoah looked at correlations of crop yields and preseason rainfall — a good indication of moisture storage in the soil profile. He also evaluated the effects of crop rotations, especially with soybean, on corn and sorghum yields. When he looked at long-term experimental data and estimated production costs, he could examine historical net returns of corn and grain sorghum assuming soybeans as the previous crop. In about half the years, switching between corn and grain sorghum was a better strategy than following a fixed rotation, using current soil moisture as a guide and considering yield impacts for soybean when returning to soybeans the second year.

The results help answer the question about choosing corn or grain sorghum when the level of soil moisture is good. Of course it's hard to predict mid-season drought, high temperatures in August, damage from hail, or the effects of insect infestations. However, it is possible to describe what is likely to happen based on long-term data sets.

Rotations

Results from all experiments are clear on the benefits of rotation on corn and sorghum yields. A 10-15% yield increase exists for both crops in two-year rotations with soybeans. Any departure from that sequence is likely to cause an equal yield loss if either crop is planted continuously. This is what the results show, even when the recommended rates of nitrogen and other nutrients are applied and the crop is protected from pests. Rotating corn with sorghum appears to give a yield advantage, but it is less than rotation of either crop with soybean. A short-term price advantage of either crop should not be considered singularly from other factors.

Soil moisture

The analyses clearly show that sorghum is favored in years where there is limited moisture through late April. Sorghum will take advantage of late spring rains and even resist mid-season drought better than corn. No-till and good amounts of crop residue are also important factors to consider. Both help conserve soil moisture, help move rainfall into the soil and permit more timely planting.

Weed control

More herbicides, especially post-emergence herbicides, are available for weed control in corn than for grain sorghum. For insect control in corn, Bt corn is available.

Yields

Yields should be projected for the two crops, especially if a dry year is predicted. The 20-30 bushel or higher advantage for dryland corn in a good year will disappear in dry years.

Production costs

Barbara Kliment, executive director of the Nebraska Sorghum Board, notes that sorghum production costs are lower than those for corn. Data from the 1996 UNL Department of Agricultural Economics Nebraska Crop Budgets for east-central Nebraska show a much lower seed cost for sorghum ($5 versus $22/acre), lower fertilizer cost ($9 versus $15/acre), lower chemical cost ($31 versus $43/acre), and about the same equipment costs for the two crops. Total operating costs are shown as $75/acre for sorghum and $111/acre for corn. These costs differ for each location, and if a producer is considering a switch, he or she should estimate their own operating costs. For example, a producer who currently plants only sorghum and soybeans would have a major investment (up to $25,000, perhaps) for a new corn head, or would have to contract for this at harvest. Producers will also need to consider what seed they’ve already purchased and whether there is any potential for exchange.

Long-term outlook

Finally, remember that a decision to enter into flexibility in the crop rotation should not be a single-year decision. How does this fit into the long-term goals for a particular field and for the entire farm? Will switching some acres from one crop to another still permit a healthy rotation of cereals with legumes?

Is there a need for certain crops to balance rations and avoid having to buy feed? Long-term average data show that in an average year corn residues provide about 2.5 AUM/acre for stalk grazing while sorghum provides 2.0 AUM/acre. In a dry year the amounts would probably be equal or sorghum could be higher.

When considering whether to plant corn or sorghum on your dryland acres, consider the whole

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Developing a strategy for weeds in wheat

Each spring various weed control scenarios exist for winter wheat. Growers can choose not to spray, to spray the whole field, or parts of the field. No herbicides are registered for controlling downy brome or jointed goatgrass in winter wheat. Some winter wheat fields are not sprayed with a selective herbicide to control broadleaf weeds because 1) weeds are not a problem, 2) weeds have not emerged, 3) wheat is beyond the optimum growth stage, or 4) the wheat stand is not sufficient to harvest for grain. Also, consideration must be made if the wheat is to be grazed or the straw is to be used for feed or bedding. This will influence the herbicide selection since some herbicides may not be registered for these purposes. Also, density and kinds of weeds, weed stage, wheat stage, and succeeding crop need to be considered when selecting a herbicide.

