Helicoverpa armigera

Scientific Name

Helicoverpa armigera Hübner, 1809

Figure 1. *Helicoverpa armigera* adult (Julieta Brambila, USDA APHIS PPQ, Bugwood.org).

Synonyms:
Bombyx obsolete Fabricius,
Chloridea armigera Hübner,
Chloridea obsoleta Fabricius,
Helicoverpa commoni Hardwick,
Helicoverpa obsoleta Auctorum,
Heliothis armigera (Hübner),
Heliothis conferta Walker,
Heliothis fusca Cockerell,
Heliothis obsoleta Auctorum,
Heliothis pulverosa Walker,
Heliothis rama Bhattacherjee Gupta,
Heliothis uniformis Wallengren,
Noctua armigera Hübner, and
Noctua barbara Fabricius

Common Name

Old world bollworm, scarce bordered straw worm, corn earworm, cotton bollworm, African cotton bollworm, tobacco budworm, tomato grub, tomato worm, and gram pod borer

Type of Pest

Moth

Taxonomic Position

Class: Insecta, **Order:** Lepidoptera, **Family:** Noctuidae

Reason for Inclusion in Manual

CAPS Target: AHP Prioritized Pest List - 2005 through 2014

Pest Description

For more information, see Common (1953), Dominguez Garcia-Tejero (1957), Kirkpatrick (1961), Hardwick (1965, 1970), Cayrol (1972), Delattre (1973), and King (1994).

Figure 2. Eggs of *Helicoverpa armigera* (BASF Corp).

Eggs: Yellowish-white when first laid (Fig. 2), later changing to dark brown just before hatching. Eggs are gum drop-shaped and 0.4 to 0.6 mm ($<^{1}/_{32}$ in) in diameter. The top is smooth, otherwise the surface contains approximately 24 longitudinal ribs. The eggs then change to dark or gray black a day before hatching (Bhatt and Patel, 2001; CABI, 2007).

Larvae: Larval color darkens with successive molts for the six instars typically observed for *H. armigera*. Coloration can vary considerably due to diet content (Fig. 3 A, B). Coloration ranges from bluish green to brownish red (Fowler and Lakin, 2001). Freshly emerged first instars are translucent and yellowish-white in color. The head, prothoracic shield, supra-anal shield and prothoracic legs are dark-brown to black as are the spiracles and raised base of the setae. The larvae have a spotted appearance (Fig. 3 A, B) due to sclerotized setae, tubercle bases, and spiracles (King, 1994; Bhatt and Patel, 2001). Second instars are yellowish green in color with black thoracic legs. Five abdominal prolegs are present on the third to sixth, and tenth abdominal segments.

