Eastern Movement of the Western Bean Cutworm into Indiana and Ohio

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The western bean cutworm, *Striacosta albicosta* (Lepidoptera: Noctuidae), is native to North America. It was first reported as a pest of Colorado pinto beans in 1915. In 1935 adults were captured in western Nebraska (Hagen, 1963) and later, in 1954, it was identified as a pest of corn in southern Idaho (Blickenstaff, 1979). Since its discovery in the late 1880s, it has slowly and steadily expanded its known distribution eastward from Arizona to Iowa (Rice, 2000) and Minnesota (O'Rourke and Hutchison, 2000). The western bean cutworm was known to occasionally occur in western Iowa prior to 1970, but it was not until 2000 that an economically damaging population was found in field corn. Since then, it has become an annual economic pest in western and central regions of the state. In 2004, western bean cutworms were collected in pheromone traps for the first time in Illinois and Missouri. Two years later, in 2006, adults were captured in Indiana and Ohio.

Description

Eggs

Western bean cutworm eggs are nearly round with small ridges extending from the top to the bottom of the egg. Eggs are laid in tightly packed, irregularly-shaped clusters that contain 21 to 195 eggs (Hagen, 1962) (Figure 1). An average cluster has 52 eggs. Eggs are white when first laid and turn dark purple a day or two before hatching.

Larvae

Newly-hatched larvae are a dull orange color with black heads, have a black pronotum (hardened plate immediately behind the head), and 8-10 black spots on each body segment. Mature larvae have a broad, faint tan stripe along the back, gray sides, no distinctive spots, an orange head, and the pronotum has two broad brown stripes (Figure 2). The brown stripes on the pronotum are a good characteristic to distinguish western bean cutworms from other corn caterpillars. Mature larvae are about 1½ inches long. There are six, and occasionally seven, larval stages.

Pupae

Pupae are orange-brown in color, occur in the soil, and are rarely seen.

Adults

The adult moth (Figure 3) is ¾-inch long and a mixture of brown, gray, and cream colors. Each forewing has a broad, cream-colored stripe along the front edge of the wing and two distinctive markings — a small, light-colored circular spot just behind and halfway along the stripe, and a buff-colored, boomerang-shaped spot near the end of the stripe. The hind wings are light tan with no distinct pattern.

Life History in Corn

In western Iowa, adult flight begins in late June, peaks in mid- to late July, and ends during mid-August (Table 1). The female emits a mating pheromone that attracts males. One to five days after mating, female moths begin laying their eggs on the upper surface of the top-most corn leaves, and especially the flag leaf. Moths are most attracted to cornfields with tassels just beginning to emerge for egg laying. Females average 407 eggs laid during their brief lifetime. Eggs hatch in five to seven days. Newly-hatched larvae feed on the tassel, corn pollen, tissue behind the leaf sheaths, and silks The 4^{th} and 5^{th} instars cut entrance holes through the husks and feed on the developing kernels (Hagen, 1962). They may migrate to adjacent corn plants. Each of the first five larval stages takes about five to six days to develop, with the 6^{th} and 7^{th}

instars averaging seven and 10 days, respectively. Unlike corn earworms, western bean cutworms are not cannibalistic so several larvae may feed in the same ear. Six larvae per ear have been found in Iowa and 20 larvae per ear have been reported from Nebraska (Seymour et al., 2004). After larvae finish feeding they chew through the cornhusk, crawl to the ground, and form a chamber 3 to 8 inches deep in the soil. Here the prepupal stage overwinters. Pupation occurs during late May in Nebraska (Hagen, 1962). Adults begin to emerge in early summer. There is one generation a year.

Soil type and moisture in Nebraska has influenced western bean cutworm populations. Sandy soils tended to have larger populations compared to clay soils. Soil moisture, from either rainfall or irrigation, is necessary for adult emergence from their pupal cells and can be a limiting population factor, especially in clay soils.

Table 1. Four-year blacklight captures of western bean cutworm adults in Woodbury County, Iowa, 2002-2005.

Year	Western Bean Cutworm Adults			
	First Capture	Peak Capture	Last Capture	Total
2002	June 28	July 13	August 11	12,739
2003	July 10	August 1	August 17	244
2004	July 5	July 23	August 10	531
2005	June 28	July 13	August 10	1,328

Damage to Corn

Newly-hatched larvae will feed in one of two places depending on the stage of corn development. In pretassel-stage corn, the larvae will penetrate the flag leaf and feed on pollen in the developing tassel. In tassel-stage corn, larvae will feed on shed pollen, leaf tissue, silks, and eventually move to the kernels. Extensive feeding on the silks during pollination may result in incomplete kernel set.