Winter annual weeds must be sprayed before they elongate and are a problem in all winter wheat varieties because they emerge with the winter wheat. Spring germinating winter annuals are not as competitive but still can produce seed to infest future crops.

Early spring germinating annual weeds such as kochia, slimleaf and common lambsquarters, Russian thistle, common sunflower, etc., are tall growing weeds that are generally not affected by wheat stands. However, tall-statured varieties have less of a problem with these weeds than short-statured varieties. Scattered early-germinating weeds will grow taller in short-statured varieties and may cause problems at harvest, necessitating a harvest-aid herbicide. Crop Watch will feature more information on harvest-aid herbicides in May.

Late germinating summer annual weeds can be a problem in wheat fields that have poor wheat stands. However, some weeds, like wild buckwheat, can be a problem even in good stands of wheat. Since it is a vine it grows up the wheat plants and causes yield loss and harvest problems. Timing is important for controlling wild buckwheat and wild vetch. Apply herbicides later than optimum for winter annual weeds but before the wheat canopy covers the ground. Best results are after these weeds have germinated and before the wheat is in the joint stage.

During the past 15 years the number of winter wheat fields sprayed in the spring with a herbicide have increased from 10% to 50%. This increase corresponds with the increase in the amount of semidwarf wheat planted. Short-statured winter wheat varieties are not as competitive with weeds as taller varieties. In general, short varieties such as TAM 107 or Vista favor switchgrass development.

If a grower is going to spray the wheat stubble after harvest for ecofallow, many of the broadleaf weed problems can be reduced by controlling these weeds in the spring with a herbicide. Kochia, slimleaf lambsquarters, Russian thistle, and common sunflower are the tall weeds that may interfere with harvest and intercept the herbicide before it reaches smaller weeds after harvest.

Growers can reduce herbicide inputs by scouting their fields and identifying areas needing treatment. In 1986, 1996, and 1997 surveys taken after winter wheat harvest showed that some fields had a poor stand of winter wheat in certain areas of the field. These areas include waterways, terraces, hilltops, or areas where the snow had blown off the fields. Wheat stands in these areas generally had fewer than 340 stems/m2 at harvest.

These areas should be sprayed with a herbicide so that competition from weeds is reduced.

Planting a adapted winter wheat at the proper time improves the wheat's ability to compete with weeds. Apply fertilizer during the prewheat-fallow period or as a starter when the wheat is planted. Delaying all the fertilizer application until spring gives the weeds an advantage. Surveys have shown that fields only receiving spring applied fertilizer have more and bigger weeds than fields fertilized the previous summer or fall.

Sometimes, wheat fields have questionable stands that may need to be destroyed and planted to another crop. If you are unsure as to what to do, spray the field with a selective herbicide that allows flexible recropping. This lets you decide later whether to destroy the field and plant another crop. The wheat must be destroyed early enough so as not to lose the stored soil water if a spring crop is to be planted.

Gail Wicks, Extension Weeds Specialist, West Central REC, North Platte

Corn vs. sorghum

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system. What will be in those fields next year and for the next several years? What does your own experience tell you about how these two crops will perform on your farm? Statewide averages are less important to consider than the current stored moisture in your fields.

Chuck Francis, Extension Cropping Systems Specialist
Bob Klein, Extension Cropping Systems Specialist
Glen Helmers, Agricultural Economist, UNL
Bob Caldwell, Extension Cropping Systems Specialist
Plan now for rotation restrictions

Producers have more options for rotating out of corn now, but only if they ensure that their choice of herbicide and its rotational restrictions fit their production plan. Failure to plan may leave some producers unable to successfully rotate to a given crop next year.

