

Illinois Soybean Pathology and Entomology Research



Rotation-Resistant Western Corn Rootworm

National Soybean Research Laboratory, Factsheet #2

Behavior

Throughout parts of the eastern cornbelt, western corn rootworm beetles, *Diabrotica virgifera virgifera* (WCR), circumvent crop rotation by leaving cornfields to lay eggs in fields of soybean and other crops rotated with corn. Historically, the fidelity of the WCR to cornfields for egg-laying and larval feeding was the basis of WCR control via crop rotation. Prior to the recent evolution of WCR resistance to crop rotation, first year corn (corn planted after another crop, usually soybeans) could be produced without the need for WCR-targeted soil insecticide treatment. It is suspected that the nearly universal adoption of crop rotation in east-central Illinois selectively favored a more mobile class of WCR females with a tendency to leave cornfields. Unfortunately, the change in WCR behavior has rendered crop rotation ineffective over an expanding area of Illinois (and states to the east) and has caused a dramatic increase in soil insecticide use in first-year corn. Until recently, the role of WCR behavior in the development of rotation resistance has not been studied.

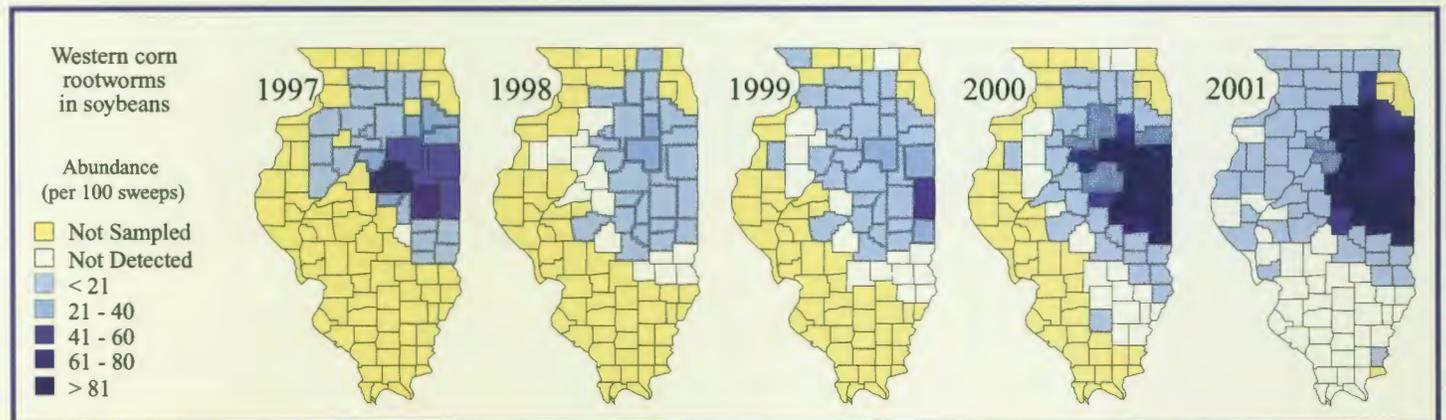
In 1996, mass WCR feeding on soybean foliage was also reported in east central Illinois. Historically, most WCR stayed in cornfields to feed until corn began to senesce. Observation of early season feeding outside of cornfields and frequent movement between corn and soybeans (and other crops) suggest that altered adult movement tendencies may be the basis of rotation resistance. Reduced fidelity to cornfields, rather than attraction to soybean, is the more likely mechanism for resistance especially since WCR cannot survive for long on an exclusive soybean diet. However, before dying from soybean feeding, WCR beetles become agitated and display an increased tendency to fly. Soybean-feeding WCR that fly back into cornfields and consume corn tissues are subsequently as vigorous as WCR that fed only on corn. Soybean-induced agitation provides a mechanism to return WCR to cornfields after egg-laying and feeding in soybean fields.



Field exhibiting considerable lodging as a result of western corn rootworm larvae feeding on corn roots.

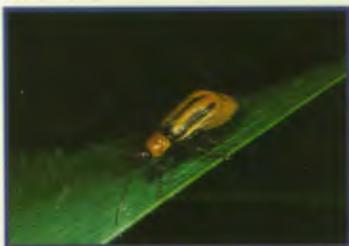
Distribution

Beginning in 1997, an annual survey of Illinois soybean fields has revealed an expansion of the WCR rotation-resistance problem area in Illinois. The spread of rotation resistance from its presumed point of origin in Ford County, Illinois is strongly influenced by the weather. The predominantly SW-to-NE track of summer storms may account for the spread of rotation-resistant WCR to portions of Indiana, Michigan and Ohio. Much of the yearly variation in WCR abundance is related to local weather conditions. Heavy rains during WCR egg hatch and larval establishment on corn roots in 1998 dramatically reduced adult population densities. Snow cover and mild temperatures can also enhance winter egg survival (e.g., 1999) and contribute to high population densities the following year.



