2001

Crop Watch No. 2001-3, March 23, 2001

Lisa Brown Jasa
University of Nebraska-Lincoln, ljasa@unlnotes.unl.edu

CROP WATCH

University of Nebraska Cooperative Extension
Institute of Agriculture and Natural Resources

No. 2001-3
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Controlling volunteer StarLink™ corn

While Aventis has pulled the genetically modified hybrid, StarLink™, from the market and it is no longer available for planting, the potential for complications continue this year in fields exposed to the genetic trait in 2000.

Corn harvest is never 100% efficient and kernels left in a field may emerge the following spring as volunteer corn. Since the StarLink™ trait is passed on in seed, each volunteer corn plant in 2001 resulting from planting StarLink™ seed corn in 2000 has a 75% chance of containing the trait. (*See story on page 24.*) The StarLink™ trait is also transmitted by pollen so that a non StarLink™ field in 2000 produced adjacent to a StarLink™ field would likely contain the StarLink™ trait as a result of pollination from the StarLink™ field. Bottom line, any field where StarLink™ corn was planted in 2000 or adjacent to a field where StarLink™ corn was produced in 2000, very likely will contain volunteer StarLink™ corn in 2001. Tolerance for the StarLink™ trait in corn for human consumption is **zero**. This means that corn from fields with either of the 2000 StarLink™ exposures described will in all likelihood not be acceptable for human food use under the current zero tolerance and will need to be marketed as such.

Tolerance for the StarLink™ trait in corn for food consumption is zero. If field exposure occurred either directly or indirectly in 2000, take steps to control volunteer corn and plan to divert harvested grain to non-food channels.

Producers have several options for controlling volunteer StarLink™ corn ranging from crop selection to cultural practices and chemical control.

Crop selection

In a field where StarLink™ was planted in 2000, the first and most important recommendation would be to not plant corn, but rather to plant a crop not intended for human consumption. Volunteer corn is impossible to distinguish from the intended hybrid and there are no strategies that provide 100% control of volunteer corn, the level required to achieve zero contamination.

Soybean is an ideal row crop to plant where volunteer StarLink™ corn is a problem because:

1) several very effective herbicides are available for volunteer corn (including StarLink™) control in soybean, and

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Nebraska ranks second in number of StarLink™ acres

Nebraska ranked second in the nation for number of acres planted to StarLink – 41,529, according to an earlier release from Aventis, its developer. This represents only about .5 % of the 8.5 million acres of corn planted in Nebraska in 2000.

Scott Kellar of the Nebraska Department of Agricultural Statistics noted that about 2.875 million acres or about 34% of the state's 2000 corn crop was planted with GMO-event seed. StarLinkTM represented aproximately 1.4% of the GMO corn seed planted in Nebraska.

Iowa planted the most StarLink corn -- 134,910 acres -- with the rest of the top five being Minnesota, 35,601, South Dakota, 34,290, and Kansas, 21,390 according to an Iowa State Grain Quality Initiative web site.

Focus on Corn

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Options increasing

Insecticide seed treatments for corn 2001

Optimum crop stand is one of the important factors necessary for maximum crop yields. During the germination and seedling establishment period, crop stands can be reduced by several environmental and pest factors, either alone or in combination. While little can be done about weather conditions, good basic agronomic methods can reduce the risk of loss, particularly from disease and insect pests. If necessary, seed treatments can be applied to provide an economical way to add protection. A seed treatment may combine two or more fungicides/ insecticides. This article deals with the insect management portion of corn seed treatments.

Until recently, most seed treatments were dusts mixed into the seed box at planting. These seed treatments could protect seedling plants against early season injury primarily from wireworms and seedcorn maggots. Lately, advances in seed coating technology have allowed insecticide to be applied to the seed during processing, enabling the farmer to buy pre-treated seed. Some of the new pre-treated seed treatments are labeled for protection against corn rootworms and other crop pests. While these advancements have led to increased protection from more pests, the costs of these pre-treated products may be significantly more than with the traditional hopper-box treatments.

Consider using seed treatments:

1) when germination may be delayed due to adverse soil conditions such as wet and cool or dry soils;

2) to protect new seedlings in fields with a history of seedling diseases or insect problems;

3) in seed production fields.

4) when planting at low and/or precise populations;

5) in fields with increased residue; and

6) depending on the product, as an alternative to other methods of corn rootworm control.

What seed treatments do NOT do:

1) increase plants stands. They only help protect what you plant.

2) protect against poor germination due to mechanical damage to seed, poor storage, or genetic differences.

3) depending on the product, they may not give season long protection. Many only last as long as it takes for the plants to emerge or germinate.

4) protect against **all** diseases or insects.

Seed attacking insects

The soil insect complex represents a concern to all field crops. Some early season damage to crop seeds and seedlings occurs every year in Nebraska. Potential pests include wireworms, seedcorn maggots, and white grubs.