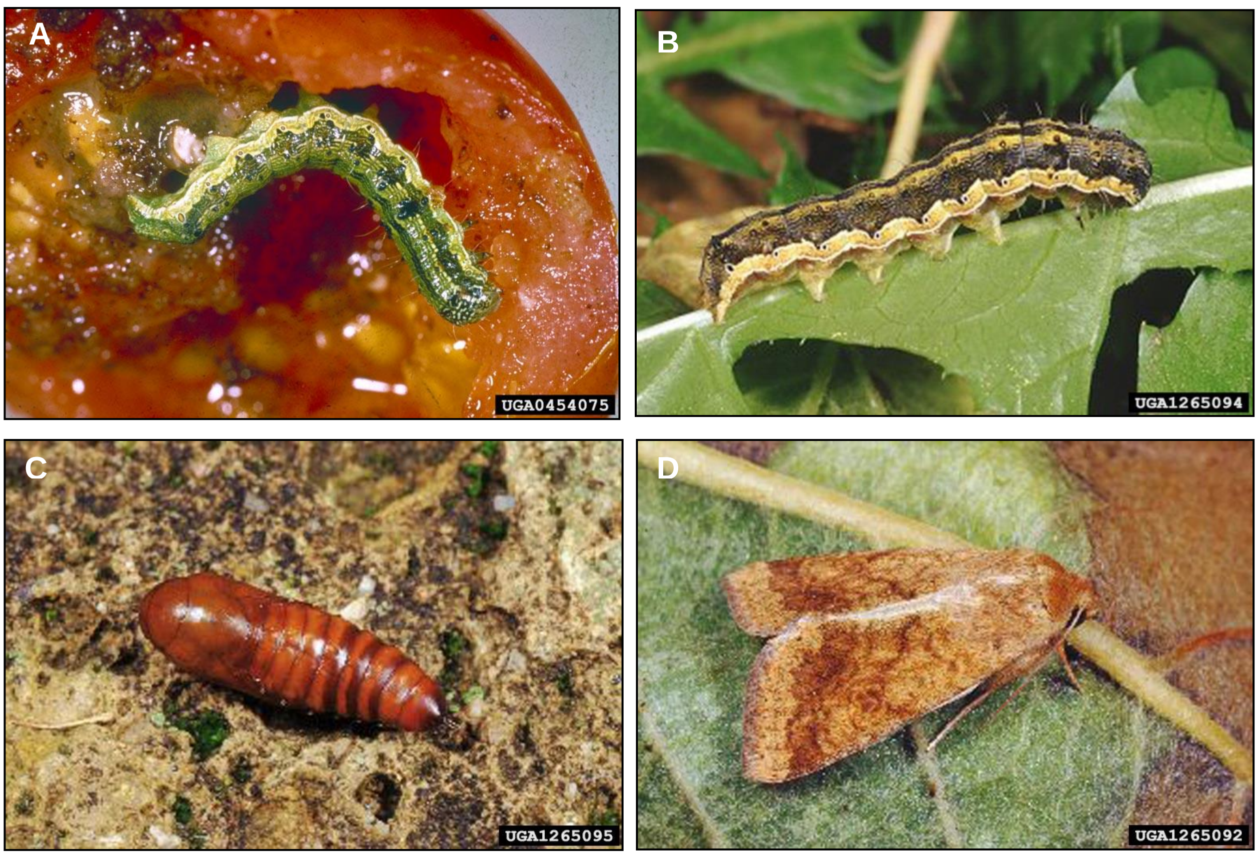

Figure 3. Life stages of *Helicoverpa armigera* (images not to scale): (A, B) larva, (C) pupa, and (D) adult. (Central Science Laboratory, Harpenden Archive, British Crown and Paolo Mazzei www.bugwood.org).

The full grown larvae are brownish or pale green with brown lateral stripes and a distinct dorsal stripe; larvae are long and ventrally flattened but convex dorsally. Larval size in the final instar ranges from 3.5 to 4.2 cm (approx. 1 $^{3}/_{8}$ to 1 $^{5}/_{8}$ in) in length (King, 1994).

Pupae: Pupae are dark tan to brown (Fig. 3 C), 14 to 22 mm (approx. $^{9}/_{16}$ to $^{7}/_{8}$ in) long, and 4.5 to 6.5 mm (approx. $^{3}/_{16}$ to $^{1}/_{4}$ in) wide. Body is rounded both anteriorly and posteriorly, with two tapering parallel spines at posterior tip. Pupae typically are found in soil.

Adults: A stout-bodied moth with typical noctuid appearance, with 3.5 to 4 cm (approx. 1 $^{3}/_{8}$ to 1 $^{9}/_{16}$ in) wing span; body is 14 to 19 mm (approx. $^{9}/_{16}$ to $^{3}/_{4}$ in) long. Color is variable, but males are usually yellowish-brown, light yellow, or light brown and females are orange-brown (Fig. 3 D). Forewings have a black or dark brown kidney-shaped marking near the center (Brambila, 2009a). Hind wings are creamy white with a dark brown or dark gray band on outer margin (Brambila, 2009a).

Identification of adult *H. armigera* requires dissection of genitalia (Common, 1953; Kirkpatrick, 1961; Hardwick, 1965).

Biology and Ecology

Helicoverpa armigera overwinters in the soil in the pupal stage. Moths emerge in May to June depending on latitude and lay eggs singly on a variety of host plants on or near floral structures. Plants in flower are preferred to those that are not in flower (Firempong and Zalucki, 1990b). Depending on the quality of the host, *H. armigera* may also lay eggs on leaf surfaces. Female moths tend to choose pubescent (hairy) surfaces for oviposition rather than smooth leaf surfaces (King, 1994). Tall plants also tend to attract heavier oviposition than shorter plants (Firempong and Zaluski, 1990b). The number of larval instars varies from five to seven, with six being most common (Hardwick, 1965). Larvae drop off the host plant and pupate in the soil, then emerge as adults to start the next generation.

