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UNL researches level of susceptibility of western corn rootworm larvae to selected soil insecticides

During the last few years, reports of insecticide control failures for adult western corn rootworms have increased in parts of Nebraska where beetle spray programs have been used for many years. Recently, we compared susceptibility of adult rootworms collected from throughout Nebraska to an organophosphate (methyl parathion, Penncap M®), a carbamate (carbaryl, Sevin®) and a pyrethroid (bifenthrin, Capture®) insecticide to determine if resistance might be evolving in areas where control failures were reported (Cropwatch; No. 96-16).

Beetles collected from areas where adult control problems were reported were generally 10-15 times more tolerant to methyl parathion, 5-10 times more tolerant to carbaryl and 2-3 times more tolerant to bifenthrin than in other areas of the state. This is based on differences in LD50 values (i.e., the amount of insecticide required to kill 50% of the population). These results in combination with reports of control failures suggest strongly that resistance has developed to both organophosphate and carbamate insecticides as a result of intensive selection on adult rootworms. Because of the importance of soil insecticides throughout the cornbelt and the potential for adult resistance to impact efficacy of soil insecticides, susceptibility of rootworm larvae reared from resistant and susceptible parents was compared to the active ingredients of four soil insecticides; tefluthrin (Force®), chlorpyrifos (Lorsban®), terbufos (Counter®), and carbofuran (Furdan®) and one adult insecticide; methyl parathion (Penncap M®). Western corn rootworm beetles were collected from Clay County in August 1994 and determined to be susceptible to all of the insecticides tested. Beetles collected from York County in August 1995 were identified as being resistant to methyl parathion and carbaryl. Collections from both sites were obtained and laboratory colonies were established at the USDA Northern Grain Insects Research Lab at Brookings, S.D. The larval offspring of the two colonies were used in bioassays of the five insecticides listed above. Larvae were allowed to develop for approximately 10 days after hatching (third instars) before being sent to the University of Nebraska for bioassays. Technical grade insecticide was dissolved in acetone and different concentrations of each insecticide were applied to individual rootworm larvae. Control larvae were treated with acetone only. Each insecticide concentration was tested against 10 insects per replication with three replications per insecticide. Mortality was recorded 24 hours after treatment. Each compound was tested individually on the resistant and susceptible strains, and therefore, direct comparisons of resistance levels among the compounds should be avoided.

Results from bioassays of larvae obtained from the resistant (York County) and susceptible (Clay County) western corn rootworm colonies indicated consistently higher LD50 values (at least 2.5 times greater) in the

(Continued on page 156)
Rootworms (Continued from page 155)

York County colony for all compounds tested. Methyl parathion was the only compound that was tested on both field-collected adults and larval offspring, and results of these bioassays indicate that the larvae were perhaps even more resistant than the adults (9 times greater for adults and 15 times greater for larvae).

Since methyl parathion is not used as a soil insecticide, it seems likely that the resistance seen in larvae is a result of selection pressure on the adult rootworms. There were only small differences in LD50’s between resistant and susceptible populations when the organophosphate insecticides terbufos and chlorpyrifos were tested (2.5-3.5 times). This suggests that there is not a general response of the methyl parathion resistant rootworm population to all organophosphate insecticides, and one cannot assume that if an adult control failure occurs with methyl parathion, all other aerial or soil applied organophosphate compounds also will fail.

LD50’s of the resistant population for compounds other than organophosphates were approximately five times higher for tefluthrin (a pyrethroid) and 16 times for carbofuran (a carbamate). It is not clear, however, whether the differences in susceptibility are the result of selection with insecticides used in adult management programs (i.e., methyl parathion) or if these differences resulted independently from selection by soil insecticides. These results may indicate that the mechanism conferring resistance is relatively non-specific and results in cross resistance to a variety of insecticide classes.

It should be stressed that results from this investigation are indicative of larval susceptibility under standard laboratory conditions and for only a single stage of development and are not indicative of product performance under field conditions. Furthermore, results obtained thus far represent only a single resistant collection site and may not be indicative of all the resistant rootworm populations that have been identified. The methods used in these bioassays provide preliminary data on larval susceptibility to soil insecticides and indicate that differences in susceptibility do exist between populations. These results suggest that slight decreases in larval susceptibility potentially could occur in areas where adult control problems have been detected. However, numerous other factors, in addition to insect susceptibility, can influence efficacy of soil insecticides including application timing, weather, calibration, rootworm population pressure, and microbial degradation.