The severity and the area affected will vary greatly, and is dependent on species involved, previous vegetation, and weather conditions. Traditionally, insecticides and seed treatments have been used to manage these insects. While effective when applied properly, unnecessary insurance treatments reduce the farmer's net return. Only wireworm activity can be assessed prior to planting. Management can be improved by using monitoring traps (*see box, page 29*).

Wireworms feed on the seeds and roots of corn, sorghum, small grains, grasses, soybeans, dry beans,

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CROP WATCH

cropwatch.unl.edu

Crop Watch is published from March to November by the University of Nebraska Institute of Agriculture and Natural Resources Communications and Information Technology, PO Box 830918, 108 Agricultural Communications Bldg., UNL, Lincoln, NE 68583-0918. To order either a printed or electronic (web) subscription or to change your address, write to ***Crop Watch*** at the above address or call (402) 472-7981. The newsletter also is available on the web at **cropwatch.unl.edu**

Lisa Jasa, Editor

For more information about a particular subject, write the authors at the addresses below:

UNL Department of Entomology
202 Plant Industry Bldg.
Lincoln, NE 68583-0816

UNL Department of Plant Pathology
406 Plant Science Bldg.
Lincoln, NE 68583-0722

UNL Department of Agronomy
279 Plant Science Bldg.
Lincoln, NE 68583-0918

UNL Department of Agricultural Meteorology
236 L.W. Chase Hall
Lincoln, NE 68583-0728

Controlling volunteer StarLink *(Continued from page 21)*

2) volunteer corn is readily spotted in soybean and escapes can be manually removed if necessary.

While not recommended, if corn is planted in fields which were exposed to StarLink™ in 2000, make certain the crop **does not reach human food channels.**

Cultural practices

No-till and ridge-till systems aid in the control of volunteer corn. Tillage "plants" volunteer corn ears and kernels. Under no-till a smaller percentage of volunteer corn kernels will germinate compared to a tilled seedbed. A ridge-till system which uses a "ridge clearing" device can move most of the volunteer corn kernels from the ridge (new corn row) and deposit them between the rows where the resulting volunteer corn can be controlled with a cultivator. The ridge clearing device must be adjusted to scrape surface soil (at least 1 inch) off the ridge in order to effectively move corn kernels to the interrow area. Both no-till and ridge-till reduce volunteer corn establishment reducing the task of controlling the remaining volunteer corn.

Chemical control

Volunteer corn often occurs in clumps as a result of ears remaining from the previous crop. Effectiveness of soil-applied herbicides in high density clumps is reduced due to "competition" between individual plants for the herbicide. Postemergence herbicide effectiveness is reduced in high plant density clumps of corn because one plant shields another resulting in inadequate herbicide coverage. As a result, complete control of volunteer corn is unlikely from a single soil-applied or postemergence herbicide application. A follow up operation will be required to control survivors.

This article will not cover the specifics of individual herbicides. Consult product labels for application rates, additives, volunteer corn growth stages and crop rotation restrictions.

When buying corn seed, the National Corn Growers Association and the American Seed Trade Association recommend that you ask for written verification that the seed you're receiving has been tested and is free of the Cry9(c) protein.

Soybean

Several herbicides can effectively control volunteer corn in soybean. The postemergence herbicides Assure, Extreme, Fusilade, Fusion,, Poast Plus, Roundup, Select, Touchdown and other brands of glyphosate all provide excellent activity. Roundup Ready soybean is required if Roundup, Touchdown, Extreme or any other brand of glyphosate is used. Raptor applied postemergence will provide moderate control of volunteer StarLink™ corn. Pursuit + Scepter applied postemergence will suppress volunteer StarLink™ corn. Best results occur if applications are made when the volunteer corn is 6-12 inches tall. Soil applied Command, Scepter and Treflan would provide some suppression of volunteer StarLink™ but are not nearly as effective as the postemergence herbicides mentioned.

Corn

Unless a government agency raises the tolerance level for the StarLink™ trait in corn for human food, it is not realistic to expect to achieve sufficient control of volunteer Star Link corn in fields exposed to StarLink™ in 2000. If the tolerance level for the StarLink™ trait is increased (a proposal Aventis has made to the U.S. Food and Drug Administration), the more effective strategies outlined may provide acceptable volunteer control in corn. Roundup, Touchdown or other brands of glyphosate can be used for volunteer StarLink™ corn control in Roundup Ready corn and would offer the most effective herbicide option. Lightning used with "IMI" seed corn will provide good control of volunteer StarLink™ corn, but is not as effective as Roundup, Touchdown or other glyphosate brands. Liberty will not control volunteer StarLink™ corn because StarLink™ corn is Liberty resistant. (*See the Genetics of StarLink on page 24*).

Grain sorghum

There are no effective herbicides available for volunteer corn control in grain sorghum. Paramount applied postemergence to small (less than 4 inches tall) volunteer corn would provide some suppression; however it is not nearly as effective as the herbicides available in soybean or corn.

Alex Martin, Extension Weeds Specialist

Testing

The Nebraska Crop Improvement Association tested corn seed for the Cry9(c) protein and did find it in some samples, but Steve Knox, NCIA Field Services Manager, says he has confidence in this year's corn seed stocks. Seed which tested positive for the StarLink protein was diverted to another use and did not enter the seed market, Knox said.

