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## NF99-367 Adult Western Corn Rootworm Insecticide Resistance in Nebraska

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## Adult Western Corn Rootworm Insecticide Resistance in Nebraska

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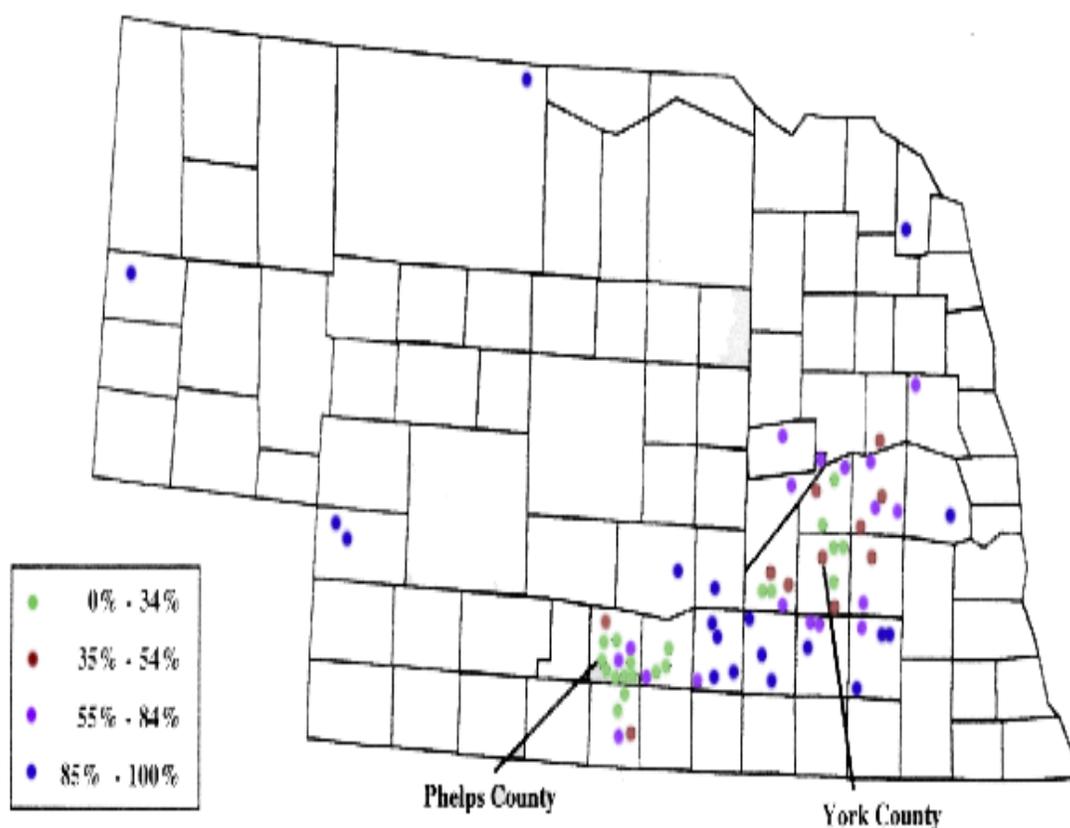
Reports from south central Nebraska of decreased adult rootworm control with foliar insecticides led to a series of studies beginning in 1994 which have documented the presence of insecticide resistant western corn rootworms in two areas surrounding York and Holdrege, Nebraska. University of Nebraska entomologists, in cooperation with USDA-ARS scientists from the Northern Grain Insects Laboratory in Brookings, South Dakota, are researching the distribution of resistant beetles in Nebraska, the underlying mechanisms responsible for resistance, and management recommendations for areas with resistant corn rootworms.

### Adult Resistance

An initial survey was conducted in 1995 to determine levels of insecticide resistance to three insecticides: methyl parathion (Penncap-M, an organophosphate insecticide), carbaryl (Sevin and SLAM, a carbamate insecticide), and bifenthrin (Capture, a pyrethroid insecticide). Western corn rootworm beetles were collected from 16 locations across the state and tested. These studies documented that 10-17 times more methyl parathion was required to kill beetles from York and Phelps counties than the most susceptible beetles. Beetles resistant to methyl parathion also required 8-9 times more carbaryl, and 2.5-3.5 times more bifenthrin to kill equal numbers of beetles as in susceptible populations. Based on these studies we concluded that the poor control in the field was associated with insecticide resistance, and not problems with application procedures or insecticide products.