There are many considerations to address when choosing a herbicide to meet specific rotational needs. Of primary importance is the ability to effectively control present weeds while allowing the producer to rotate to the desired crop the next spring. For example, the use of Contour or Exceed will not allow the producer to rotate to alfalfa the next spring. Failure to acknowledge this could potentially set back a forage program one year. Even the best planning can result in mishap if herbicide labels are not given proper attention.

With the many herbicides now available, selecting the right herbicide for your situation involves some attention to detail, but spending a little more time now can help you avoid potential problems later.

Jeff Rawlinson, Extension Weed Science
Alex Martin, Professor Weed Science

### Corn herbicide rotation restrictions

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>The following season, DO NOT rotate to:</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrazine</td>
<td>Sugarbeets, vegetables, dry beans, spring-seeded small grains, small-seeded legumes and grasses</td>
<td>If applied after July 10, do not rotate to crops other than corn or sorghum for 18 months after application if greater than 2 lb ai atrazine was applied. DO NOT plant soybeans for 18 months if soil pH is over 7.2.</td>
</tr>
<tr>
<td>Bicep II/</td>
<td></td>
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<tr>
<td>Bicep Lite II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accent</td>
<td>Soil pH &gt;6.5-sugarbeets and pH &gt;7.5—sorghum, sunflower</td>
<td></td>
</tr>
<tr>
<td>Accent Gold</td>
<td>Peas, potatoes, sunflower, sweet corn; sugarbeets and canola — 26 months.</td>
<td>DO NOT rotate to soybeans for 18 months if precipitation is &lt;15 in and soil OM &lt;2%.</td>
</tr>
<tr>
<td>Action WP</td>
<td>No rotation restrictions after 12 months.</td>
<td></td>
</tr>
<tr>
<td>Balance</td>
<td>DO NOT plant rotational crops until following use season.</td>
<td></td>
</tr>
<tr>
<td>Banvel</td>
<td>Following a normal harvest of barley, oats or wheat, any rotational crop may be planted. Corn, sorghum, soybeans and wheat may be planted the spring following Banvel applications.</td>
<td></td>
</tr>
<tr>
<td>Basis</td>
<td>No rotation restrictions after 12 months.</td>
<td></td>
</tr>
<tr>
<td>Basis Gold</td>
<td>DO NOT rotate to crops other than corn, sorghum, cereals and soybeans.</td>
<td></td>
</tr>
<tr>
<td>Beacon</td>
<td>Sugarbeets.</td>
<td></td>
</tr>
<tr>
<td>Bladex DF</td>
<td>No rotation restrictions after 12 months.</td>
<td></td>
</tr>
<tr>
<td>Broadstrike+Dual</td>
<td>Sweet corn, sunflower, sugarbeets, canola.</td>
<td></td>
</tr>
<tr>
<td>Buctril</td>
<td>DO NOT plant rotational crops until the following spring.</td>
<td></td>
</tr>
<tr>
<td>Bullet</td>
<td>DO NOT rotate to crops other than corn, sorghum, soybeans or peanuts.</td>
<td></td>
</tr>
<tr>
<td>Clarity</td>
<td>No rotation restrictions exist if normal harvest of treated crop has occurred.</td>
<td></td>
</tr>
<tr>
<td>Contour</td>
<td>Alfalfa, oats, sorghum, sweet corn, pop corn, potatoes, sugarbeets, safflower, and sunflower.</td>
<td>Check with seed dealer for corn inbred lines.</td>
</tr>
<tr>
<td>Double Play</td>
<td>DO NOT rotate to crops other than corn, soybeans, sorghum, tobacco or wheat.</td>
<td></td>
</tr>
<tr>
<td>Dual/Dual II</td>
<td>No rotation restrictions after 12 months.</td>
<td></td>
</tr>
<tr>
<td>Eradicane</td>
<td>DO NOT rotate to crops other than corn, soybeans, sorghum, tobacco or wheat.</td>
<td></td>
</tr>
<tr>
<td>Extrazine II DF</td>
<td>DO NOT rotate to crops other than corn, sorghum or soybeans.</td>
<td></td>
</tr>
<tr>
<td>Exceed</td>
<td>Alfalfa, clover, sunflower or sugarbeets.</td>
<td>In Nebraska Panhandle or areas with pH&gt;7.8, rotate to corn, sorghum, small grain cereals and proso millet.</td>
</tr>
</tbody>
</table>
## Rotation restrictions (Continued from page 35)

