MAPPING THE CORN ROOTWORM VARIANT

The Southeast Wisconsin Variant Trapping Network[1]

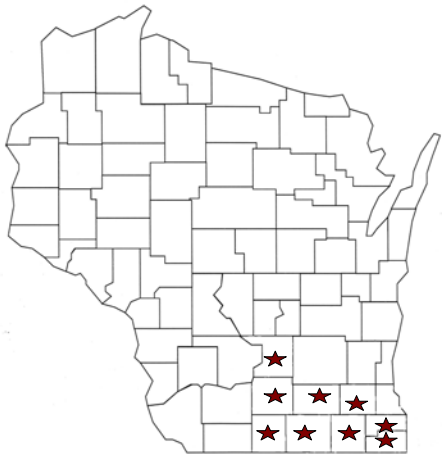

Figure 1 Area of Wisconsin currently monitored by the SE Wisconsin Variant WCR Trapping Network

The 'eastern variant' of the western corn rootworm (WCR), *Diabrotica virgifera virgifera*, has developed a behavioral adaptation to the corn-soybean rotation in some areas of the Midwest. The variant western corn rootworm (VWCR), first documented in east-central Illinois, is known to circumvent the corn-soybean crop rotation by laying eggs in soybean. Like normal corn rootworm beetle populations, the VWCR moves readily between corn and other crops between late July and early September. Unlike normal corn rootworm beetle populations however, the VWCR can lay heavy populations of eggs in soybean fields, resulting in economic injury to corn planted in the same field the following year.

Beginning in 2003, efforts of UWEX County Agricultural Agents, Extension Specialists, and corn-soybean producers from Racine, Kenosha, Rock, Walworth, Green, Waukesha, Jefferson, Dane and Columbia counties, coalesced to form the *Southeast Wisconsin Variant Western Corn Rootworm Trapping Network*.

Project Goals

- Monitor and delimit range expansion of the VWCR in southeast and southern Wisconsin and communicate findings to Wisconsin corn and soybean producers.

- Inspect root condition in first-year corn fields for western corn rootworm (WCR) larval feeding (or lack thereof) to confirm that beetle activity in the previous years soybean is the behavioral adaptation (that it is the variant).

- Assess WCR beetle activity in soybeans during August to determine whether threshold levels are met which indicate egg-laying is taking place in soybean that will cause economic injury to first year corn the following year.

---

[1] Eileen Cullen, UW-Entomology and UWEX Field Crops Entomologist; David Fischer, Dane County UWEX; Matt Hanson, Dodge County UWEX; Bryan Jensen, UW IPM Program; Peg Reedy, Walworth County UWEX; Kevin Shelley, UW NPM Program; Jim Stute, Rock County UWEX and Karen Talarczyk, UW NPM Program.

Supported by the University of Wisconsin Center for Integrated Agricultural Systems, Pesticide Use and Risk Reduction Project and the Wisconsin Soybean Marketing Board.

Background

In addition to our recent confirmation of VWCR activity in extreme southeast Wisconsin, the adapted WCR behavior (sometimes referred to as 'rotation-resistant') has previously been documented in eastern Illinois, northwestern Indiana, southern Michigan, and western Ohio. The scouting method that we have been using to monitor emergence of this variant WCR behavior in Wisconsin was developed by field crop research and extension entomologists at the University of Illinois at Urbana-Champaign. This is near where the problem was first observed in the 90s, thus the reference to 'eastern variant' of the western corn rootworm. An excellent website summarizing U of I scouting protocol and management recommendations for the VWCR can be accessed at: http://www.ipm.uiuc.edu/fieldcrops/insects/western_corn_rootworm/index.html.

Currently, we are monitoring nine counties (Figure 1) in southeastern-southern Wisconsin. The problem, presenting as economic larval root pruning injury in first year corn fields, has to date not been reported from counties outside of the southeastern portion of the state. Crop rotation continues to be a highly effective cultural control for managing corn rootworm in the majority of Wisconsin. Furthermore, all nine counties in the trapping network are not affected. Results from 2004 are presented below.

Scouting Methods

Pherocon AM yellow sticky traps, available from Gempler's [www.gemplers.com or 1-800-382-8473] and Great Lakes IPM [www.greatlakesipm.com or 1-989-268-5693], are used to monitor beetle abundance in soybean. Much like the corn rootworm scouting protocol in continuous corn, adult beetle numbers are assessed each year during August after rootworm beetles have emerged from the soil, and are in the process of feeding, mating and ovipositing the eggs which will overwinter in the soil. Trapping WCR beetles (Figure 3) in August will tell you if they are present in a soybean field and if so at what level. Next year's corn rootworm treatment decision will be based on this year's beetle count.