NCIA does offer an Identify Preserved Program which provides testing, field visits, and third party verification of whether a specific crop/field is GMO free. This is particularly important to those producers on contract or raising a crop for a specific food use. For more information, contact the Nebraska Crop Improvement Association, housed at the University of Nebraska at Lincoln, at (402) 472-1444.

Understanding the genetics of the situation

Why StarLink™ will be back this summer

This summer volunteer corn plants with the StarLink™ trait will be growing in Nebraska fields, extending contamination concerns through yet another production season. This is an important issue for Nebraska corn producers because to date, the FDA has not approved corn with this trait for human consumption and this grain will need to be directed toward non-food markets. Corn produced this summer could undergo the same rigorous testing we are currently seeing for this genetically engineered trait.

This article addresses why the StarLink™ event presents a food safety concern to the regulatory agencies that other commercial Bt events do not, and why the gene's inheritance will cause the volunteer corn issues this growing season.

The StarLink™ Gene

StarLink™ corn makes a Bt protein that is toxic to European corn borer (ECB) larvae. This genetically engineered trait has a similar history to the other Bt traits in corn. Genes were discovered in strains of a *Bacillus theringeonsis (Bt)* soil bacteria that have the DNA information to encode specialized crystalline proteins. These "Cry" proteins can bind to midgut receptors in European corn borer and kill the larvae before they damage corn plants.

Genetic engineers modified the "Cry" genes prior to introduction into corn so that they would be expressed in the cells of a corn plant. They removed the bacteria gene promoter (the gene's on/off switch) and replaced it with a promoter that will be recognized in a plant cell. A promoter sequence called 35S that originated from a plant virus was used for the StarLink™ gene and the two commercial Yieldgard events. The 35S promoter was combined with the portion of the Bt gene that contained the protein coding information (the coding region). In the case of StarLink™, the Bt coding region was called Cry9(c) while the Yieldgard events used a coding region from a different Bt gene called Cry1a(b). Bt proteins encoded by Cry9(c) bind to different midgut receptors in the larvae than proteins encoded by Cry1a(b). Cry9(c) Bt proteins kill European corn borer by different modes of action than Cry1a(b) Bt proteins. This fact has significance in the long-term resistance management of European corn borers.

The difference in Bt proteins is also the reason why there are food safety concerns with StarLink™ but not with Yieldgard. Tests that predict the rate of protein digestion in a human stomach demonstrated that StarLink's™ Cry9(c) encoded proteins digest more slowly than the Cry1a(b) encoded Bt proteins found in Yieldgard. Because allergies to some foods such as nuts and wheat are caused by proteins that digest slower in the stomach, the EPA decided to wait for further information before approving the bacterial Cry9(c) protein found in StarLink™ as a safe additive to human food. Because the 35S promoter used in StarLink™ directs expression of the gene in all plant parts, the protein was made in the seed and is detectable in corn grain products that have not been subject to processing procedures employing high heat that destroys proteins. Consequently, StarLink™ corn makes a Bt protein in the grain that may have the potential to be a food allergen in some corn food products to some people.

The StarLink™ event

When genetic engineers introduced the modified Cry9(c) gene into one of the corn chromosomes, they generated the genetic event that was later called StarLink™. This event involved the co-introduction of a Liberty herbicide resistance gene into the same region of the corn chromosome. StarLink™ corn plants express resistance to Liberty herbicide in addition to making the Cry9(c) version of a Bt protein. This fact has implications for the control of volunteer StarLink™ corn plants. If a StarLink™ plant passes on the Cry9(c) gene, it also will pass on the Liberty resistance gene.

StarLink™ event inheritance

Once the StarLink™ genes were introduced into the corn chromosome they were replicated and passed on like the other genes on that chromosome. Therefore we can apply fundamental rules of gene inheritance to predict how StarLink™ will be passed on to seeds produced in a commercial production field. There are two situations for corn producers to consider: "Was the StarLink™ growing in my field last year or was the StarLink™ growing in a neighboring field?"

Volunteer StarLink™ in last year's StarLink™ field

Commercial StarLink™ hybrid seed was produced to be genetically uniform and have one copy of the StarLink™ gene per cell. Most seed produced in a hybrid field results from hybrid plants in that field crossing among themselves. Simple rules of inheritance predict that three out of four seeds made on any given ear will have one or two copies of the StarLink™ gene per cell. While a vast majority of these seeds will be harvested, some seeds remain in the field, will survive over winter and can germinate as volunteers the next growing season. Three out of four

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StarLink genetics (Continued from page 24)

volunteers would be expected to be plants that make the Cry9 (c) protein and express Liberty resistance. These plants may never produce seeds themselves but if they shed pollen that lands on the silks of plants in that field, the StarLink™ gene could be passed on and the seeds will make the Cry9(c) protein. The high proportion of volunteers with the StarLink™ gene gives this scenario a high likelihood. Consequently, it will be difficult to avoid StarLink™ contamination in a cornfield that follows StarLink™ corn from the previous year.