Additional experiments will be conducted to evaluate whether resistance detected in adult rootworms affects the efficacy of soil insecticides. A number of soil insecticide trials were conducted during 1996 in areas of Nebraska where adult resistance has been detected. However, rootworm population pressure was too low to obtain meaningful results. Experiments to test the efficacy of soil insecticides under field conditions and development of bioassays that more directly reflect field conditions will continue in 1997 in order to confirm the impact of adult resistance on larval control strategies.

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Bob Wright, Extension Entomologist
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Lisa Brown Jasa, Editor

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Starter phosphorus improves yields when planting winter wheat late

Many wheat growers will be planting or replanting winter wheat after the optimum seeding date this fall because of recent rains.

Some are asking how much delayed planting will reduce yields and can anything be done to minimize this reduction.

Yield reductions do not normally occur until about 10 days after the optimum planting date for your area (Figure 1). If you’re planting at the high end of the recommended seeding rate already, increasing the rate usually will not increase yields; however, starter fertilizer can make a difference.

Seed-applied phosphorus or dual-placed phosphorus have both performed similarly in several experiments across Nebraska, both much superior to broadcast phosphorus. However, research indicates that dual-placed phosphorus is only equal to seed applications with optimum seeding dates (Figure 2). If the seeding date is delayed or growing conditions prevent or delay root growth to the dual placement band, as is the case this year, seed placement is the preferred method of application. Poor root growth for whatever reason limits root-fertilizer contact and limits tillering which affects yield.

Based on these and other data, it is recommended that 25 to 30 lbs of P₂O₅ be placed in the furrow with the seed, when planting winter wheat after the optimum planting date for your area.

Bob Klein, Drew Lyon, Gary Hergert
Dave Baltensperger
Extension Agronomists
Soil nitrate sampling is considered a best management practice for evaluating the proper nitrogen fertilization rate. Nitrogen remaining in the soil profile after the crop is harvested is a valuable source of nitrogen and considerable fertilizer savings can be realized if it is accounted for in formulating nitrogen recommendations for the next year. Nitrogen resident in soil from the past season may be present as inorganic nitrogen (primarily nitrate) or as nitrogen incorporated in crop residue or manure. Nitrate-N is very mobile in soil and is subject to loss from leaching or gain from the mineralization (decomposition) of crop residue and manure. The processes that govern nitrate accumulation in soils are most active in the spring when fresh residues are incorporated from spring tillage and soil water and temperature are at an optimum for nitrogen mineralization. The time and depth of soil nitrate sampling, therefore, are important factors in the success of estimating nitrogen fertilizer need.

Taking residual soil nitrate samples as close as possible to the corn crop’s maximum nitrogen uptake will result in the best nitrogen fertilizer recommendation. Soil nitrate sampling in the fall is an acceptable practice, but there is a much higher probability that nitrate status will change in spring. Soil samples may be collected in the spring prior to planting (preplant) or just prior to sidedress application time (presidedress). Presidedress sampling generally reflects changes in soil nitrate concentrations from mineralization. Research results have shown that presidedress sampling generally reduces the risk of over fertilization, however presidedress sampling time is best suited to production situations where fertigation is possible (See Table 1).

Nitrate-N in the 1-2 foot depth is an important source of N for corn. In Nebraska, we recommend soil nitrate sampling to a depth of at least 2 feet regardless of whether samples are taken at preplant or presidedress time. However, preplant samples taken to a depth of 4 feet will improve the accuracy of resulting nitrogen recommendations. Past fertilizer management will affect the probability that soil nitrate-N sampling will be profitable. There are several signals that may be used to trigger the decision to take deep soil samples. Answering yes to any of the following would indicate a high probability of high residual nitrate-N accumulation.

1. You have applied manure in the past two years and have not reduced your nitrogen fertilization rate.
2. The very lowest corn leaves are dark green after silks are dry.
3. You are applying more than 1.2 lbs of nitrogen per bushel of corn produced.
4. You have a higher incidence of stalk rot than usual.

Daniel Walters
Associate Professor of Soil Science
Department of Agronomy

Soybean, sorghum, dry bean update

Soybean condition was rated 87% good to excellent. Statewide, 95% of the acreage had turned color, compared with 92% last year and an average of 96%. Soybean harvest was 2% completed, as of Sunday, compared with 5% last year and an average of 24%.

Sorghum was rated at 84% good to excellent with almost half the fields having reached maturity.

Dry bean harvest progressed ahead of average, with 74% complete as of Sunday.

### Table 1. Effect of time and depth of soil nitrate-N sampling on soil nitrate-N concentration and the frequency of over fertilization. Data is a summary of 290 site-years.

