A MULTI-TACTIC APPROACH TO MANAGING WESTERN BEAN CUTWORM

Dean S. Volenberg[1]

Since first being detected in 2005, Western Bean Cutworm (WBC), *Striacosta albicosta* (Smith) (Lepidoptera: Noctuidae) has become a pest throughout most of Wisconsin. WBC was first detected in corn in southern Wisconsin and by 2006 WBC had spread into several counties in the state. Populations are most prevalent south of highway 29/Interstate 94 based on 2010 pheremone trap captures (Pestwatch, 2010). Since WBC initial collection and identification (Smith, 1887) in the late 1800s in the western United States, the pest has continued to migrate both to the north and east.

WBC as the name implies was first found damaging dry beans in Colorado (Hoerner 1948). A number of years passed after the pest was identified in beans before WBC was identified as a pest in corn. Even after WBC was identified as pest in these two crops in mid-1940 (Crumb, 1956), migration to the north and east took a period of approximately 50 years. Today, the migration of WBC has hastened with many states each year adding WBC to their lists of new pests. The quickened pace of WBC migration may be the result of corn growers adoption of specific corn hybrids that have favored WBC over other corn earworm pests (Dorhout and Rice 2010). Regardless of migration, once WBC becomes established in an area, a number of tactics should be implemented to manage WBC. Before any management is implemented, a thorough understanding of WBC biology will greatly aid you in management.

Biology and Ecology of Western Bean Cutworm

The first stage of WBC that many corn growers are introduced to is the larval stage in infected ears. Like most other corn insect pests, WBC has four life stages: egg, larvae, pupae, and adult. Eggs are often laid on the upper leaf surface on corn leaves high in the crop canopy. The eggs go through three distinct color changes: creamy white, tan, and purple. WBC eggs in the purple stage will likely hatch within 24 hours. A large amount of variation exists in the number of eggs per egg mass, 20 to 200 is common. Although most egg masses are often found high in the corn canopy, egg masses can sometimes be found on the ear husk.

Newly emerged first instar larvae are extremely small (2 to 3 mm) and remain around the egg chorion for an extended period while feeding on the egg shells. Depending on the corn stage, pre-tassel or post tassel, larvae will either move upwards or downwards on the corn plant. In pre-tassel corn, larvae will move into the plant whorl and feed upon the developing tassel and young leaf tissue. In post-tassel corn, larvae will move downward to feed upon the ear silk. Some larvae will also move to other corn plants, resulting in multiple plant infections from a single egg mass.

Once larvae attain the third instar, they begin to move into and feed on the developing ear tips. If high densities of larvae are present, larvae may bore directly through corn husks and feed on developing corn kernels. At this point in WBC development, other plants can also serve as hosts to complete larval development. For example, the weed black nightshade (*Solanum nigrum*) is a suitable host for late instar development (Blickenstaff and Jolley, 1982).

[1]Agricultural Educator, Univ. of Wisconsin-Cooperative Extension, Door and Kewaunee counties, 421 Nebraska St., Sturgeon Bay, WI 54235.

At the completion of larvae development in the corn ear, larvae drop to the ground and burrow into the soil and overwinter as mature larvae. Larvae begin to pupate when soil temperatures reach 50°F. Adult moths begin to emerge during the end of June with peak emergence typically occurring during the second and third weeks of July in southern Wisconsin. In northern growing regions, WBC peak emergence will occur in late July or early August.

The success of WBC overwintering is likely dependent on soil type. Anecdotal reports suggest that WBC populations are higher in crop fields planted on sand soils versus loam or clay soils. The greater success of WBC in sandier soils can be attributed to a higher percentage of larvae overwintering at deeper depths in sand type soils compared to soils containing a larger percentage of loam or clay soil types (Hein, 2000).

The Role of Corn Phenology

The life cycle of WBC is synchronized with corn development. Pre-tassel corn is the preferred corn stage selected by gravid adult females for egg laying. The pre-tassel stage can be defined as the period between the last leaf stage and VT. The VT stage is when 50% of the tassels have emerged. At the VT stage of corn development the first reproductive stage (silking) will occur in 2 to 3 days. A number of factors, including corn hybrid, relative maturity, planting date, and climatic conditions will impact when corn plants attain these stages of development. Corn development can be tracked by monitoring the number of growing degree days (GDD) that accumulate at base 50. For example, a corn hybrid with a relative maturity of 105 days planted on May 1 in southern Wisconsin will attain VT when approximately 1,200 growing degree days have accumulated. Although, corn phenology can be used to predict when corn is susceptible to egg laying, more direct techniques can be applied to monitor WBC.

Monitoring and Scouting

The adult moth of male WBC can be monitored using a pheromone trap. The trap attracts male moths using a lure that mimics a natural pheromone secreted by female WBC adults to attract a mate. The trap is easily constructed from a 1 gallon milk jug. For step by step directions for constructing a WBC trap, see A3856 Western bean cutworm: A pest of field and sweet corn (Cullen and Jyotika, 2008).

Traps should be installed on the edge of a cornfield around July 1 and monitored weekly. The trap captures will be more meaningful if the traps are monitored consistently; i.e. check traps on same day of the week. Replenish the trap solution weekly and replace the pheromone lure every 4 weeks.