Volunteer StarLink™ from a neighboring field

Corn naturally outcrosses and the light weight of corn pollen allows for drift to occur across long distances. This is why the EPA regulatory approval indicated that it expected an isolation distance greater than 660 feet between StarLink™ and any food grade corn production field. This expectation was commonly violated or ignored if neighboring corn fields were not in production for food grade markets. Consequently, there was ample opportunity for pollen drift from StarLink™ fields to neighboring corn fields. Half of the pollen from a StarLink™ field carried the StarLink™ gene. Pollen load would depend on distance and prevailing winds.

The potential of the drifting pollen to produce seeds in a neighboring field depends on the presence of fresh silks and the dose of competing pollen being made in that field when the StarLink™ pollen arrived. All of these factors impact the odds of volunteer StarLink™ occurring in a field that did not have StarLink™ the previous year. The factors are difficult to quantify. A producer must recognize they are taking a risk of having StarLink™ in this year's crop if they are planting corn in a field grown the previous year in corn that might have been exposed to StarLink™ pollen drift.

In fields planted to StarLink in 2000, three out of four volunteers would be expected to be plants that make the Cry9(c) protein and express Liberty resistance. These plants may never produce seeds, but if they shed pollen that lands on the silks of plants in that field, the StarLink™ gene could be passed on and the seeds will make the Cry9C protein.

Avoiding problems with volunteer StarLink™

To avoid problems with volunteer StarLink™ corn, the volunteer plants must be prevented from developing to the pollen shedding stage and spreading pollen to this season's corn plants. This will be best controlled by rotating to a crop other than corn in any field that had corn last year which may have been grown to StarLink™ or exposed to StarLink™ pollen. (*See story on controlling volunteer corn on page 21.*)

Producers face a challenging situation if their best option is to plant corn in fields that had StarLink™ exposure last year. Given the likelihood of StarLink™ volunteer escapes from any control method, it is recommended that producers plan to deliver the corn crop produced in these fields to destinations that will not have StarLink™ restrictions.

Don Lee, Associate Professor, Department of Agronomy and Horticulture

StarLink™ web resources

For more information, check the following short list of links. Also check sites hosted by the key government regulatory agencies involved: USDA (www.usda.gov), EPA (www.epa.gov), and FDA (www.fda.gov). Check *CropWatch* at cropwatch.unl.edu for a more detailed list and active links.

Aventis' StarLink. Product information and genetics at http://www.us.cropscience.aventis.com/AventisUS/CropScience/stage/html/starlinkcorn.htm; claim procedures: http://www.us.cropscience.aventis.com/AventisUS/CropScience/stage/html/Starlinkgrower.htm and list of affected hybrids: http://www.us.cropscience.aventis.com/AventisUS/CropScience/stage/html/varieties.htm

EPA "white paper" related to the effects of food processing on the CRY9(c) protein at http://www.epa.gov/pesticides/biopesticides/otherdocs/wetmill18.PDF; comments requested. (Short-term approval is still possible for yellow corn with a larger tolerance for StarLink to be used in wet milling.)

Iowa State University Grain Quality Initiative -- a valuable site with information, recommendations, maps of counties planting StarLink and links to news stories and regulatory information at http://www.exnet.iastate.edu/Pages/grain/gmo/gmo.html

FDA recommendations for sampling and testing yellow corn and dry-milled yellow corn shipments intended for human food use for Cry9C protein residues at http://vm.cfsan.fda.gov/~dms/starguid.html

USDA Grain Inspection, Packers and Stockyards Administration with new testing, marketing and export information at http://www.usda.gov/gipsa/biotech/starlink/starlink.htm

Seed treatments *(Continued from page 22)*

sugarbeets, 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 depending on the product, may not protect emerged plant parts. Under heavy infestations of wireworms, a granular soil insecticide may be necessary.

Seedcorn maggots attack the seeds of many crops before or just at germination, preventing germination by killing the newly emerging coleoptile. Seedcorn maggots tend to prefer areas with high organic matter, particularly where manure has been spread, an old feedlot, or where cover crops have been incorporated prior to planting. Using a seed treatment can prevent damage from seedcorn maggots.

White grubs feed on roots deeper in the soil. Crop emergence may appear normal in the beginning. Later the stand becomes thin or patchy, and plants appear wilted or show signs of nutrient deficiencies. Roots of crops are usually chewed off cleanly. White grubs are difficult to predict and control.

Types of seed treatments

Seed treatments are available as planter box treatments, which the farmer can apply, or commercially applied slurries. The advantage to slurries is there should be little or no dust associated with the treatment. They cost more than planter box treatments.

Insecticides used for seed treatments in crops include diazinon, lindane, imidacloprid, permethrin, chlorpyrifos, and tefluthrin.

Seed treatments for corn

See *Table 1* for a list of products available for seed protection. This table does not include every product. Check with your local agricultural chemical dealer for additional seed treatments. Remember most seed treatments protect only the seed and may not protect the seedling after germination.