The corn ear is the primary feeding site for larvae. Larvae enter the ear by chewing through the husk or the silks. Unlike corn earworms, which restrict most of their feeding to the ear tip, western bean cutworms will feed on developing kernels in the ear tip, middle of the ear, and ear butt (Figure 4). This injury to developing kernels can result in constricted and deformed ears, particularly when larvae feed on milk-stage kernels. Yield losses from one larva per corn plant at dent stage were estimated at 3.7 bushels per acre in Nebraska (Seymour et al., 2004) while ears with single larvae in Iowa showed 4.1-10.9% yield loss per ear during 2006 (Figure 4). In Colorado, yield reductions of 30-40% have been noted from heavily-infested ears. In addition to this loss of grain, ear molds may develop on the kernels, further reducing the yield quality at harvest.

Movement from Iowa to Ohio

Prior to 2000, the western bean cutworm was considered to be extremely rare in Iowa and economic damage (i.e., losses exceeding the economic threshold) had never been reported. The first significant damage was observed in 2000 in a cornfield at Holstein (Rice, 2000). This western Iowa field had approximately 95% of the ears heavily damaged. Two years later, larvae or their damage could be found in most western Iowa counties and adult moths were being collected in blacklight traps in central Iowa. In 2004, pheromone traps were placed throughout eastern Iowa including counties bordering the Mississippi River. Adult moths were collected in every trap placed in eastern Iowa and the insect was assumed to occur in every Iowa county.

In addition, pheromone traps were placed for a single night in July 2004 in northeast Missouri and west-central Illinois counties near Iowa. Western bean cutworm adults were trapped in Warren County, Illinois and Harrison and Putnam counties in Missouri (Dorhout and Rice, 2004). These captures were the first documented occurrence of this insect in these two states and represented a significant southeastern movement of the insect from its previously known distribution.

Pheromone traps were placed throughout Illinois during 2005 to monitor what was believed to be a continuing range expansion of this insect. But in Illinois, the eastern distribution could not be defined — traps placed throughout central and eastern Illinois collected adults. The trapping effort was then expanded eastward in 2006, and in cooperation with extension entomologists and seed companies, pheromone traps were placed throughout northern Indiana and central Ohio. Moths were trapped in 10 of 12 Indiana counties with a Newton County trap capturing 102 adults and Whitley County being the easternmost location for trap captures with 11 adults (Figure 5). Surprisingly, adults also were reported to be trapped in Fulton, Shelby and Van Wert counties in western Ohio. The Ohio captures probably represent the most easterly distribution of this insect in the Corn Belt as no moths were reported from traps in Clark, Crawford, Franklin, Licking, Pike, Wayne and Wood counties (Iowa State University, 2006).

Scouting

Scouting in field corn can be initiated by using either degree days or trap catches. Degree days (base 50˚F) for 25, 50, and 75% adult emergence are 1319, 1422, and 1536, respectively (Ahmad, 1979). Adult populations also can be monitored using a blacklight trap or a commercial brand (i.e., Scentry) western bean cutworm pheromone. A common trapping procedure is to cut out windows on the upper half of a plastic one-gallon milk jug. The pheromone is suspended inside the milk jug then filled with a 4:1 mixture of soapy water and anti-freeze that kills and preserves any captured specimens. The trap can then be placed on a post 3-4 feet high near a cornfield.

Start scouting western bean cutworm eggs in corn based on trap catches or 50% predicted adult emergence. Inspect the upper three or four leaves on 20 consecutive plants at five locations. Hybrids in different stages of development or different leaf characteristics (upright vs. open) should be scouted separately as adult moths may be more attracted to one hybrid than the other. A nominal threshold recommended by the University of Nebraska is 8% of the plants with eggs or young larvae found on the flag leaf or in the tassel (Seymour et al., 2004). A simple economic threshold that considers the value of corn and the cost of the insecticide application is shown in Table 2. The values in this table, based on research conducted at the University of Nebraska, assume 3.3% survival of the eggs. Of these two thresholds, the 8% infested plants is more commonly used, but the relative accuracy of one method over the other is unknown.

Table 2. Economic injury levels (eggs per plant) for western bean cutworm in dent stage corn.[1]

Corn Value ($/bu)	Control Costs ($/acre)				
	$8	**$10**	**$12**	**$14**	**$16**
$2.00	33	41	49	57	65
$2.25	29	37	44	51	57
$2.50	26	33	40	46	52

[1]Modified from Appel et al., 1993.

