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Western Corn Rootworm

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Introduction

The western corn rootworm (WCR), *Diabrotica virgifera virgifera* LeConte, is the most economically damaging pest of corn (*Zea mays*, L. Poaceae) in the United States, including Virginia. WCR larvae survive exclusively on corn roots, making annual crop rotation the standard and most effective tool for management. Some WCR populations have developed behavioral adaptations to avoid crop rotation[1], however this has not occurred in Virginia. Additionally, insecticide resistance to some chemicals and transgenic proteins used for WCR management have been documented[1,2], and resistance to control measures is an ongoing concern. WCR costs U.S. growers an estimated $1 billion in annual control costs and yield losses annually. Control costs, resistance development, and several documented cases of cultural control evasion make WCR a pest of focus for corn growers across the U.S.

Figure 1. Adult western corn rootworm (WCR, *Diabrotica virgifera virgifera* LeConte). Photo credit: Ward Upham, Kansas State University, Bugwood.org

Identification

Larvae

WCR larvae live beneath the soil, often burrowing into corn roots. First instar larvae are smaller than 3 mm in length, and third instars can reach 12 mm. Larvae have cream-colored bodies, a brown head, and a brown distal end (Fig. 2). WCR larvae are not easily spotted in the field. Larvae hatch in late May or early June, undergo a two week pupation in late June, then hatch into adults by early July[4].

Figure 2. WCR larva. Photo credit: Scott Bauer, USDA Agricultural Research Service, Bugwood.org

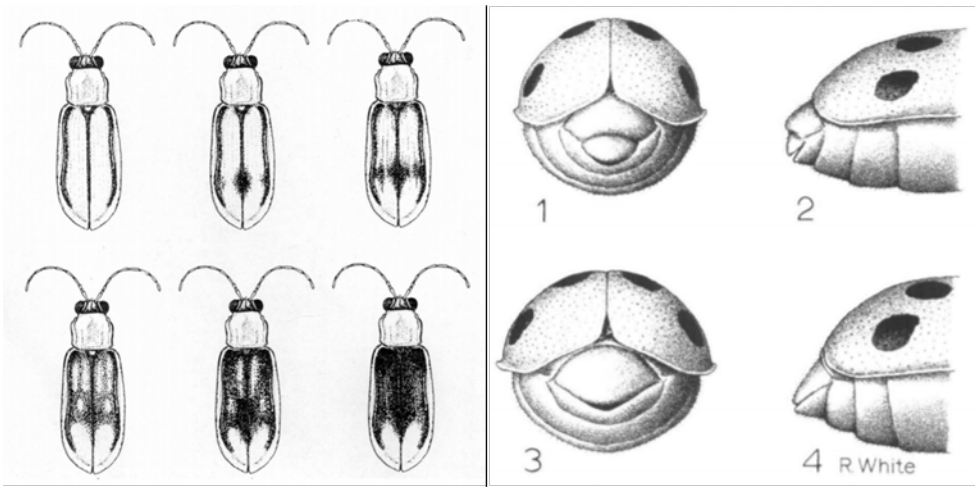

Figure 3. **(*Left*)** WCR adult color variants. Three separate longitudinal stripes (top row) are predominantly displayed by females; black patches (bottom row) are predominantly displayed by males[5]. **(*Right*)** Distal terminus of WCR abdomen for males (top row) and females (bottom row)[6]

Adults

WCR adults are predominantly yellow with black heads, and their elytra have distinct black longitudinal stripes. Stripes sometimes merge into black patches, especially in males (Fig. 3, left, bottom row). These coloration patterns can be correlated with sex; females exhibit three distinct stripes more often than males[5] (Fig. 3, left, top row). Females, on average, also have larger body and head capsule size than males. Although color differences correlate with sex, coloration alone cannot always reliably discriminate between sexes. Males have an abdominal sclerite, giving the tip of their abdomen a more blunt appearance, compared to females (Fig. 3, right)[6]. Sex can also be distinguished by basitarsal pad morphology on the prothoracic and mesothoracic legs (Fig. 4)[7].