New seed treatments for 2001

Some new seed treatments have come to the market and, as stated earlier, go beyond the traditional early season protection role. Not only do they protect against early season insects such as wireworms and seedcorn maggots, but they also are labeled for use against other pests such as flea beetles and corn rootworms. Gaucho and Prescribe from Gustafson are new products available for corn in 2001. The active ingredient in both is imidacloprid, a systemic insecticide that has been used in other crops such as sorghum. The product used for both Gaucho and Prescribe is Gaucho 600. The imidacloprid rate for corn varies according to the target insects. If only seedling insect control is desired, the rate is lower and will be sold under the name Gaucho. Two rates of Gaucho are available, one for field corn and another higher rate for more susceptible inbreds (Gaucho Extra). Gaucho, although systemic, does not claim to protect the seedling plant from wireworm attack after the plant has emerged from the seed. Flea beetle control is expected through the first true leaf stage for Gaucho and through the 5-leaf stage for Gaucho Extra. The rate is

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Table 1. Seed treatments for corn

Product Name	*Common Name*	*Rate*	*Application methods*
Agrox DL Plus	15% captan + 15% diazinon + 25% lindane	3.6 oz/cwt	Planter box
Agrox Premiere	Captan + diazinon + lindane + metalaxyl	3.6 oz/cwt	Planter box
Assault*	25% permethrin	2.0 oz/cwt	Slurry
Barracuda*	25% permethrin	2.0 oz/cwt	Slurry
Enhance Plus Suppression of seedcorn maggot.	20% carboxin + 35% maneb + 18.75% lindane	3 oz/bu	Planter box
Gammasan Suppression of seedcorn maggot.	32.8% captan + 16.6% lindane	5.4 oz/cwt	Planter box
Germate Plus	14% carboxin + 15% diazinon + 25% lindane	2 oz/bu, or1.5 oz/42 lb	Planter box
Kernel Guard	14.7% captan + 15% diazinon + 25% lindane	2 oz/bu, or1.5 oz/42 lb	Planter box
Kernel GuardSupreme	10.4% permethrin + 14% carboxin	1.5 oz/42 lb	Planter box
Maneb-Lindane Suppression of seedcorn maggot.	50% maneb + 18.75% lindane	3 oz/bu	Planter box
Nugro-Isotox F	12.5% captan + 25% lindane	3 oz/bu	Planter box
Raze* Wireworm only	26.8% tefluthrin	3 fl oz/cwt	Slurry
Sorghum Guard Wireworm only.	32.5% captan + 16.6% lindane	8 oz/cwt	Planter box

*For use only by commercial seed treaters

Seed treatments *(Continued from page 26)*

increased further to provide suppression of corn rootworms and this product is sold under the brand name Prescribe. "Suppression" is a category we would rather not see on a label but it is an indication that some mortality of target insects will occur, but under certain conditions control may not be considered satisfactory. It is expected to give much longer control of flea beetles. These products will be sold through your seed dealer as pre-treated seed and the added cost will range (approximately) from $10 a bag for Gaucho to $40 a bag for Prescribe.

ProShield from Syngenta is a tefluthrin-based seed treatment also labeled for control of corn rootworms. It was used in some fields in 2000. The seed is coated with Force ST equivalent to approximately two-thirds of the rate of granular Force insecticide. It was included in a yield trial conducted at the Haskell Ag Lab near Concord, NE in 2000. (*See results in Tables 2 and 3*).

Cost of ProShield will be similar to that of granular insecticides ($15-$18 an acre based on seeding rate). Based on the results of the above trial and others on ProShield, and on the suppression label for Prescribe, we advise caution in the selection of these products as rootworm control choices. As these new products are further tested and used in the field, we will get a better idea of how these new seed treatments compare to other corn rootworm standards like planting time insecticides. As with all products it is necessary for growers to assess their own individual situations before deciding on what control method to use. More data can be found on the Northeast Research and Extension Center website http://nerec.unl.edu/ipm/jarvi.htm and on the South Central REC website at http://ianrwww.unl.edu/ianr/screc/entomology/index.htm

Table 2. Novartis ProShield corn rootworm insecticide screening experiment, Haskell Ag Lab, Concord Ne 2000. Root Ratings

Treatment	*Application method*	*Rate oz/1000 row ft*	*Rate lb ai/1000 row ft*	*Root rating*
Aztec 2.1 G	TB	6.7 oz	0.14	2.50 a
Force 3 G	TB	4 oz	0.12	2.55 a
Force 3 G	IF	4 oz	0.12	2.65 a
Fortress 5 G	TB	3 oz	0.15	2.70 a
Regent 4 SC	IF	0.24 oz	0.13	2.80 a
Counter 20 CR	TB	6 oz	1.20	2.85 a
Lorsban 15 G	TB	8 oz	1.20	2.90 a
ProShield	Pre-treated seed			4.50 b
Untreated				5.10 b

Means with the same letter are not significantly different. (LSD = 1.0332; alpha = 0.05)