In the SE Wisconsin network, we employed the U of I scouting protocol. The traps (Figure 2), mounted on stakes just above the soybean canopy level, capture and hold beetles with a sticky glue coating. Twelve traps are placed in each field during the last week of July in a grid pattern, evenly spaced throughout the field and avoiding field edges. Beginning the first week in August, western corn rootworm beetles are counted, data recorded, and traps replaced every 7 to 10 days. This process is repeated into the first week of September.

For each field scouted, the following equation is used to calculate average WCR densities in the soybean field for the trapping period:

Total WCR beetles (male and female) caught / # traps / # days the field was monitored

Example:

- 1680 western corn rootworm beetles trapped
- Trapping Period was Aug. 8 to Sept. 6 (28 days)
- 12 traps/field

[1680 (number of beetles)/12 (traps)] /28 (days) = ***5 beetles/trap/day***

Figure 2. Pherocon AM yellow sticky trap used to monitor Variant WCR in soybean.

Figure 3. Western corn rootworm
Photo by Kathryn Thomas, UW Madison

Based on the U of I research referenced above, beetle numbers within the range of 0 to 4 Beetles/Trap/Day (B/T/D) over the entire 4-week trapping interval in soybean, resulted in no visible corn rootworm larval feeding, minor root scarring, to some root feeding, but not pruned to within 1.5 inches of the plant in first-year corn the following year. A B/T/D for the entire soybean trapping interval of 5 B/T/D did result in several roots pruned to within 1.5 inches of the plant the following year, but never an entire node. The latter represents a root damage score of economic significance and certainly higher than you'd expect in a first-year corn field under normal conditions. Trap numbers above the 5 B/T/D reference threshold sustained even greater root damage (more than one entire node pruned).

The Affected Area in Wisconsin

The map in Figure 4 illustrates results of our 39 soybean fields monitored in the 2004 network. Fields were located over nine counties, with greater sample sizes (more fields) in extreme southeast WI. In 2003, soybean field scouting indicated that VWCR was limited to Kenosha, Racine and southern Walworth counties. By 2004, VWCR detection shifted westward into eastern Rock County, as well as northward within Walworth County. This shift is depicted in Figure 5.

Table 1 presents corn root node-injury ratings in first-year corn from the network counties in 2004 using the Iowa State University 0 to 3 scale. Node-Injury root rating values on the 0 to 3 scale have been explained in previous conference proceedings (Jensen, 2003). Node-injury mean scores were highest in Rock, Kenosha and Walworth counties in 2004. Our sample size is admittedly small (e.g. 3 fields in Kenosha County) in some counties. However, 2004 network soybean fields which reached or exceeded 5 B/T/D occurred in eastern Rock and Walworth counties as well. As in 2003, we did not detect first year corn damage or threshold B/T/D in soybeans in Dane, Columbia, Green, Jefferson, or Waukesha counties.

Is the Variant WCR a Concern for You?

At this time, based on our network results the VWCR has been positively documented in Walworth and Eastern Rock counties. It is important to note that in 2003, soybean fields in Racine and Kenosha met or exceeded the 5 B/T/D threshold. However, 2004 soybean trapping results in our small Racine/Kenosha sample size were below threshold. Based on these variable trapping results, and our 2004 root evaluations in Kenosha County, we still consider Racine and Kenosha to be within the affected area.

