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J. F. Witkowski

University of Nebraska-Lincoln, jwitkowski1@unl.edu

David L. Keith

University of Nebraska-Lincoln, dkeith1@unl.edu

ZB Mayo

University of Nebraska-Lincoln

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Western Corn Rootworm Soil Insecticide Treatment Decisions Based on Beetle Numbers

This NebGuide describes how counting western corn rootworm beetles throughout the summer can be used to determine the need for insecticide applications the following spring.

*J.F. Witkowski, Extension Entomologist
D.L. Keith, Extension Entomologist
ZB Mayo, Professor of Entomology*

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Western corn rootworms are one of Nebraska's most serious insect pests of corn. Eggs laid in the soil from late July through September overwinter and begin hatching in late May or early June. Larvae feed on corn roots, causing plants to lodge, and may reduce grain yields. The greatest injury usually occurs from late June to mid-July, when all corn roots may be destroyed if infestations are heavy. Fully grown larvae pupate in the soil and change into the adult beetle. Beetles emerge from pupae in the soil and are present in cornfields from early July until frost. Counting beetles in the cornfield throughout the summer will help you decide whether or not you need to use a soil insecticide if corn is to be planted in that field the following spring.

The frequent occurrence of rootworm problems in continuous corn has led to routine applications of soil insecticides to protect roots from rootworm damage. Such a soil insecticide application at planting or cultivation without knowledge of beetle populations the previous years is "preventive insurance," and may be a needless expense. Previous studies indicate that as much as 40 to 60 percent of soil insecticide applications for rootworm control are unnecessary.

The new management approach in continuous corn for the western corn rootworm uses summer beetle numbers as the factor for determining if an insecticide application is needed to prevent economic damage to corn roots the following year. *The applicability of this approach with the yellowish, green northern corn rootworm is uncertain.* If a specified beetle density is reached, an insecticide may be justified (an alternative would be to rotate to a different crop). If beetle populations remain below the specified number, a treatment is not justified if the field is again planted to corn. The key to using beetle populations in decision-making is careful weekly monitoring of beetles throughout the summer.

Damage Prediction

Entomologists continue to develop more reliable methods to forecast rootworm larval damage. To date,

predicting root damage levels associated with known numbers of beetles has not been perfected for all situations. However, based on low summer/fall beetle counts, cornfields intended for corn the following season can be separated into two categories:

1. Fields with the potential for economic rootworm damage, and
2. fields with little or no probability of economic rootworm damage.

Fields in the latter category need not be treated with soil insecticide to prevent rootworm larval damage.

If populations either average less than one beetle per whole plant or less than 1/2 beetle per ear zone at all sample times during the summer egg-laying period, there is little chance of economic damage to corn roots the next season. This is based on 18,000 plants per acre in continuous corn and assuming the field had a larval population.

CAUTION ON EAR ZONE COUNTS: The accuracy of the ear zone count is correlated with plant stake. Ear zone counts made during pollen shed may bias population estimates upward, and conversely, ear zone counts made at brown silk and beyond may bias population estimates downward. Whole plant counts have been proven to be more reliable.

Beetle threshold numbers for other plant populations and further adjustments according to cropping sequence appear in *Table I*. This table shows how increasing plant populations above 18,000 per acre **lowers** the number of beetles per plant required to categorize the field as having the potential for economic damage, and how plant populations below 18,000 per acre **raises** the number of beetles per plant required to place the field in the category with potential for economic rootworm damage.

Cropping sequence may influence the sex ratio of the beetle population. First year cornfields or fields that did not have a larval population are "acceptor" fields, and usually have a higher proportion of female than male rootworm beetles moving into them during the summer. Consequently, beetle threshold numbers (*Table I*) should be lowered in these fields to account for a higher proportion of egg-laying females in the migrating population. Fields that lose beetles to neighboring fields are termed "donor" fields.

In Nebraska tests, approximately 90 percent of the cornfields with numbers of beetles below the threshold have not had serious root damage the following year. Predictions of significant root damage in fields with beetle numbers above the threshold have been less accurate. The majority of these missed predictions have been "on the safe side" when predicted rootworm damage did not occur. Therefore, although not as accurate as we would like, this prediction system errs on the conservative side and has helped to reduce the number of unnecessary applications of soil insecticides in fields with low beetle counts.

Table I. Average number of beetles present in cornfields (July through September) that may produce an economically damaging rootworm population in corn the following year.

<i>Average number of rootworm beetles</i>				
<i>Ave. No of plants/acre</i>	<i>Continuous corn¹</i>		<i>First year corn^{2,3}</i>	
	<i>Per plant</i>	<i>Per ear zone</i>	<i>Per plant</i>	<i>Per ear zone</i>
14,000	1.28	0.64	0.96	0.48
16,000	1.12	0.60	0.84	0.42
18,000	1.00	0.50	0.75	0.37
20,000	0.90	0.45	0.68	0.34
22,000	0.81	0.40	0.61	0.30
24,000	0.75	0.37	0.56	0.28
26,000	0.69	0.34	0.52	0.26

¹Based on a 50:50 ratio of females to males.