Table 3. Novartis ProShield Corn Rootworm Insecticide Screening Experiment, Haskell Ag Lab, Concord NE 2000. Yield

Treatment	*Application method*	*Rate oz/1000 row ft*	*Rate lb ai/1000 row ft*	*Yield bu/ac*
Regent 4 SC	IF	0.24 oz	0.13	119 a
Force 3 G	IF	4 oz	0.12	118 a
Lorsban 15 G	TB	8 oz	1.20	117 ab
Fortress 5 G	TB	3 oz	0.15	116 ab
Counter 20 CR	TB	6 oz	1.20	114 ab
Force 3 G	TB	4 oz	0.12	110 abc
Aztec 2.1 G	TB	6.7 oz	0.14	107 bcd
ProShield	Pre-treated seed			103 cd
Untreated				98 d

Means with the same letter are not significantly different. (LSD = 10.076; alpha = 0.05)

Application methods

TB = 7 inch T-band in front of press wheel at planting time
IF = In-furrow in front of press wheel at planting time

Problems associated with seed treatments

Like any other agricultural chemicals, seed treatments must be used according to the label. These materials are toxic and must be handled with care. Always read the label before purchase and before using. Do not use insecticide treated seed for any other purpose than planting.

Some reported problems are:

1) Some products (lindane based) by themselves may themselves cause reduced germination under adverse environmental conditions or over-application. Problems in Illinois in 1996 were attributed to using higher rates than the label specifies. Mix only the amount necessary and do not mix too far ahead of application. Avoid leaving treated seed sitting under hot conditions. Germination of poor quality seed may also be affected.

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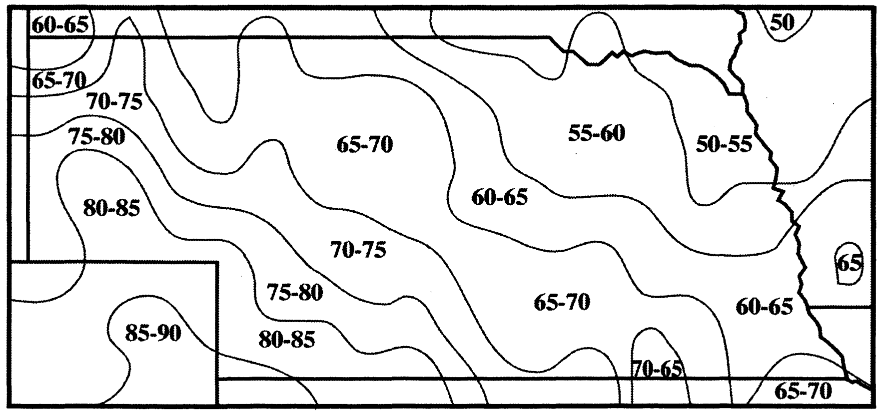
Potential for corn flea beetle damage reduced



Nebraska's colder than normal winter was bad news for overwintering corn flea beetles. Any areas with numbers over 90 would be likely to have corn flea beetle populations; however, no areas in Nebraska reached this level this winter. The corn flea beetle feeds directly on corn and is a vector of the Stewart's wilt bacterium.

Due to the colder winter weather, corn flea beetle survival is expected to be below average this year. If the sum of the monthly average temperatures for December, January and February is greater than 90, overwinter survival of flea beetles is expected to be high. Based on the accompanying map for Nebraska, no areas exceeded 90. This means that corn flea beetle populations are not expected to be as high as last year, although economic damage may still occur in areas where high populations developed last year.

Corn flea beetles overwinter as adults in protected areas near corn fields. They become active in April and feed on a variety of grasses before corn emerges. Corn flea beetles can directly injure corn by feeding on seedling plants; however, probably more importantly they vector the bacterium which causes Stewart's wilt.

To minimize damage caused by flea beetle feeding:

- Avoid hybrids or inbreds known to be more susceptible to Stewart's wilt (see seed catalog or local seed company representative)
- Avoid early planting dates if susceptible inbreds or hybrids are planted.
- Use seed treated with a systemic insecticide such as imidacloprid (Gaucho, Gaucho Plus, or Prescribe). Gaucho contains 0.16 mg ai/kernel, Gaucho Plus contains 0.60 mg ai/kernel and Prescribe contains 1.34 mg ai/kernel. Higher rates of imidacloprid provide longer residual control of flea beetles. Other currently available corn seed treatments are not systemic and would not be expected to control flea beetles.
- Scout for corn flea beetles on seedling corn. Treatment may be warranted on dent corn if 50% of plants show severe flea beetle injury and an average of five or more flea beetles per plant are found Severe injury may be indicated when plants look silvery or whitish or leaves begin to die. If susceptible inbreds or hybrids are grown, an insecticide may be needed when an average of two to three flea beetles per plant are present and 10% of the plants show severe flea beetle injury. A variety of foliar insecticides are effective in controlling flea beetles. They include Lorsban 4E, 2-3 pt/acre; Sevin XLR Plus, 1-2 quarts per acre, Asana XL, 5.8-9.6 fl. oz per 1000 row-ft; Lannate LV 0.75-1.5 pt/acre; Pounce 3.2 EC 4-8 fl. oz per acre; and Warrior T 2.56-3.84 fl. oz per acre.