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>The following season, DO NOT rotate to:</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontier</td>
<td>No rotational restrictions the following spring.</td>
<td></td>
</tr>
<tr>
<td>Fultime</td>
<td>DO NOT rotate to crops other than corn, soybeans, sorghum, or wheat.</td>
<td></td>
</tr>
<tr>
<td>Guardsman</td>
<td>Sugarbeets, tobacco, vegetables, spring seeded small grains or small seeded legumes and grasses.</td>
<td>Injury may occur to soybeans planted to calcareous soils.</td>
</tr>
<tr>
<td>Harness</td>
<td>DO NOT rotate to crops other than soybeans, corn, sorghum, wheat or tabacco.</td>
<td></td>
</tr>
<tr>
<td>Harness Xtra</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hornet</td>
<td>Sugarbeets, sunflower, peas and canola.</td>
<td>Use successful field bioassay.</td>
</tr>
<tr>
<td>Laddok S-12</td>
<td>Sugarbeets or sunflower.</td>
<td>DO NOT plant oats in soils with calcareous surface layer.</td>
</tr>
<tr>
<td>Lasso/Lasso II</td>
<td>No rotation restrictions if crop treated previously is carried to harvest.</td>
<td></td>
</tr>
<tr>
<td>Liberty</td>
<td>No rotation restrictions after 12 months.</td>
<td>DO NOT plant wheat for 120 days.</td>
</tr>
<tr>
<td>Lightning</td>
<td>Oats, popcorn, sorghum, safflower, sweet corn, potatoes, sugarbeets.</td>
<td>Only rotational crops harvested at maturity may be used for feed or food.</td>
</tr>
<tr>
<td>Marksman</td>
<td>Sugarbeets, vegetables, spring seeded small grains, or small-seeded legumes and grasses.</td>
<td>If applied after June 10, or in dry areas requiring irrigation, rotate only to corn or sorghum. Rotation to soybeans in soils with calcareous layer may result in injury.</td>
</tr>
<tr>
<td>Permit</td>
<td>No rotation restrictions after 12 months.</td>
<td>Wheat, 3 months, soybeans, 10 months</td>
</tr>
<tr>
<td>Poast</td>
<td>No rotation restrictions after 12 months.</td>
<td></td>
</tr>
<tr>
<td>Prowl</td>
<td>Sugarbeets; winter wheat and barley — 4 months</td>
<td>Treated land may be planted to other crops the following year.</td>
</tr>
<tr>
<td>Resolve SG</td>
<td>Oats, popcorn, sweet corn, safflower, sorghum, potatoes, and sugarbeets.</td>
<td>Sugarbeets — 40 months</td>
</tr>
<tr>
<td>Resource</td>
<td>No rotation restrictions after 12 months.</td>
<td></td>
</tr>
<tr>
<td>Roundup Ultra</td>
<td>No rotation restrictions after 12 months.</td>
<td></td>
</tr>
<tr>
<td>Scorpion III</td>
<td>Sugarbeets, canola, peas, and sunflower.</td>
<td>Sugarbeets and canola — 26 months</td>
</tr>
<tr>
<td>Sencor</td>
<td>Sugarbeets and other root crops.</td>
<td>Cover crops for soil building or erosion control may be planted anytime, but do not graze or harvest for food or feed.</td>
</tr>
<tr>
<td>Spirit</td>
<td>Alfalfa, clovers, sunflowers, sugarbeets</td>
<td>If pH&gt;7.8, rotate to corn, sorghum, proso millet or small-grain cereals the year following spirit application.</td>
</tr>
<tr>
<td>Surpass</td>
<td>DO NOT rotate to crops other than corn, soybeans, sorghum or tobacco</td>
<td></td>
</tr>
<tr>
<td>Tough</td>
<td>No rotation restrictions after 12 months.</td>
<td></td>
</tr>
<tr>
<td>Topnotch</td>
<td>DO NOT rotate to crops other than corn, soybean, sorghum, tobacco, or wheat</td>
<td></td>
</tr>
<tr>
<td>Treflan</td>
<td>DO NOT rotate to sorghum, proso millet, oats, and annual or perennial grass crops or grass mixtures for 18 months in areas with less than 20 in. rainfall.</td>
<td></td>
</tr>
<tr>
<td>2,4-D</td>
<td>No rotation restrictions after 12 months.</td>
<td>Consult label for individual restrictions.</td>
</tr>
</tbody>
</table>
Plan for early season insect control