Management — Insecticides

Timing of an insecticide application is critical. If the tassel has not emerged when the larvae hatch they will move into the whorl and feed on the developing pollen grains in the tassel. As the tassel emerges, the larvae will move down the plant to the green silks and then into the silk channel to feed on the developing ear. Once the larvae reach the ear tip and enter the silks, effective control with an insecticide is nearly impossible. Seymour et al. (2004) state that if the eggs have hatched, insecticide applications should be made after 95% of the plant tassels have emerged, but before larvae enter the silks. If the eggs have not hatched and plants have tasseled, time the insecticide to when most of the eggs are expected to hatch. Eggs that are dark purple will hatch within a day.

If an insecticide application is needed, cornfields should be checked for the presence of spider mite colonies. If mites are found, select a product that does not stimulate mite reproduction. Products that contain permethrin (Pounce, Ambush) or esfenvalerate (Asana) have been associated with increased mite reproduction. Other products labeled for western bean cutworm control on corn include Capture 2EC, Lorsban 4E, Penncap-M, Sevin XLR Plus, and Warrior 1EC.

Management — Transgenic Corn

Transgenic corn is available with control against several insect species (Table 3). Only corn with the Bt protein Cry1F offered in Herculex I or Herculex Xtra hybrids have the potential to control western bean cutworms.

Table 3. Pest control spectrum of Bt corn for Lepidoptera.[1]

Product	Event/ Gene	Western Bean Cutworm	European Corn Borer	Corn Earworm	Armyworm	Fall Armyworm	Black Cutworm
Herculex[2]	TC1507Cry 1F	Control	Control	Suppression	Not labeled	Control	Control
YieldGard	Mon810Cry 1Ab	Not labeled	Control	Suppression	Not labeled	Suppression	Not labeled
YieldGard	Bt11 Cry1Ab	Not labeled	Control	Suppression	Not labeled	Suppression	Not labeled

[1]As stated by seed industry literature.
[2]Includes Herculex I and Herculex Xtra.

Table 4. Western bean cutworm damage to Herculex I, Herculex Xtra, and YieldGard Corn Borer hybrids at three Iowa locations, 2006.

Location	Company	Hybrid	Trait	Mean cm Damage/Ear[a,b]
Laurens	Mycogen	2J454	----	5.60 a
	Northrup King	N51-T8	YG-CB	4.88 ab
	Mycogen	2D545	----	4.73 ab
	Northrup King	N46-J7	YG-CB	4.55 ab
	Mycogen	2E522	----	3.93 abc
	Northrup King	N51-V9	YG-CB	3.70 abc
	Mycogen	2J525	----	3.03 bcd
	Northrup King	N36-R6	YG-CB	3.00 bcd
	Northrup King	N53-U1	YG-CB	2.45 cd
	Garst	8693	YG-CB	2.38 cd
	Garst	8880	YG-CB	1.45 de
	Garst	8534	YG-CB	1.38 de
	Mycogen	2A498	----	1.38 de
	Mycogen	2G677	HX-X	0.10 e
	Mycogen	2R570	HX-I	0.03 e
Mallard	Mycogen	2K541	YG-CB	4.08 a
	Mycogen	2D545	----	3.08 a
	Mycogen	2E633	HX-I	1.35 b
	Mycogen	2D555	HX-I	0.43 bc
	Mycogen	2R570	HX-I	0.35 bc
	Mycogen	2E526	HX-X	0.10 c
	Mycogen	2J527	HX-I	0.05 c
Rembrandt	Mycogen	2K541	YG-CB	5.00 a
	Mycogen	2D545	----	4.53 a
	Mycogen	2E522	----	4.30 a
	Mycogen	2J665	----	1.05 b
	Mycogen	2E633	HX-I	0.20 b
	Mycogen	2D555	HX-I	0.00 b
	Mycogen	2D673	HX-I	0.00 b
	Mycogen	2P722	HX-I	0.00 b
	Mycogen	2R570	HX-I	0.00 b

[a]Means at the same location and followed by the same letter are not statistically significant by ANOVA, P=0.05.

[b]N=20 ears per hybrid except Mallard, Mycogen 2K541, n=60 ears.