Bob Wright
Extension Entomologist
South Central REC

Controlling winter annual weeds in wheat

Broadleaf winter annual weeds, such as blue mustard, tansy mustard, tumble mustard, field pennycress, and shepherd's-purse, are very competitive with winter wheat because they compete with the crop throughout most of its life cycle. Unfortunately, many growers are unaware of these weeds in their fields until they start to bloom in the spring. By this time, control is difficult and most of the crop damage has already occurred. To be effective, winter annual broadleaf weeds need to be controlled in the late winter or very early spring, before the plants begin to bolt or the stems elongate.

Blue mustard is perhaps the most difficult of the winter annual broadleaf weeds to control because it bolts very early. Early April applications of 2,4-D usually provide excellent control of tansy mustard and the other winter annual broadleaf weeds, but it provides only fair control of blue mustard. Adding a sulfonylurea herbicide, such as Ally or Amber, to 2,4-D will improve control, particularly after these plants have bolted, but it may not help increase yield because most yield damage has already occurred. If the sulfonylurea herbicide is used after bolting, but prior to seed production, it may be useful to reduce the amount of seed produced.

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Seed treatments

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2) Some farmers (and the University of Missouri) believe dry seed treatments may not perform satisfactorily in planters with air-metering devices. Consider using pre-treated seed instead.

3) Dry materials may cause problems with population monitors. Clean electric eye population monitors as often as necessary, depending on conditions.

4) Graphite talc may be necessary to enhance the flowability of seed in the hopper box, depending on the planter. Use the manufacturer's recommendations when deciding if and when to use talc.

Alternatives to seed treatments

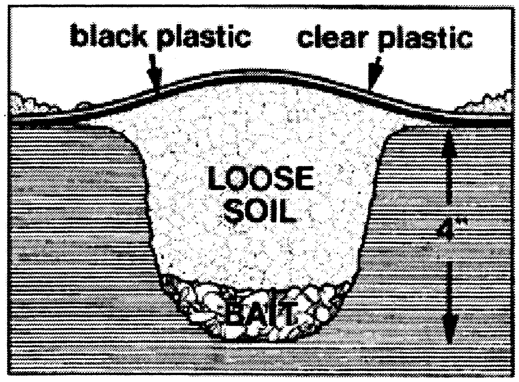
Farmers can use options other than seed treatments to control seedling insects. Granular insecticides can be used in-furrow at lower than labeled rates if only seedling insect control is desired. Usually one-half rates of the standard rootworm amounts are used. Calibration and accurate delivery is critical for satisfactory control with reduced rates. **Caution**. Some companies **will not** support lower than labeled rates for insect control. Contact your dealer to determine if the company allows reduced rates.

The use of liquid insecticide placed in the furrow with the seed has gained in popularity over the last few years as a convenient and inexpensive method to achieve wireworm and seedcorn maggot control. Often the insecticide is placed in the furrow with starter fertilizer, although it is not necessary.

Pounce 3.2 EC and Warrior T have been used primarily for this purpose. Both have Section 2 ee labels for wireworm control, Pounce at 4 to 8 oz/acre and Warrior at 1.92 fluid oz/acre. Cost for these treatments is roughly $4.00 an acre at labeled rates. However, some farmers have been cutting these rates in half and are reportedly achieving satisfactory control. The manufacturers of other liquid insecticides such as Regent may support lower labeled rates for wireworm control. Capture 2EC is also registered for wireworm control at one-half the rootworm rate. The cost for a Capture treatment is approximately $7.50 an acre. See your dealer for details.

Caution. We have little trial data to compare these treatments under heavy wireworm pressure. Until we get more data from trials we are reluctant to recommend one method of seedling insect control over another. The traditional planter box treatments usually work quite well and are among the least expensive options.

Keith Jarvi, IPM Extension Assistant, Northeast REC
Tom Hunt, Extension Entomologist, Northeast REC
Bob Wright, Extension Entomologist, South Central REC



Set and monitor wireworm traps two to three weeks before planting to determine how serious the problem may be and what the best control options may be. For more information, check Insects That Attack Seeds and Seedlings of Field Crops, *NebGuide G91-1023.*

Bait station construction

1. Use a 1/2 cup mixture of untreated wheat and untreated shelled corn for each station.
2. Dig a hole and bury the bait about four inches deep. Cover the bait with loosely packed soil, and cover the soil with 18-inch square pieces of black and transparent plastic anchored on the edges with soil. The plastic helps heat the soil with sunlight and speeds seed germination.
3. Mark each station with a flag or stake.
4. In 10 to 14 days, dig up the stations and count the wireworms.
5. An average of one or more wireworms per trap indicates the need for an insecticide product.