The objective of monitoring adult moths is to determine peak moth flight. During peak moth flight the greatest number of eggs are laid. The pheromone trap provides a direct method to establish peak flight. An alternative to the pheromone trap is using a GDD model to predict peak moth flight.

Adult moth emergence can be monitored by tracking the number of growing degree days that accumulate. To track WBC emergence, begin counting growing degree days starting on May 1. Although you can calculate GDD simply (see Cullen and Jyotika, 2008) the degree day information is readily available from the University of Wisconsin Agricultural Research Stations online. If you choose to use GDD data from a research station, select GDD data from a research station located closest to your production fields. Relying on GDD data from distant locations will be inaccurate since a large variation in GDD exists between southern and northern corn growing areas. There are two important GDD periods for WBC:

1,320 GDD. Approximately 25% of WBC moths have emerged.
1,422 GDD. Approximately 50% of WBC moths have emerged.

If you are monitoring WBC with a pheromone trap, trap captures should peak at or around 1,422 GDD and this is called peak flight.

A major advantage of the degree day model to track WBC is that emergence can be tracked simply without entering the corn fields. One of the major drawbacks of relying just on the GDD model is that the level of pest pressure is unknown. WBC populations, like many other insect pests are known to pass through cycles. For example, WBC populations may be high one year and low the next. Only by monitoring a pheromone trap will you get an early indication of WBC pressure.

Scouting Corn

Scouting should begin once 1,322 GDD have been accumulated. If pheromone traps have been set out well in advance of 1,322 GDD and moths are present in traps, scouting should commence. In a field, 20 plants should be evaluated in five different locations. Scout fields in different stages of development separately. In pre-tassel corn, look for egg masses on the upper three or four leaves of each plant. Egg masses of WBC are small and vary in the number of eggs per mass. WBC egg masses can be confused with egg masses of some stink bugs. Stink bug egg masses differ from WBC egg masses, Stink bug egg masses start out white and turn brown, whereas WBC egg masses start out white, turn tan, and then purple. Corn fields planted with corn hybrids that are resistant to WBC and associated corn refuges should also be scouted for egg masses or small larvae. Fields should be scouted on a daily basis between 1,320 and 1,422 GDD. This span in GDD occurs normally over 4 to7 calendar days. Scouting should continue for at least another 7 days beyond peak emergence.

Thresholds of WBC in Field and Sweet Corn

Field corn should be treated with an insecticide if 5% or more of the 100 plants had an egg mass or small larvae. In sweet corn, an insecticide should be applied if 4% or more of the plants had egg masses or small larvae. Insecticides for control should be applied when corn is 95% tasseled. A listing of insecticides for managing WBC can be found in A3646 Pest Management in Wisconsin Field Crops. Timing of insecticide applications is critical to attain control of WBC. Corn needs to be treated before larvae enter the corn ear. Once larvae are within the ear, insecticide applications are no longer effective in controlling these larvae.

Conventional corn growers in Door County have been successfully managing WBC by applying insecticides when 1,422 GDD have accumulated and egg mass/small larvae thresholds are 5% or greater. The incidence of WBC ear damage was reduced by 90% in treated versus untreated corn in 2009.

Corn Hybrid Selection in Managing WBC

WBC can be managed by planting corn hybrids that have the Bt trait Cry 1F or Viptera trait Vip3A (DiFonzo and Cullen 2010). The Vip3A (vegetative insecticidal protein) has similarities to the Cry 1F toxin. Both the Cry and Vip toxins are proteins from *Bacillus thuringiensis* (Bt) and work by rupturing the gut of susceptible insects. Corn hybrids containing these traits are still susceptible to attack by WBC, especially when WBC pressure is high. Ear damage in corn hybrids containing Cry 1F is likely the result of loss of the traits being expressed as the plant starts to senesce. In corn, the level of the Cry 1F protein is higher during vegetative growth through pollen shed and declines with corn senescence. The concentration of the Cry 1F protein is highest in the corn stalk, followed by pollen, then leaf, and lastly the corn silk (U.S. Environmental Protection Agency 2001). WBC that hatch late in the vegetative stage or beginning of the reproductive stage of corn development, would likely be exposed to lower concentrations of the Cry 1F protein. Bt toxins targeted against WBC are not 100% effective, corn with the Cry 1F trait is 70 to 90% effective against WBC.

Some Corn is More Susceptible to WBC

All field corn and sweet corn is susceptible to attack by WBC, yet some corn is more susceptible than others. Late planted corn is more prone to a WBC infestation than corn that is planted earlier (Holtzer 1983). Corn planted late will more likely be at the pre-tassel stage of development when WBC is at peak flight. Also, corn with a long relative maturity, planted often for silage in a shorter relative maturity zone, will likely be at the vulnerable pre-tassel stage at or near peak WBC flight. Late plantings of sweet corn are also more prone to WBC attack.

Multi-tactic Management of WBC

Monitoring, scouting, and using corn hybrids with resistance to WBC should be used together to manage WBC. Corn hybrids that are resistant to WBC offer a first line of defense, but these hybrids are still susceptible to WBC attack. High WBC pressure in WBC–resistant corn may need to be treated if pest densities meet or exceed thresholds. Refuge acres also need to be monitored and scouted for WBC. Monitoring pheromone traps will indicate when peak flight has occurred and give an indication of WBC pest pressure. Scouting corn for the presence of WBC egg masses or small larvae will determine whether the corn should receive an insecticide treatment.

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