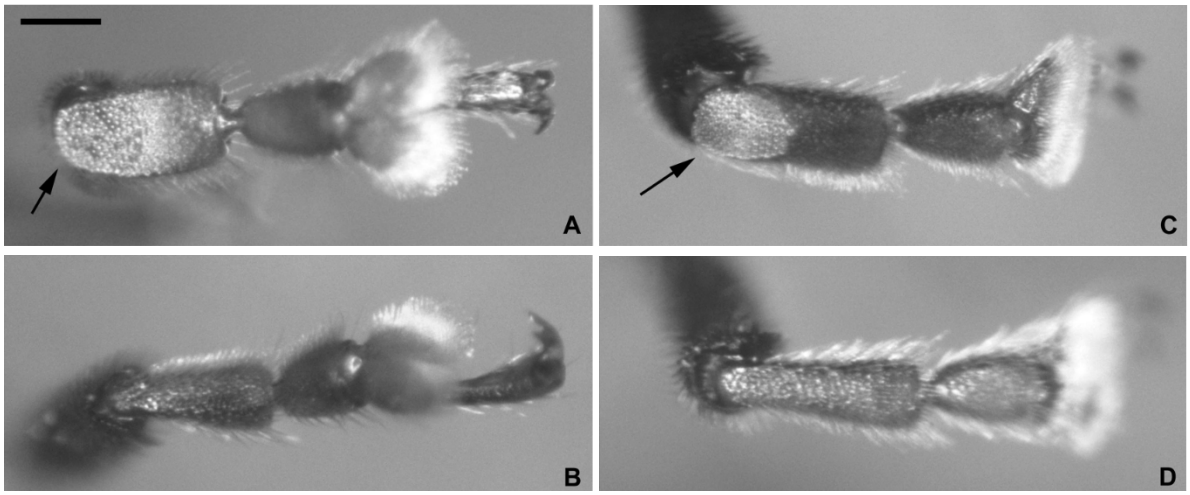

Figure 4. Stereomicrographs of *D. v. virgifera* tarsi in ventral view, with arrows indicating planar patch on tarsomere 1 of males. Prothoracic tarsus of male **(A)** and female **(B)**. Mesothoracic tarsus of male **(C)** and female **(D)**. Scale bar **(A)** = 200 um and applies to all Fig. 4 photographs[7]

Eggs

WCR females lay their eggs beneath the soil by venturing into cracks and crevices created by corn plants, earthworms, or dry conditions[8,9,10]. The eggs are small and cream-colored. They are unlikely to be found in the field without using sensitive sampling techniques and close observation.

Figure 5. Lodging caused by WCR larvae feeding on roots near Clyde, NC in 2018. Photo credit: Dan Pitts, Monsanto

Description of Damage:

WCR larvae can cause severe economic damage to corn. Larvae tunnel into corn roots and feed on plant tissue. Yield may not be affected if the population of WCR is low, however entire roots can be pruned off during severe infestations. Since corn plants rely on sturdy root systems to remain upright, severe infestations by WCR can cause plants to lean or fall over, known as lodging (Fig. 5). Photosynthetic potential is reduced in leaning plants[11], therefore leaning plants produce considerably lower yield than plants that are upright; plants that fall over may not be harvestable at all. Adult beetles feed on corn pollen, silks, and foliage, but this feeding rarely causes significant damage. Root tunnels left by WCR larvae can be identified if plants are dug up and washed thoroughly with water to remove dirt. Damaged roots can be rated on a 0-3 scale to quantify infestation severity (Fig. 6)[12].

Figure 6. Node injury scale is used to quantify WCR feeding damage, a reliable indicator of infestation severity[12].

Treatment:

Crop rotation is the best management tactic for WCR. In some regions, WCR populations have evolved resistance to crop rotation[3], but this has not occurred in Virginia. For growers unable to adhere to annual rotation, there are several transgenic *Bt* traits, as well as soil and seed-applied insecticides that are rated for WCR management. Although attempts to develop monitoring techniques for predicting WCR damage have been made[13], growers usually opt to treat preventatively by planting transgenic corn in addition to applying seed and/or soil insecticides. For current WCR control recommendations, please consult the most recent Pest Management Guide for Field Crops, Virginia Cooperative Extension Publ. No. 456-016. Link: https://pubs.ext.vt.edu/456/456-016/456-016.html

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