Because *H. armigera* exhibits overlapping generations, it can be difficult to determine the number of completed generations. Typically two to five generations are achieved in subtropical and temperate regions and up to 11 generations can occur under optimal conditions, particularly in tropical areas (Tripathi and Singh, 1991; King, 1994; Fowler and Lakin, 2001). Temperature and availability of suitable host plants are the most important factors influencing the seasonality, number of generations, and the size of *H. armigera* populations (King, 1994).

The duration of the different life stages decreases as temperature increases from 13.3 to 32.5°C (56 to 91°F). A thermal constant of 51 degree days above the threshold of 10.5°C (51°F) was required for the development of eggs. The larval stage required 215.1 degree days and the pupal stage 151.8 degree days above 11.3 and 13.8°C (52 and 57°F) developmental thresholds, respectively (Jallow and Matsumura, 2001). In a laboratory study, 475 degree days above an 11°C (52°F) threshold were needed to complete development from larvae to adult (Twine, 1978).

Helicoverpa armigera has a facultative pupal diapause, which is induced by short day lengths (11 to 14 hours per day) and low temperatures (15 to 23°C; 59 to 73°F) experienced as a larva (CABI, 2007). A summer diapause, in which pupae enter a state of arrested development during prolonged hot, dry conditions, has been recorded in the Sudan (Hackett and Gatehouse, 1982) and Burkina Faso (Nibouche, 1998).

Under adverse conditions, moths can migrate long distances (King, 1994; Zhou et al. 2000; Casimero et al., 2001; Shimizu and Fujisaki, 2002; CABI, 2007). Adults can disperse distances of 10 km during "non-migratory flights" and hundreds of kilometers (up to 250 km) when making "migratory flights," which occur when host quality or availability declines (Saito, 1999; Zhou et al., 2000; Casimero et al., 2001; Fowler and Lakin, 2001).

For further information, see Dominguez Garcia-Tejero (1957), Pearson (1958), Hardwick (1965), Cayrol (1972), Delattre (1973), Hackett and Gatehouse (1982), King (1994), and CABI (2007).

Damage

Helicoverpa armigera larvae prefer to feed on reproductive parts of hosts (flowers and fruits) but may also feed on foliage. Feeding damage results in holes bored into reproductive structures and feeding within the plant. It may be necessary to cut open the plant organs to detect the pest. Secondary pathogens (fungi, bacteria) may develop due to the wounding of the plant. Frass may occur alongside the feeding hole from larval feeding within.

Figure 4. Larva feeding on corn cob (Antoine Gyonnet, Lépidoptères Poitou-Charentes, www.bugwood.org).

Chickpea: Larvae feed on foliage, sometimes entire small plants consumed. Larger larvae bore into pods and consume developing seed. Resistant cultivars exist.

Corn: Eggs are laid on the silks, larvae invade the ears (Fig. 4) and developing grain is consumed. Secondary bacterial and fungal infections are common.

Cotton: Bore holes are visible at the base of flower buds, and the buds are hollowed out. Bracteoles are spread out and curled downwards. Leaves and shoots may also be consumed by larvae. Larger larvae bore into maturing green bolls; young bolls fall after larval damage. Adults lay fewer eggs on smooth-leaved varieties.

Peanut: The leaves, and sometimes flowers, are attacked by larvae; severe infestations cause defoliation. Less preferred varieties exist.

Pigeon pea: Flower buds and flowers bored by small larvae may drop; larger larvae bore into locules of pods and consume developing seed. Short duration and determinate varieties are subject to greater damage. Less-preferred varieties exist.

Sorghum: Larvae feed on the developing grain, hiding inside the head during the daytime. Compact-headed varieties are preferred (CAB, 2004).

Tomato: On tomatoes, young fruits are invaded and fall; larger larvae may bore into older fruits. Secondary infections by other organisms lead to rotting.