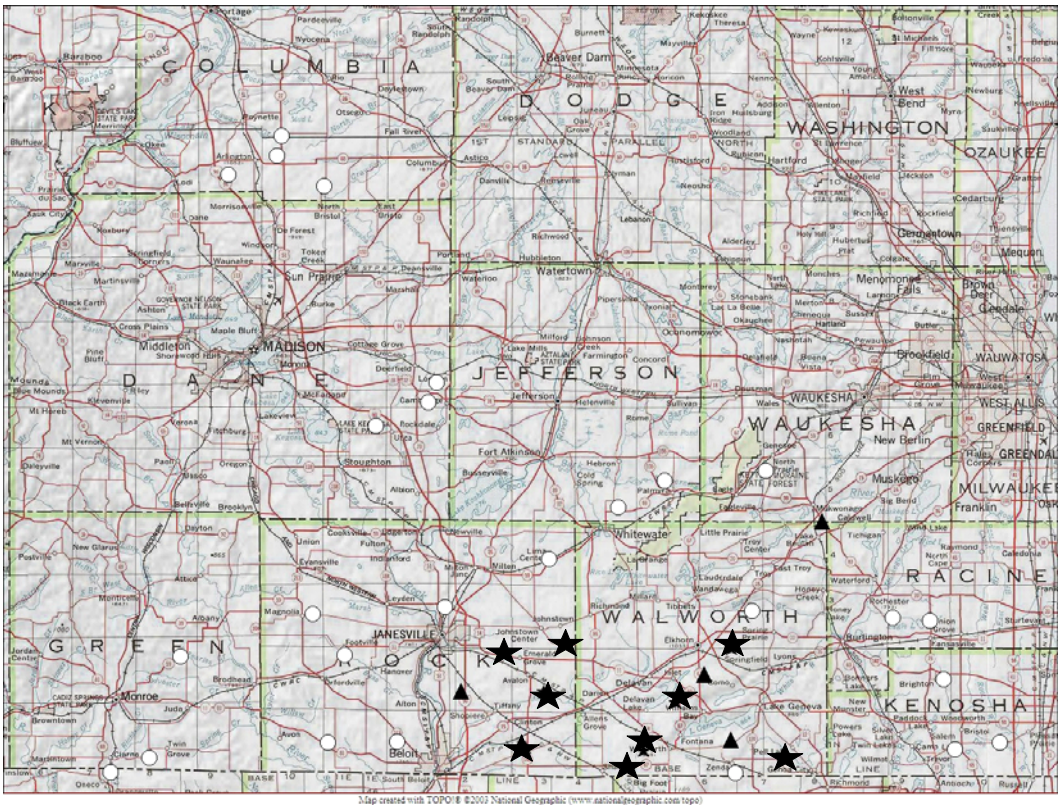

Figure 4. Western corn rootworm beetle abundance in 39 fields trapped for 4-5 weeks during August-September, 2004. Open white circles below threshold [0.00 to 3.50 B/T/D]; Solid triangles sub-threshold [3.51 to 4.99 B/T/D]; Solid stars above threshold [5.00 or more B/T/D].

Table 1. Node-injury results in first year corn fields, 2004.

County	No. of Fields	Node-injury County Average (1)	% of Roots Rating 0.50 to 0.75	Node-Injury Range
Dane	5	0.00	0	0.00 - 0.10
Columbia	7	0.01	0	0.00 - 0.20
Green	6	0.03	0	0.00 - 0.30
Jefferson	3	0.03	0	0.00 - 0.20
Racine	2	0.04	0	0.00 - 0.40
Waukesha	1	0.00	0	0.00 - 0.00
Kenosha	3	0.15	13	0.00 - 1.25
Rock	10	0.12	8	0.00 - 1.30
Walworth	11	0.52	20	0.00 - 3.00

(1) Uses Iowa State University 0 to 3 rating scale.