Soil insect control is changing as new products are developed for control of corn rootworms and other soil-inhabiting insects. While most of the emphasis is still in continuous corn, the trend toward earlier planting dates and increased residue cover has increased the need for managing seed and seedling attacking insects like wireworms and seedcorn maggots, even in crop rotations. Farmers have several management options for dealing with soil insects, and will need to assess their operation when selecting the best option for them.

Corn rootworm control

Corn rootworms are still the most economically important insects in Nebraska. While in certain years other insects like the European corn borer may cause more yield loss, more money is spent controlling rootworms — many continuous corn acres are treated with an insecticide for rootworms. Insecticides are applied as granular formulations at planting or cultivation time or as liquid formulations at planting or post-emergence for larval control. Some farmers opt to kill adult beetles to prevent egg laying. These control methods are all adequate to protect yield potential when materials are applied properly, at the right time, and under normal environmental conditions. Environmental conditions may have a major impact on performance of any control method.

The surest way to eliminate rootworm problems is through crop rotation. Rootworm problems in crop rotations are extremely rare. While some areas of east central Illinois and northwest Indiana may be experiencing problems with western corn rootworms in strict corn-soybean rotations, this has not occurred in Nebraska.

Isolated areas in Dixon and Cedar counties in northeast Nebraska have occasionally seen problems with northern corn rootworms in strict corn-oats rotations. Establishing multi-crop rotations is a good first step in managing many pest problems.

Granular insecticides for rootworm control

Most granular insecticides are applied at planting. Provided that all materials are handled safely, advantages of this method are relative ease of application (most growers have insecticide boxes and know how to use them) and less worry about timing. In most years this control method will provide adequate protection. In-furrow or T-banded applications perform similarly for rootworm control. Problems may occur when growers forget to calibrate application equipment (this should be done yearly regardless of whether the same product is used), high winds move the material away from the seed furrow or band, and early planting dates allow for environmental breakdown of the materials. Insecticide labels require that these materials should be incorporated with a chain or other soil disturbing device behind the press wheel. Any granules left on the soil surface will degrade rapidly and may harm non-target animals. Rotate insecticides to reduce the chances of resistance development. While there is some variation in performance from year to year, all registered insecticides will perform satisfactorily under most conditions.

Cultivation-time applications of granular insecticides usually provide somewhat better root protection than planting time applications since the material is applied closer to rootworm egg hatch. In Nebraska rootworm egg hatch normally occurs in late May through June. Reduced insecticide rates often work well with cultivation time applications. Disadvantages are that extremely wet weather conditions may not allow application and corn may grow past the point of getting over it with a tractor or extremely dry conditions may fail to activate the insecticide.