Pest Importance

Heliothine moths of the genus *Helicoverpa* are considered to be among the most damaging insect pests in Australian agriculture, costing approximately $225.2 million per year to control (Clearly et al., 2006). *Helicoverpa armigera* is a major insect pest of both field and horticultural crops in many parts of the world (Fitt, 1989). The pest status of *H. armigera* is due in part to the broad host range of its larvae; its feeding preference for reproductive stages of plants; its high fecundity; its high mobility; and its ability to enter facultative diapause and thus adapt to different climates (Cleary et al., 2006). These characteristics make *H. armigera* particularly well adapted to exploit transient habitats, such as man-made ecosystems. Worldwide, *H. armigera* has been reported on over 180 cultivated hosts and wild species in at least 45 plant families (Venette et al., 2003). The larvae feed mainly on the flowers and fruit of high value crops, and thus high economic damage can be caused at low population densities (Cameron, 1989; CABI, 2007).

Helicoverpa armigera has been reported to cause serious losses throughout its range, in particular to tomatoes, corn, and cotton. Lammers and MacLeod (2007) state that this species is predominantly a pest of outdoor tomato crops in Portugal and Spain. Economic losses to field grown tomatoes have also been recorded in Italy. This species can also cause damage in greenhouse settings; in southern Moravia, Czech Republic, the highest damage caused to tomatoes was 5%. In the Metaponto region of Italy, this species has been a serious pest of pepper. Damage to 30% of the fruit and 70 to 80% of the plants was recorded in 2003. Larvae damage occurs on the leaves, flowers, and fruits (reviewed in Lammers and MacLeod, 2007).

On cotton, two to three larvae on a plant can destroy all the bolls within 15 days. On corn, the larvae consume grains. On tomatoes, larvae invade fruits, preventing fruit development and causing the fruit to fall (CABI, 2007). Young larvae (second and third instar) can cause up to 65% loss to cotton yields (Ting, 1986). In pigeon pea, an important grain legume in south Asia, east Africa, and Latin America, this single pest causes yield losses of up to 100% in some years and locations, and worldwide losses to pigeon pea of more than $300 million per year (Thomas et al., 1997).

Management of *Helicoverpa* spp. in the past has relied heavily on the use of insecticides, and this has led to resistance problems in cotton (Fitt, 1994). Resistance to pyrethroids amongst *H. armigera* is a serious problem (McCaffrey et al., 1989; Trowell et al., 1993).

Known Hosts

Note: Not all host plants are equally preferred for oviposition but can be utilized in the absence of a preferred host. There have been several studies within the laboratory setting on host preference. Jallow and Zalucki (1996) found that oviposition was highest on corn, sorghum, and tobacco, followed by cotton varieties. Cowpea and alfalfa were the least preferred hosts for oviposition. Cotton and corn were more suitable for development and reproduction of the cotton bollworm than peanut (Hou and Sheng, 2000). Pigeon pea and corn are considered to be the most suitable hosts for this insect, when compared to sorghum, red ambadi (*Hibiscus subdariffa*), marigold, and artificial diet (Bantewad and Sarode, 2000). Tobacco, corn, and sunflower were categorized as the most preferred hosts; soybean, cotton, and alfalfa were categorized as intermediate hosts; and cabbage, pigweed, and linseed were the least preferred in an additional study (Firempong and Zalucki, 1990a).

Major hosts

Abelmoschus esculentus (okra), *Allium* spp. (onions, garlic, leek, etc.), *Arachis hypogaea* (peanut), *Avena sativa* (oats), Brassicaeae (cruciferous crops), *Cajanus cajan* (pigeon pea), *Capsicum annuum* (bell pepper), *Carthamus tinctorius* (safflower), *Cicer arietinum* (chickpea, gram), *Citrus* spp., Cucurbitaceae (cucurbits), *Dianthus caryophyllus* (carnation), *Eleusine coracana* (finger millet), *Glycine max* (soybean), *Gossypium* spp. (cotton), *Helianthus annuus* (common sunflower), *Hordeum vulgare* (barley), *Lablab purpureus* (hyacinth bean), *Linum usitatissimum* (flax), *Malus* spp. (apple), *Mangifera indica* (mango), *Medicago sativa* (alfalfa), *Nicotiana tabacum* (tobacco), *Pelargonium* spp. (geranium), *Pennisetum glaucum* (pearl millet), *Phaseolus* spp. (beans), *Phaseolus vulgaris* (common bean), *Pinus* spp. (pines), *Pisum sativum* (pea), *Prunus* spp. (stone fruit), *Solanum lycopersicum* (tomato), *Solanum melongena* (eggplant), *Solanum tuberosum* (potato), *Sorghum bicolor* (sorghum), *Triticum* spp. (wheat), *Triticum aestivum* (wheat), *Vigna unguiculata* (cowpea), and *Zea mays* (corn) (CABI, 2007).