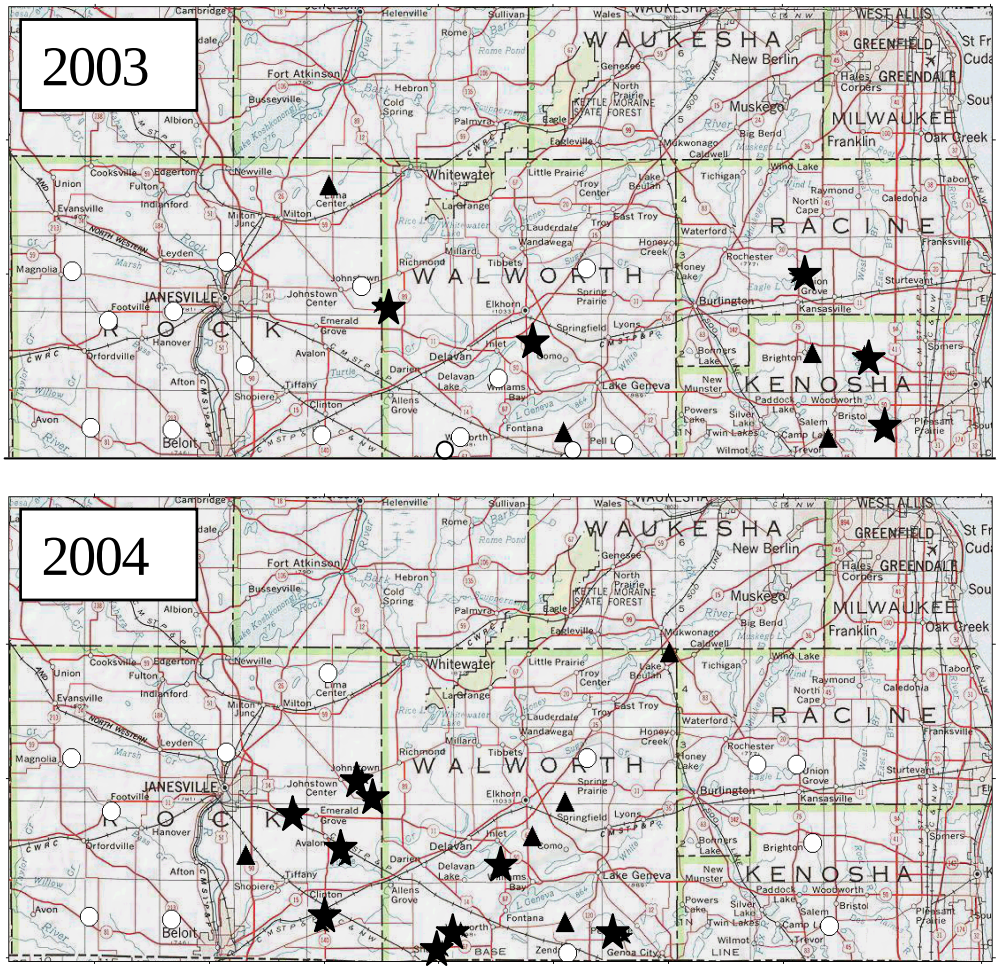

Figure 5. Change in western corn rootworm beetle abundance between 2003 and 2004 in the affected area. Open white circles below threshold [0.00 to 3.50 B/T/D]; Solid triangles sub-threshold [3.51 to 4.99 B/T/D]; Solid stars above threshold [5.00 or more B/T/D].

In affected areas (Table 1 and Figure 4), producers and consultants can take steps to minimize the risk of first-year corn damage by western corn rootworm. It is important to scout for WCR beetles in soybean fields to determine whether beetles are present in sufficient (threshold) numbers to cause economic damage to corn roots the following year (indicating beetles are VWCR). Treating first-year corn fields without first establishing the need is both economically and environmentally unsound. Just as important as knowing where the VWCR has been documented in Wisconsin, is knowledge of where we have not yet detected it's presence (Figure 4). We will continue to monitor the situation in 2005, and respond to suspect affected areas with new field locations in the network.

Data collected thus far indicate variability of both beetle populations in soybean fields and resulting damage to first-year corn roots the following year, as indicated by the range of root injury displayed in Table 1. Monitoring WCR populations in individual fields with Pherocon AM

yellow sticky traps is currently the only way to determine the potential for economic damage in first-year corn. While the map in Figure 4 provides a general idea of the affected area, it should not be used to solely base treatment decision on for an entire county. On a regional scale we are still working with a relatively small sample size (n=39 fields) of one or two fields per township. The map should, however, give you an indication of whether field scouting is something to consider going into 2005.

The cost of monitoring beetles is relatively low compared to routine treatment of first-year corn with any of the available control options. Table 2 shows the per-acre monitoring cost over a range of field sizes and compares them to routine treatment with soil-applied insecticides. The return to management (the decision to scout) is substantial and increases rapidly with field size if monitoring indicates that treatment is unwarranted. The return to management column represents the return for each hour spent monitoring soybean fields in August, whether an individual does their own monitoring or has it done by someone else. Conversely, the investment in monitoring is small should treatment be required, and could be viewed as insurance that the correct management decision is made, and inputs are not used unwisely.

Table 2. Cost and return of monitoring VWCR populations versus routine treatment.

	Monitoring Costs				Difference Between Routine Treatment and Scouting		Return to Mgt. if Tmt Unnecessary
Field Size (acres)	Total Labor (hours)	Labor ($/acre)	Traps and Materials ($/acre)	Total ($/acre)	($/acre)	($/field)	($/hour)
50	4.00	1.20	0.92	2.12	14.88	744.10	186.03
100	4.68	0.70	0.46	1.16	15.84	1583.90	338.44
150	5.36	0.54	0.31	0.84	16.16	2423.70	452.18
200	6.04	0.45	0.23	0.68	16.32	3263.40	540.30
250	6.72	0.40	0.18	0.59	16.41	4103.25	610.60
300	7.40	0.37	0.15	0.52	16.48	4943.10	667.99

Assumes: Labor, $15.00/hour; Pherocon AM sticky traps and materials (stakes and shipping), $45.89/field and routine treatment, $17.00 /acre for soil-applied insecticide

Plans for 2005

In July we will revisit the 2004 soybean fields you see on the map in Figure 4 when these fields are expected to be in corn. Some will be treated based on 2004 trapping data, others will not require treatment based on our results. In treated fields, where cooperators allow, we'll evaluate roots in an untreated strip area. In evaluating these fields for corn rootworm larval feeding injury in 2005, we will continue to validate the 5 B/T/D threshold correlation between WCR beetle abundance in soybean and subsequent first-year corn root damage in Wisconsin. We will also expand beetle trapping sites and monitored area to continue delineation of the affected area.

References

Jensen, B. 2003. Rotation- resistant western corn rootworm: A concern for Wisconsin? *In* Proc. 2003 Wisc. Fert. Aglime and Pest Mgt. Conf. 42:81-83.