Liquid insecticide for rootworms

A new insecticide, Regent 80 WG (fipronil), is now being marketed for control of corn rootworms as well as first generation European corn borers. It is also labeled for control of most other soil inhabiting insects. This liquid formulation is applied in-furrow at planting, with either specially designed equipment or with pop-up fertilizer. While Regent provides corn rootworm control comparable to granular insecticides applied at planting, it also has shown systemic activity against first generation European corn borer. Field testing has shown variable results, with reduction of corn borer cavities ranging from 40% to 70%. Since it is a relatively new compound, we are still trying to determine the environmental and application factors that account for the variability. As a comparison, well-timed treatments of standard first generation European corn borer insecticides can give 80-90% or more control.

Post-emergence liquid formulations Lorsban 4E and Furadan 4F are other alternatives to granular applications. Chemigation of Lorsban 4E is popular with some growers. Furadan 4F also has gained some acceptance. These applications will perform adequately when application occurs shortly after the beginning of egg hatch. Note: Data from Nebraska trials indicates that post-emergence applications of Furadan 4F when applied for optimum rootworm control will

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Insects in corn (Continued from page 37)

normally not protect against first generation European corn borers. Corn borers will still need to be managed with other methods.

In some areas of Nebraska, growers manage rootworms by killing the adults in late July-August. Well-timed applications prevent egg laying and a planting or cultivation time insecticide is not necessary the next year. Many programs are designed as multiple applications to control other insects as well, like second generation European corn borer. In most areas of Nebraska this technique will work for rootworm management under a proper scouting program. However, repeated application of the same product has caused the onset of resistance to some materials applied to control adult beetles. Growers in affected areas (primarily York and Phelps counties) will have to choose alternative strategies; either a new class of adulticides, soil insecticides, or rotation away from continuous corn.

Seed and seedling insect pests

Wireworms, seedcorn maggots, and white grubs have become an increasing concern for Nebraska farmers. While there may not necessarily be any greater populations than in the past, increased awareness has led many to believe the problem to be more severe than it was several years ago. Also, a series of cool, wet springs in some areas of the state, combined with more surface residue, have led to cooler soil temperatures and slower germination. This allows more time for these insects to find the seeds. Producers must plan to manage these insects because no rescue treatments are available. Since planting time insecticides usually control these insects, we don’t normally worry about them where this is standard practice. Usually these pests are rare in row crop rotations and you don’t necessarily need a seed treatment or soil insecticide unless there is a past history of problems in that particular field. However, seed treatments should be considered:

1) When germination may be delayed due to adverse soil conditions such as wet and cool or dry soils. Early planted fields are more likely to fall into this category.
2) To protect new seedlings in fields that have a history of seedling diseases or insects.
3) In seed production fields.
4) When planting at low and/or precise populations.
5) In fields previously in pasture or idle for several years.

Wireworms feed on the seeds and roots of corn, sorghum, small grains, grasses, soybeans, dry beans, sugar beets, potatoes, and various other root crops. Wireworm feeding may reduce seed germination or produce weak seedlings. Wireworms eat the germ of the seeds or hollow them out completely, leaving only the seed coat. Larvae boring into the underground (mesocotyl) portion of the stem cause seedlings to die or become stunted. Seed treatments will reduce damage to seed, but will not protect emerged plant parts. Under heavy infestations of wireworms a granular soil insecticide may be necessary. Bait stations may be used to assess levels of wireworm infestation before planting (See Seed and Seedling Insect Pests of Corn, NebGuide G91-1023). The bait consists of germinating corn and wheat seeds. Substances produced by the seedlings attract the wireworms to the bait.

Bait stations should be set up two to four weeks before the planned planting date. They should be placed randomly throughout the field with a minimum of ten stations per field. Be sure to place stations in different parts of the field (areas with different soil types, low or high spots, etc.) to obtain a representative sample. If you find an average of one or more wireworms per bait station, use an in-furrow application of a labeled soil insecticide. If wireworms are present at low levels (less than one per station), seed treatment alone should be sufficient.

Seedcorn maggots attack the seeds of many crops before or just at germination, preventing germination by killing the newly emerging coleoptile. Damage from seedcorn maggots can be prevented by using a seed treatment.