Poor hosts

Vitis vinifera (grape) (Voros, 1996).

Wild hosts

Acalypha spp. (copperleaf), *Amaranthus* spp. (pigweed, amaranth), *Datura* spp., *Datura metel* (datura), *Gomphrena* spp., *Hyoscyamus niger* (black henbane), and *Sonchus oleraceus* (annual sowthislte) (Gu and Walter, 1999; CABI, 2007).

For a complete listing of hosts see Venette et al. (2003).

Pathogens or Associated Organisms Vectored

Helicoverpa armigera is not a known vector and does not have any associated organisms.

Known Distribution

Asia: Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Brunei, Cambodia, China, Cocos Islands, Republic of Georgia, Hong Kong, India, Indonesia, Iran, Iraq, Israel, Japan, Jordan, Kazakhstan, Korea, Kuwait, Kyrgyzstan, Laos, Lebanon, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Saudi Arabia, Singapore, Sri Lanka, Syria, Taiwan, Tajikistan, Thailand, Turkey, Turkmenistan, United Arab Emirates, Uzbekistan, Vietnam, and Yemen; **Europe:** Albania, Andorra, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Cyprus, Denmark, Finland, France, Germany, Gibraltar, Greece, Hungary, Ireland, Italy, Lithuania, Macedonia, Malta, Moldova, Portugal, Romania, Russia, Serbia and Montenegro, Slovenia, Spain, Sweden, Switzerland, and Ukraine; **Africa:** Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Cote d'Ivoire, Democratic Republic of the Congo, Egypt, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mayotte, Morocco, Mozambique, Namibia, Niger, Nigeria, Republic of Congo, Reunion, Rwanda, Saint Helena, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, and Zimbabwe; **Oceania:** American Samoa, Australia, Belau, Christmas Island, Cook Islands, Federated States of Micronesia, Fiji, Guam, Kiribati, Marshall Islands, New Caledonia, New Zealand, Norfolk Island, Northern Mariana Islands, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu; **South America:** Argentina, Brazil, and Paraguay (CABI, 2007; Fibiger and Skule, 2011; EPPO, 2012; Sugayama, 2013; Senave, 2013; Murúa et al., 2014).

Pathway

Helicoverpa armigera could potentially move through international trade. This species has been intercepted over 800 times at U.S. ports of entry. Most interceptions occurred on material meant for consumption (838), 23 interceptions were on material for non-entry, and 3 were on material meant for propagation. Plant material interceptions have occurred on: *Bupleurum* sp. (73), *Ornithogalum* sp. (60), *Leucospermum* sp. (45), *Veronica* sp. (38), *Tagetes* sp. (32), and *Capsicum* sp. (25) among others. Most interceptions originated on material from the Netherlands (275), Israel (209), India (64), Kenya (28), Italy (27), Spain (25), and Zimbabwe (22) (AQAS, 2012; queried August 29, 2012).

This species is also capable of long-distance migratory flights (King, 1994; Zhou et al., 2000; Casimero et al., 2001; Shimizu and Fujisaki, 2002; CABI, 2007).

Survey

CAPS-Approved Method*:

The CAPS-approved method is a trap and lure. The lure is effective for 28 days (4 weeks). The length of effectiveness of this lure may be reduced in hot and dry climates. In these environments, lures may need to be changed every two weeks instead of every four weeks.

Any of the following Trap Product Names in the IPHIS Survey Supply Ordering System may be used for this target:

1) Plastic Bucket Trap
2) Heliothis Trap
3) Texas (Hartstack) Trap

The Lure Product Name is "*Helicoverpa armigera* Lure."

The Plastic Bucket Trap is also known as the unitrap. The trap has a green canopy, yellow funnel, and white bucket and is used with a dry kill strip. See Brambila et al. (2014) for instructions on using the plastic bucket trap.

The Texas (Hartstack) trap is not available commercially. See Hartstack et al. (1979) or Johnson and McNeil (no date) for images and trap design.

IMPORTANT: Do not include lures for other target species in the trap when trapping for this target.