New Research Findings

Field and laboratory studies indicate some WCR adults move between corn and soybean fields multiple times per day. On two days, one in August 1997 and the second in August 2001, between 0.2 and 0.3 million WCR likely flew into or out of our 4 acre intensive study plot in Champaign County. Daily WCR flight between corn and soybean fields and WCR abundance in soybean fields, peaks in mid-morning and just before dusk. Little WCR movement occurs under windy conditions and WCR do not fly at night. WCR flight also varies with elevation. Once WCR adult emergence and mating occurs in early July, newly mated female WCR that have just left the cornfields are commonly caught flying 10 m above corn and soybean crops. These females are presumably dispersing to new habitats and must feed in a cornfield before they are capable of laying eggs. Local spread of rotation-resistant WCR is accomplished by these and later season flights. Long distance spread of rotation-resistant WCR may also occur at this time with the aid of atmospheric conditions; airborne WCR are routinely drawn into summertime convective storms and carried aloft before being washed out of the atmosphere by precipitation many miles downwind of their origin.



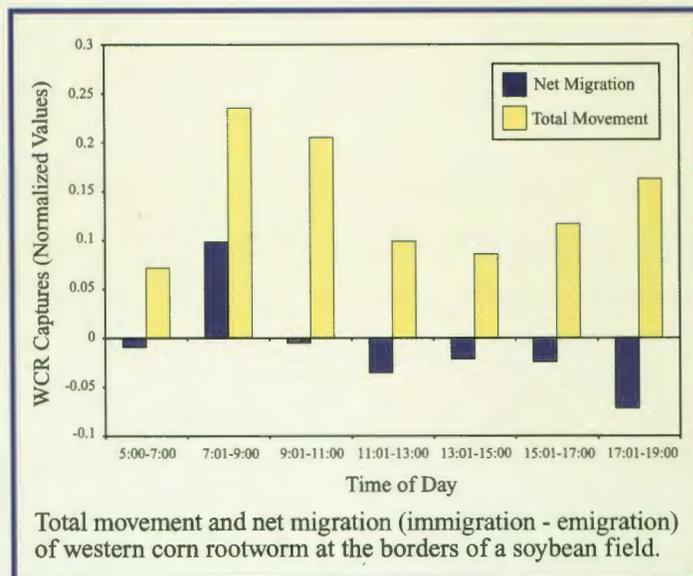
Clockwise from top left: Adult female western corn rootworm; Aerial sampling; WCR larvae feeding on developing corn roots.

Further Information

The latest information on the behavior of rotation-resistant WCR may be found at: www.staff.uiuc.edu/~s-isard/index.html

Biological information on western corn rootworm and management recommendations may be found at: www.ipm.uiuc/agriculture/corn/rootworm.html

A PDF file of this publication is available at the National Soybean Research Laboratory web site, www.nrsl.uiuc.edu



Total movement and net migration (immigration - emigration) of western corn rootworm at the borders of a soybean field.

Recommendations

Producers in east-central Illinois who have experienced rootworm larval injury in first-year corn and find many WCR adults in soybean fields should consider using a soil insecticide in corn rotated with soybeans the following year (Illinois Agricultural Pest Management Handbook 2001, pp 2 - 4). Because of spatial and temporal variability in WCR abundance, treatment decisions for corn following soybeans should be based on a monitoring tool like the Pherocon AM yellow sticky trap that is left in the field over the course of time. Instructions for using Pherocon AM traps to monitor WCR in soybean fields and current economic thresholds are available at the University of Illinois, College of Agricultural and Consumer Science Integrated Pest Management website:

www.ipm.uiuc.edu/ipm/publications/infosheet/1-wcornr/wcornr.html

Adult WCR control in soybean fields is not recommended. The proper timing of within-season control to target egg-laying females is unclear; no sampling strategies or economic thresholds have yet been developed for adult WCR control in soybeans. The periodicity of WCR movement between corn and soybean fields and large daily fluctuations in WCR numbers in soybean fields suggest that rapid re-colonization of treated fields from untreated areas is likely.

Support from the Illinois Soybean Program Operating Board and the Illinois Council on Food and Agricultural Research fund this WCR monitoring and field research. Through careful attention to insect behavior in the field and population monitoring throughout the growing season, we hope to continue to learn about the mechanisms behind rotation resistance in WCR and develop new strategies to restore the utility of crop rotation for Illinois growers.

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