White grubs feed on roots deeper in the soil. Crop emergence may appear normal in the beginning. Later the stand becomes thin or patchy. Roots of crops are usually chewed off cleanly. White grubs can only be controlled by granular soil insecticides.

The seed corn beetle, while listed on many labels, is not normally a factor in seedling establishment.

The active ingredients in seed treatments are lindane and/or diazinon for insect control and a fungicide (i.e. captan, maneb) is

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**Insects in corn**  (Continued from page 38)

In most cropping situations, a seed treatment is the best economic return over many years. It is excellent for seedcorn maggot protection and most wireworm situations. For farmers with air planters or those who do not like working with the dusty conditions produced by seed treatments, a commercial applicator can apply a product called "Raze" to the seed in a liquid slurry before planting. Availability is somewhat limited since most seed is ordered well in advance of planting season. This would be more expensive than a regular seed treatment. The active ingredient of Raze — tefluthrin — is the same as that in Force; however, Raze is only a seed protectant and would not protect against cutworms or rootworms. During the next several years we will be testing new seed treatment products that have shown potential for both corn rootworm and seedling insect control. We'll keep you posted as we test these products.

Keith Jarvi, Extension Assistant, Integrated Pest Management Northeast REC, Norfolk
Bob Wright, Extension Entomologist, South Central REC, OayCenter

Often included to inhibit seedling diseases. Most have graphite included for smooth flow. While the graphite enhances flow, problems have been experienced with graphite on seed monitors of air/vacuum planters. To prevent this buildup some manufacturers have talc products to add to the mix to limit this problem. These products come in packets, 1 lb bags, 5 lb bags or 10 lb bags. For corn, generally the rate is 4 oz of product per 100 lb of seed. Under very hot conditions or with the use of poorly germinating seed, these products in themselves may cause seed injury. Also, incomplete mixing of the insecticide in the planter box may cause seed to be exposed to higher than labelled rates, which may cause reduced germination. Follow label directions carefully for use. Costs run about $1.00 - $1.50 acre, depending on plant population. Several companies offer these products under various trade names. Most local agchem dealers carry seed protectant products. Seed dealers also may have these products.

Some farmers have taken to using reduced rates of granular insecticides in-furrow as a substitute for seed treatments, or use of granular insecticides at full rates. Unfortunately, we have very little data on reduced rates of soil insecticides for control of soil insects other than corn rootworms. In many cases, these treatments appear to "work" because there was not a damaging population of soil insects present. If you do use below labeled rates of a soil insecticide, the chemical companies are under no obligation to compensate you for loss.

Normally once there is an established row crop rotation with good weed control, seed attacking insect populations are relatively low and a seed treatment such as Kernel Guard or Agrox D-L will give stand protection equal to that of a soil insecticide at much less cost (about $1 an acre for seed treatment vs. $16-$20 for a soil insecticide). In

**Herbicide resistance**  (Continued from page 31)

and commercial applicators may need to use more specific legal descriptions. During the last few years there have been several cases of a non herbicide-resistant crop being mistakenly treated with a herbicide requiring a resistant variety.

Producers who use herbicide resistant crops will need to carefully plan their crop rotations. For example, if a producer uses Liberty Link corn the first year, the use of Liberty Link soybeans the next year will complicate management due to volunteer corn. Volunteer resistant crops will dictate that producers switch strategies yearly for efficient weed management. Careful crop rotation planning will minimize this problem.

With increased use of herbicide-resistant crops, management implications that seem obvious may plague even the most seasoned professional. Good recordkeeping and common sense will minimize these problems; however, there is no substitute for integrated weed management. In that respect, management of herbicide-resistant crops won’t be too much different from that of conventional crops.

Jeff Rawlinson, Extension Assistant, Weed Science
Alex Martin, Extension Weeds Specialist, Lincoln

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Adjust planter for 1 1/2 to 2 1/2 inch seed depth

Planting depth is an important factor in successful corn production and should be monitored carefully.