²Based on a 70:30 ratio of females to males.

³Use this threshold for continuous corn fields that did not have larval populations earlier in the season.

Beetle Scouting Procedure

Timely scouting for beetles in the cornfield, beginning soon after first beetle emergence in early July, is necessary to make decisions regarding insecticide treatment the following spring. Rootworm beetle scouting should continue as long as beetles are present. However, scouting can be discontinued whenever the beetle population reaches or exceeds the threshold level and therefore categorizes that field with the potential for economic damage the following year. If this occurs, apply a soil insecticide the next year or rotate to a different crop.

If beetles are not found the first few times a cornfield is scouted, continue weekly field checks until late August for beetles that may move in from surrounding cornfields. If the field pollinates later than surrounding cornfields, continue scouting through the "dough/beginning dent" stage of the corn, regardless of date.

Two sampling methods for beetle counts can be used (*Table II*). For both methods, count the beetles on at least 10 plants per sampling site in each of several widely separate areas of the field (*Figure 1*). Always walk into fields at least 20 rows (about 50 feet) before beginning your counts.

Various factors affect the accuracy of beetle counts. Competence and diligence when making beetle counts are essential. Sample size is also important. In general, as the number of sample sites increases, so does the accuracy of the estimate of the beetle population. The larger the field, the more sample sites are needed to accurately estimate the beetle population density. Conversely, the smaller the field, the fewer the sample sites needed. We suggest a minimum of five sample sites per field, regardless of field size, or approximately one sample site per 25 acres for cornfields exceeding 130 acres. If beetle populations appear to be approaching the threshold level, increase the number of sites to provide a more accurate estimate. Do not examine the same plants each time a field is scouted; you can go into the same general area, however. Temperature extremes may affect counts. Avoid counting during extremely hot or cool periods of the day when beetles are less active and therefore less visible.

Table II. Alternative methods for counting rootworm beetles in a cornfield.

Whole Plant Counting Method

1. Choose all plants at random. Do not look for infested plants. Approach plants cautiously to avoid disturbing beetles. Sample individual plants at least two paces apart to minimize disturbance from previous sampling.
2. When the sample plant is selected and approached, quickly glance over all exposed plant surfaces, counting all rootworm beetles. At the same time, grasp the ear tip and hold it shut while inspecting the entire plant in greater detail for beetles that might be hidden behind leaves, leaf sheaths, etc.
3. Finally, release the ear tip and count the beetles in the silk.
4. Record all observations, including date and field location.

Ear Zone Counting Method

1. Choose all plants at random. Do not look for infested plants. Approach plants cautiously to avoid disturbing beetles. Sample individual plants at least two paces apart to minimize disturbance from previous sampling.
2. When the sample plant is selected and approached, count only those beetles between the upper surface of the first leaf below the primary ear and the under surface of the first leaf above the primary ear. At the same time, grasp the ear tip and hold it shut until you finish counting the beetles on the leaf

surfaces.

3. Finally, release the ear tip and count the beetles in the silk.
4. Record all observations, including date and field location.

NOTE: Ear zone counts are easier and faster, but whole plant counts have proven to be more reliable. And, ear zone counts are influenced more by plant maturity than are whole plant counts. Ear zone counts made during pollen shed may bias population estimates upward and, conversely, ear zone counts made at brown silk and beyond may bias population estimates downward.

Because beetles are attracted to fresh green silks and pollen, avoid counting beetles in areas of late-maturing corn in a field if those sites are not representative of the entire field. Late-maturing plants will attract beetles from the surrounding area and increase potential for rootworm damage in that area. Also, since plant maturity plays such an important role in attracting beetles, consider each corn variety and/or maturity group within a single field as a separate field, sample each as a separate field, and make insecticide use decisions accordingly.

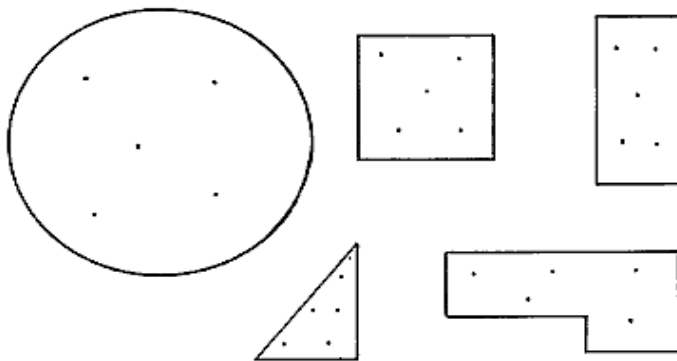


Figure 1. Suggested sample sites in variously shaped fields. Use a minimum of 5 sample sites per field regardless of field size, or approximately 1 sample site per 25 acres for cornfields exceeding 130 acres. Spread samples out so they are representative of the entire field. If more than one variety or maturity group is planted in a single field, consider each variety or maturity group as a separate field when sampling.

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