Weeds in wheat *(Continued from page 28)*

The bottom line is that winter wheat growers need to scout their fields in late fall or winter to determine if they will need to control winter annual broadleaf weeds in late February or early March in the case of blue mustard, or in early April for the other winter annual broadleaf weeds. Once you see the plants flowering above your wheat crop, it is probably too late for this year. If timed correctly, 2,4-D (8 oz/acre of LV4 ester or 16 oz/acre of 4 lb/gal amine) provides low-cost and effective control of these weeds.

If winter annual broadleaf weeds are a regular problem, change the crop rotation. Including a spring-seeded crop such as corn, sorghum, soybean, oat, proso millet, or sunflower in the rotation with winter wheat-fallow provides an additional year in which to prevent seed production and allows the soil seedbank to gradually decrease. Additional information on blue mustard can be found in the NU NebGuide, *Blue Mustard Control*, at: http://www.ianr.unl.edu/pubs/weeds/g1272.htm.

Drew Lyon
Extension Dryland Cropping Systems Specialist

Improving tractor performance

Duals not needed with front-wheel-assist

Many producers are buying front-wheel-assist tractors and operating them as regular two-wheel-drive tractors. This decreases performance, reduces tractive efficiency, and wastes fuel. To get the most out of the extra money spent for front-wheel-assist, operate them as front-wheel-drive tractors.

For optimum front-wheel-assist performance, start with weight distribution. About 40% of the static tractor weight should be on the front wheels and 60% on the rear. In contrast, two-wheel-drive tractors should have about 25-30% of their weight on the front tires and 70-75% on the rear. Most tractor manufacturers recommend the same total tractor weight per horsepower for front-wheel-assist and two-wheel-drive tractors. This can mean up to 33% less rear axle weight with front-wheel-assist, resulting in less compaction. (Compaction is a function of axle weight.) Also, make sure rear tires follow in the tracks firmed by the front wheels, again reducing compaction up to 80% compared to multiple wheel tracks.

Always use single rear tires on front-wheel-assist tractors. Using duals cuts traction, increases slip, and increases rolling resistance because the outer dual wheel "lifts" the inner tire from the tracks left by the front drive tires. Producers who think they increased pull because of duals on a front-wheel-assist tractor did so because they added weight (of the duals) to the rear of the tractor. They probably would have increased pull even more by adding the same amount of weight distributed to both the front and rear of the tractor to maintain the proper 40/60 ratio.

In the field, use the front-wheel-assist all the time. Ballasting for front-wheel drive and not using it wastes power and makes steering difficult. Ballasting for two-wheel drive and only engaging the front-wheel drive in tough spots doesn't leave enough front weight for traction, contributing to "wheel hop". Tractors with powered front wheels have less rolling resistance because drive wheels continually climb out of their tracks. In addition, the rear drive wheels have less rolling resistance and can pull 28% to 50% more than the front wheels because they are running in already-firmed tracks. Because of these firm tracks, a properly ballasted front-wheel-assist tractor will have 3% to 7% higher tractive efficiency than a two-wheel-drive tractor of the same horsepower and weight.

For optimum field performance, always use the recommended tires and inflation pressures on the front and rear tires of a front-wheel-assist tractor. Improper size of inflation can change the rolling radius of the tire, reducing the tractive efficiency, and may damage the power train or cause excessive tire wear. Consult the owner's manual for these and other recommendations to get the most from your front-wheel-assist tractor.

Paul Jasa
Extension Engineer

Duals may increase compaction

Dual wheels or large floatation tires can help minimize surface compaction but have little influence on subsurface compaction. Depending on the size and hub type, adding duals may increase a tractor's weight from ½ to 2 tons, increasing compaction because compaction is a function of axle weight. By increasing the tire effective width, about twice the soil volume is compacted compared to single tires. The greatest danger related to duals and compaction is the temptation to use the added floatation to work soil when it is wet.

Producers often add duals or weight to increase the pull of their tractor. But traction does not always increase with duals. In fact, single tires can pull as much as duals in firm soil when both are weighted equally. The increased traction from duals often comes from the added weight of the duals. However, any added weight adds to compaction. Another disadvantage of duals is that the weight and increased rolling resistance from duals requires extra power to move the tractor itself through the field, reducing performance compare to single tires. To make more effective use of the tractor's power, producers are usually better off by reducing draft (implement width or operating depth) and increasing operating speed since power is a function of both. The reduced draft requires less weight on the tractor to develop the needed pull, further reducing compaction.

Running duals can increase a tractor's load-carrying capacity if single tires cannot support the load safely. But duals can create a "pinch row" effect on the soil between the duals. Rather than using duals, a producer may be better off by switching to larger diameter tires or tires with a higher star (or ply) rating to carry the load. However, any added load increases the potential for compaction. A better alternative may be lift assist wheels on mounted equipment or switching to pull-type equipment so that more axles are available to carry the load. In addition to reducing compaction, not as much tractor front end weight will be needed for stability. Usually, lift assist wheels are cheaper than duals and are more effective at handling the load safely, especially during transport.

Paul Jasa
Extension Engineer