The ideal depth for planting in most soils ranges from 1 ½ to 2 ½ inches. Shallow (1 ½ inches) works best for the fine-textured soils and deeper planting (2 ½ inches) works with the coarse-textured soils. The closing wheels on many planters are set to firm the seed at 1 3/4 to 2 inches.

Planting too shallow can result in poor stands and uneven emergence if the soil moisture line moves down before seed germination and seedling establishment. With shallow planting (less than 1 ½ inches), the plants may emerge but the secondary or nodal roots may not become established properly because roots will not grow through dry soil. This results in “rootless” corn, only holding on by the mesocotyl until rain or growing conditions improve. Also, with shallow planting, the growing point will be much closer to the soil surface, making it more susceptible to frost or herbicide injury. With shallow seeding the secondary or feeder roots seem to develop right at or above the soil surface instead of below the surface as they should. This corn is more subject to lodging because the brace roots may not grow through dry, hot soil. Improperly rooted corn plants, especially those with exposed roots, are certainly subject to 2,4-D injury.

Planting too deep (3 inches or more) slows early development and increases chances of insect and disease damage. It also increases the possibility of a surface crust forming and obstructing the growing points of seedlings. Proper planting depth is important — not too shallow to restrict root development and not too deep to bury the seed.

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Managing corn diseases with biological products

Products to biologically control plant diseases have been under development for many years and are part of three main strategies:

1. The use of living microorganisms (bacteria, fungi, or viruses) that have a negative impact on certain plant pathogens or that stimulate plant defense mechanisms;
2. The use of metabolic compounds produced by microbes to inhibit plant pathogens or to stimulate plant defense mechanisms; and
3. The use of microbial gene sequences to develop transgenic plants with expressed disease resistance.

Biological products of all three types have been in commercial use in other cropping systems in the United States for several years. However, few biological products have been registered for use as disease management products on row crops in Nebraska.

One product from BioWorks Inc. has strain T-22 of the soil fungus Trichoderma harzianum as the active ingredient. This fungus is common to many agricultural environments and is a known antagonist of plant pathogens. It naturally colonizes the root systems of many plants and inhibits the growth of pathogens by out-competing the pathogen for growth sites on the roots or by the production of compounds that inhibit the growth of the pathogen. Strain T-22 was specifically selected for its ability to thoroughly colonize the root system and protect against root pathogens. It is the same strain as used in a product available for turf systems.

Concern was raised in recent popular news articles about the variability in performance of T-22. While University researchers haven’t tested this product widely under Nebraska cropping systems, concerns may compare with those related to similar products. Historically, there have been three concerns with the performance of biological plant disease management products: lack of complete disease control (less than 100%), slow to act (relative to synthetic chemicals), and inconsistency (doesn’t always work or doesn’t work everywhere).

For the most part, biologicals differ little from synthetics with respect to performance. It is unrealistic to expect any product (synthetic or biological) to work 100%, every time, everywhere, under all conditions. Any product strong enough to meet those expectations probably would not get EPA registration. Consider the hybrids we grow. They do not yield the same from year-to-year or from field-to-field. The reasons may have to do with variation in the local weather conditions or variations in soil characteristics within and between fields. The performance of biological disease control agents is regulated by the same environmental conditions and soil variables as the crops we grow so we should anticipate variation across locations and time. Such variation in performance does not mean the hybrid is not valuable or the biological product is not useful. Synthetic chemicals are generally less sensitive but not immune to environmental conditions; contrary to popular belief, synthetic chemicals do not work all the time under all conditions.

Biological products soon will become more plentiful and more important. They will not replace synthetic chemicals but rather will supplement them. There will be applications where a biological can be used as a stand alone product, there will be applications where a synthetic is the best choice, and there will be applications where a combination of biological and synthetic products offer the most effective disease management option. As we gain experience with biologicals, they will become more consistent and more predictable.

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