In 2006, corn ears were examined at three locations in northwestern Iowa. Each ear was divided into four equal quadrates (looking down from the tip of the ear) and the length of damage was measured in centimeters, with damage from all quadrates combined per ear. A minimum of 20 ears per hybrid were examined at each location. Field observations indicate that Herculex provided the best level of protection against western bean cutworm (Table 4) and it was consistently better than YieldGard Corn Borer hybrids in providing protection (Tables 4-6). Herculex does not provide complete protection against western bean cutworm damage, but the amount of damage was very small when compared to damage on YieldGard ears at all locations and across all hybrids (Table 6).

An interesting find in two of the three locations was that YieldGard Corn Borer hybrids had more kernel damage than the untreated check hybrids (Table 5). Data are still being analyzed as of this writing, but experiments at Iowa State University suggest that a YieldGard Corn Borer hybrid changes the ratio or proportion of caterpillar species that attack YieldGard hybrids, thereby indirectly favoring the western bean cutworm and allowing it to cause more damage.

Table 5. Western bean cutworm damage (summarized by location) to Herculex[a] and YieldGard Corn Borer hybrids, Iowa, 2006.

Location	Trait	Ears Examined	Mean±S.E. cm Damage/Ear[b]
Laurens	Herculex I	n=40	0.06±0.54 b
	YieldGard CB	n=160	2.97±0.27 a
	Check	n=100	3.73±0.34 a
Mallard	Herculex I	n=100	0.46±0.20 c
	YieldGard CB	n=60	4.08±0.44 a
	Check	n=20	3.08±0.34 b
Rembrandt	Herculex I	n=100	0.04±0.26 c
	YieldGard CB	n=20	5.00±0.57 a
	Check	n=60	3.29±0.33 b

[a]Herculex I and Herculex Xtra ratings combined.
[b]Means at the same location and followed by the same letter are not statistically significant by ANOVA, P=0.05.

Table 6. Composite performance of all Herculex[a] and YieldGard Corn Borer hybrids at three Iowa locations, 2006.

Trait	Ears Examined	Mean cm Damage/Ear[b]
Herculex I	n=240	0.22±0.19 b
YieldGard CB	n=240	3.42±0.19 a
Check	n=180	3.51±0.22 a

[a]Herculex I and Herculex Xtra ratings combined.
[b]Means followed by the same letter are not statistically significant by ANOVA, P=0.05.

The Future

The western bean cutworm is firmly established as a pest of field corn in Iowa. Its movement into Indiana and Ohio was unexpected, yet not surprising, considering the adaptive ability of many pest insects to expand their range (i.e., western corn rootworm, European corn borer, soybean aphid). Whether the western bean cutworm will become a significant pest in Indiana and Ohio field corn can only be answered in the future. However, the damage potential represented by this species strongly suggests that it should not be ignored, nor should fear of economic damage be an immediate reason to invest in increased acres of transgenic Bt corn. Fortunately, corn growers have a primary tool at their disposal to manage the western bean cutworm should it reach economically damaging levels: scouting combined with a properly timed insecticide. If the western bean cutworm does become an established, economically damaging pest in Indiana and Ohio, then growers should consider an additional pest management tool: planting transgenic Herculex I or Herculex Xtra corn hybrids.

Figure 1. Western bean cutworm eggs.

Figure 2. Western bean cutworm larva.

Figure 3. Western bean cutworm adult.

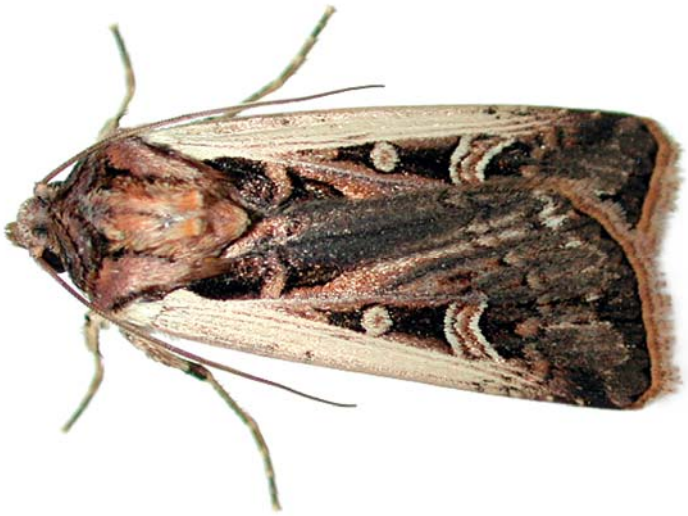

Figure 4. Corn ear damaged by western bean cutworm.

Figure 5. Total pheromone trap captures by county for adult western bean cutworms, Indiana, 2006.

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