<table>
<thead>
<tr>
<th>Time of sampling</th>
<th>Depth of sampling</th>
<th>% of sites overfertilized with nitrogen</th>
<th>Average soil Nitrate-N concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Feet</td>
<td>%</td>
<td>ppm</td>
</tr>
<tr>
<td>Preplant</td>
<td>0-1</td>
<td>35</td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td>0-2</td>
<td>23</td>
<td>8.1</td>
</tr>
<tr>
<td>Presidedress</td>
<td>0-1</td>
<td>25</td>
<td>13.4</td>
</tr>
<tr>
<td></td>
<td>0-2</td>
<td>18</td>
<td>11.7</td>
</tr>
</tbody>
</table>
Scout fields from the combine seat

Proper scouting is essential to monitor crops, pests, and potential problems in crop production. Even though harvest is upon us and many people think scouting is done, planning for next year’s crop begins with scouting now. The successes or weaknesses in this year’s management can often be identified from the combine-seat view of harvest.

During harvest, scouting includes a visual evaluation of what weeds were present and went to seed, so to better plan weed control for next year. In addition, the general production of the fields should be evaluated, making notes on field maps marking specific places that need further exploration. Areas with lower yields should be investigated for insect, disease, or weed control problems, or for problems with fertility or irrigation water management. After harvest, scouting can include soil sampling to determine nutrient levels to identify potential deficiencies and start planning the fertilizer program for next year.

To make this scouting at harvest easier, combine yield monitors and GPS/GIS technologies are gaining popularity. However, all of the factors affecting yield have to be considered when trying to make meaningful conclusions from the yield data or resulting yield maps. For example, many first time users of yield monitors note that the low yields are where the weed escapes were in the field and they really didn’t need to spend all that money to learn that. Without the visual reference of the weed growth from the combine seat, someone interpreting the map may not know that the weed’s competition for moisture and nutrients caused the lower yields. Similarly, cultivator blight killing one row can reduce yields by about 10 percent on that pass, again not directly noted on the map but something to be considered.

Some yield monitors and accompanying software have a feature to allow the operator to “set flags” in the data set to mark various field observations such as specific weed pressures or cultivator blight. Unfortunately, with all that goes on in a combine cab during harvest, sometimes a flag gets turned on and not turned off once through the problem area. To be an effective scouting tool, the flags have to be complete and accurate. Even without a yield monitor, visual observations should be made and the specific locations of these types of problems should be noted on detailed field maps and addressed in next year’s cropping plans.

The usability of yield maps requires equipment calibration and common sense interpretation. Improper installation and setup of the monitoring and GPS equipment or operational problems may result in maps not representative of the actual yield. With the view from the combine seat and estimates of grain in the tank or truck, an operator can approximate the yield or its variability and can then check the “correctness” of the yield maps. Detailed field notes on each load, especially when first starting to use the yield monitoring equipment, and periodic calibration checks are needed to ensure data accuracy.

As another example requiring common sense interpretation, some force-plate yield sensors which mount in the top of the clean grain elevator on the combine read differently if the grain is being “thrown” against them uphill versus downhill. On a sloping field, the resulting yield map will have alternating high and low yields for adjacent combine passes, yet the operators view and the actual harvest showed no differences.

Yield monitors and the resulting maps become more powerful tools when used for several years, especially when determining the production potential of specific areas within a field. Data from one year or detailed notes on a field map are valuable scouting tools when used to identify areas needing further investigation. With the longer term yield data and the information gained from the further investigation, management changes can be made in the cropping plans.

Paul Jasa
Extension Engineer

Ag at the Crossroads conference to address agricultural marketing

Marketing in the Next Century will be the theme of this year’s Ag at the Crossroads Conference to be held Nov. 8 at the Cornhusker Hotel in Lincoln. The 7th Annual Conference is sponsored by the Nebraska Ag Relations Council and the Department of Agricultural Economics. Farmers, ranchers, rural residents and representatives of agribusiness are invited.

Topics will include marketing potentials for agricultural commodities, including the international arena, the Nebraska property tax situation; and trends in rural Nebraska associated with what many term the Rural-Urban Gap. Dr. Duane Acker, a former Vice Chancellor for Agriculture and Natural Resources at the University of Nebraska Lincoln will be the luncheon speaker. Other speakers will include:
- Timothy J. Galvin, associate administrator, USDA Foreign Agricultural Service, on Bringing Global Markets Home.
- Greg Ruhle, executive vice president, Nebraska Cattlemen, on Selling Cattle or Marketing Beef?
- Kenneth Hbbie, president and CEO, U.S. Feed Grains Council, on U.S. Agriculture and the Global Marketplace: Crossroads or Super Highway?