Next, a bioassay was developed for methyl parathion that quickly identifies whether a rootworm population is resistant or susceptible. A minimum of 50 beetles were collected in the field and returned to the laboratory. Beetles (10 per vial) were placed in vials coated on the inside with a known concentration of methyl parathion, and then checked in four hours for mortality. This dose will kill a high proportion of the population if it is susceptible and a low proportion of beetles if the population is resistant. Field reports of poor adult control with insecticides have correlated well with 50 percent or less mortality in this laboratory bioassay.

Using this procedure, annual surveys have been conducted since 1996 to better understand the distribution of insecticide resistant rootworms in Nebraska. Figure 1 shows results from the 1998 survey. The four ranges of percentages shown in the figure refer to percent mortality after four hours when exposed to a uniform dose of methyl parathion in the laboratory. The potential for poor adult control in the field when using products or tank mixes that contain methyl parathion is highest in areas marked with a star or solid square (= 0-50 percent kill in bioassay). Populations of highly resistant (0-25 percent mortality) beetles were found in Phelps, Kearney, Adams, Franklin, and Gosper counties in the west and Hamilton, York and Polk counties in the east. Sites in between Holdrege and York with populations of susceptible (76-100 percent mortality) beetles were found in Adams, Buffalo, Hall, and Clay counties. Based on the presence of susceptible beetles in between the two resistant populations and laboratory studies on the resistance mechanisms, we conclude that these two areas of resistance have developed independently of each other. Since 1996, the proportion of beetles tolerant to methyl parathion has increased in many locations and the geographic distribution of resistant populations has expanded, as documented by annual bioassay surveys and poor product performance in the field.



**Figure 1. 1998 Methyl parathion vial bioassay summary; percentage of western corn rootworm beetles killed after 4 hours; N=100 beetles/site.**

## Management Recommendations

People farming in areas with documented resistance to insecticides by adult rootworms should consider the following options:

- Crop rotation is highly effective in controlling rootworms in Nebraska and has the added benefit of not increasing the selection for insecticide resistance.

- Base the decision to use insecticides on the level of rootworms present in individual fields, based on adult scouting and economic thresholds. (See *Western Corn Rootworm Soil Insecticide Treatment Decisions Based on Beetle Numbers*, NebGuide G774.)

Where economic thresholds are exceeded:

- Other foliar insecticides may be used in place of Penncap-M to avoid the adult resistance problem, however most available options are more expensive than Penncap-M, do not provide the degree of residual activity, and may not control the same spectrum of pests.
- Increasing gallage of spray applications may provide better control with existing insecticides by providing better coverage of insecticides within the canopy. Labels for Penncap-M and Warrior recommend a minimum of one and two gallons spray volume per acre, respectively.
- Avoid spraying too early for adult beetle control. Males begin to emerge before females and females require about two weeks after emergence before they are ready to lay eggs.
- Soil insecticides are another chemical control option. Resistant rootworm larvae do not respond similarly to all organophosphate insecticides. Based on 1997 research at Holdrege, planting time applications of Lorsban, Counter and Aztec provided adequate levels of root protection against a moderate to heavy rootworm population at a location known to have adult resistance to methyl parathion and carbaryl.
- If using soil insecticides, do not use less than labelled rates for rootworm control.
- Whether you use adult control or soil insecticides, do not use the same insecticide in a field for several successive years.

People farming outside the resistance area should consider the following practices to decrease the potential for insecticide resistance developing:

- Rotate some of your corn acres.
- Whether you use adult control or soil insecticides, do not repeatedly use the same insecticide in a field over several years.
- Base the decision to use insecticides on the level of rootworms present in individual fields, based on adult scouting and economic thresholds. (See *Western Corn Rootworm Soil Insecticide Treatment Decisions Based on Beetle Numbers*, NebGuide G774.)

## **For More Information**

- Meinke, L. J. 1995. *Adult Corn Rootworm Management*, UNL Agricultural Research Division, Misc. Publ. 63.
- J. F. Witkowski, D. Keith and Z B Mayo. 1986. *Western Corn Rootworm Soil Insecticide Treatment Decisions Based on Beetle Numbers*, UNL Cooperative Extension, NebGuide G774.

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