For more information phone (402) 472-2821 or write the Nebraska AgRelations Council, 104 ACB, P.O. Box 830918, University of Nebraska, Lincoln, NE 68583-0918.
Properly store grain to maintain value

With corn prices up, it’s even more important to make sure that the grain going into storage maintains its quality. Be sure that only high quality grain goes into clean storage bins.

First, clean the bin site. Spilled grain and feed accumulations near bins are frequently overlooked as potential sources of migrating insects, as are dusts created by feed grinders or feed left in self feeders.

Remove leftover grain from the bin and sweep and vacuum the walls. If long term storage (over 10 months) is planned, consider treating the cleaned bin with protective insecticides two to three weeks before new grain is added. Apply the spray to the point of runoff to as many surfaces as possible, especially joints, seams, cracks, ledges, and corners, including outside the bin at the foundation and near doors, ducts, and fans. As with all pesticides, read and follow label directions carefully.

Before any grain is harvested, clean all grain handling equipment including augers, combines, trucks, and wagons and remove old grain residue. Combines should be adjusted to minimize grain damage and maximize removal of fines and other foreign material. Many common grain insects are secondary feeders — feeding only on broken or cracked kernels and other materials, not sound kernels. Be especially careful when harvesting and handling grain from stressed crops because this grain is more easily damaged.

Operate augers at full capacity to reduce wear and grain breakage. With variable incoming flowrates, reducing auger speed can keep the auger operating at full capacity. Another option is to add a hopper over the auger intake, keeping it full. Be sure that all safety shields and auger intake grates are kept in place and in good working order.

To reduce the incidence of molds and insects, cool and dry the grain immediately after combining. Deterioration of grain quality occurs rapidly at higher moistures and temperatures.

Table 1. Maximum recommended moisture contents for properly managed, aerated grain.

<table>
<thead>
<tr>
<th>Storage period</th>
<th>Corn</th>
<th>Corn + sorghum</th>
<th>Soybeans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fed by April</td>
<td>18%</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>by June</td>
<td>15.5%</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Up to one year</td>
<td>14%</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>Over one year</td>
<td>13%</td>
<td>11%</td>
<td></td>
</tr>
</tbody>
</table>

For example, grain held continuously at 75 F and 25% moisture content will deteriorate more in four days than 15% moisture grain held at 60 F would in 250 days. Warm, moist grain is also more prone to molds and insects.

Moisture content of the grain going into storage is critical to assuring that quality can be maintained. Recommended moisture contents depend on the length of time that grain will be stored (see Table 1). These recommendations assume the grain is aerated to control temperatures. Reduce the recommended moisture contents by 1 percentage point when storing low quality grain. This include immature grain, severely cracked and damaged grain, and grain subject to previous insect or mold activity.

Grain going into a bin should be clean. Broken kernels, foreign material, and fines will create additional problems in stored grain, particularly when they accumulate in pockets. Besides being more attractive to some insects, broken kernels are more susceptible to spoilage than whole ones. Also, airflow from drying or aeration fans tends to go around pockets of fines so they cool and dry more slowly. These pockets often develop into hot spots that result in spoiled grain.

The most effective way to remove broken kernels, fines, and other foreign material is to use a high capacity rotating grain cleaner. If this is not possible, a power spreader may be used to minimize concentration of fines, although a doughnut-shaped accumulation of material often occurs in the bin. If a power spreader is not used, install a grain cone to break up the inflow of grain and partially spread the fines.

More grain goes out of condition because temperatures are not controlled than for any other reason. When first storing grain, cool to the prevailing temperature. While in storage, grain should be held at temperatures within 10 F to 15 F of the average outside air temperature. Temperatures below 50 F will prevent insect feeding and reproduction.

As grain is being augured into storage, apply a liquid or dust grain protectant, especially if the grain will be stored for 10 months or more.

Stored grain represents a major investment. Precautions taken as the grain is stored can pay dividends later by helping to assure that quality is maintained.

David P. Shelton, Extension Agricultural Engineer, Northeast District
David D. Jones, Associate Professor, Biological Systems Engineering
Keith J. Jarvi, Extension Assistant, Integrated Pest Management, Northeast District

Use masks to avoid bin dust

Cleaning grain bins can be hazardous to your health if you don’t take the necessary safety precautions. Inhaling the fine dust from the grain bins can cause congestion as well as flu-like symptoms when the dust was from moldy grain. Wear a two-strap dust mask or a cartridge respirator to alleviate the potential hazard. Consult label for proper precautions if applying any pesticides in the bin.