Trap spacing: When trapping for more than one species of moth, separate traps for different moth species by at least 20 meters (65 feet).

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Literature-Based Methods:

Trapping: (From Venette et al., 2003). Pheromone traps using (*Z*)-11-hexadecenal and (*Z*)-9-hexadecenal in a 97:3 ratio have been used to monitor populations of *H. armigera* (Pawar et al., 1988; Loganathan and Uthamasamy, 1998; Loganathan et al., 1999; Visalakshmi et al., 2000; Zhou et al., 2000). Of three pheromone doses tested in the field (0.75, 1.0, and 1.25 mg/septum), 1 mg attracted the most males (Loganathan and Uthamasamy, 1998); the trap type was not specified. Rubber septa impregnated with these sex pheromone components (1 mg/septum) were equally effective in capturing males for 11 days in the laboratory (Loganathan et al., 1999). Captures of *H. armigera* in the field were significantly lower with 15-day-old lures than with fresh lures, and the authors recommend replacing lures every 13 days (Loganathan et al., 1999). Similar observations were reported by Pawar et al. (1988). Males responded to the pheromone during dark hours only, commencing at 6:00 PM and terminating at 6:00 AM. The highest response was between 11:00 PM and 4:00 AM (Kant et al., 1999).

Trap design has a significant impact on the number of male *H. armigera* moths that will be captured with pheromone lures. Funnel traps and Texas traps are substantially more effective than sticky traps (Kant et al., 1999). Hartstack *(i.e.,* hollow cone) traps have also been used to effectively monitor densities of adults (Walker and Cameron, 1990). Cone traps are significantly more effective than water-pan traps (Sheng et al., 2002).

Survey site selection:
This species can be surveyed for in a variety of crops due to its polyphagous nature. The larvae feed mainly on the flowers and fruit of high value crops. *Helicoverpa armigera* has been reported causing serious losses throughout its range, in particular to tomatoes, cotton, and corn.

Trap placement:
Traps should be placed 1.5 to 1.8 m (~5 to 6 ft) above the ground (Aheer et al., 2009; Kant et al., 1999; and Zhou et al., 2000).

Time of year to survey:
Moths emerge in May to June depending on latitude, and lay eggs singly on a variety of host plants on or near floral structures.

Not recommended: Visual inspections of plants for eggs and/or larvae are frequently used to monitor and assess population sizes for *H. armigera*. Females lay several hundred eggs on the top 20 cm ($7\ ^{7}/_{8}$ in) of leaves, flowers, and fruits (Duffield and Chapple, 2000). The lower leaf surface is a preferred oviposition site. Eggs may hatch in less than 3 days at an optimum temperature of 27 to 28°C (81 to 82°F). The feeding larvae can be seen on the surface of plants but they are often hidden within plant organs (flowers, fruits, etc.). Bore holes and heaps of frass (excrement) may be visible, but otherwise it is necessary to cut open the plant organs, especially damaged fruit, to detect the pest (Bouchard et al., 1992). In temperate regions, *H. armigera* overwinters as a pupa buried several cm in the soil. Adults appear in April to May and can be observed until October, because of the long migration period.

In vegetative Australian cotton and irrigated soybean, a minimum of 60 whole plants per 100 hectare commercial field are examined for the presence of *H. armigera* eggs or larvae. When plants begin to produce squares, only the upper terminal (approximately 20 cm or $7\ ^{7}/_{8}$ in) of a plant is inspected (Brown, 1984; Dillon and Fitt, 1995; Duffield and Chapple, 2000). In experimental plots, visual inspections for *H. armigera* in pigeon pea were restricted to the upper third of whole plants (four sets of five plants in a 30 x 30 meter plot) (Sigsgaard and Ersbøll, 1999).

Leaves of tomato plants are more attractive than flowers or fruits as *H. armigera* oviposition sites, but use of a single-leaf sample unit (with a sample size of 30 plants per field) has proven ineffective in detecting low densities of *H. armigera* (Cameron et al., 2001). On some tomato cultivars, leaves in the upper half of the plant are preferentially selected for oviposition (Saour and Causse, 1993).

For CAPS surveys, visual survey is not an approved method for this species.

Adults of both sexes can be captured in black light traps. For CAPS surveys, light traps are not an approved method for this species as they are not species-specific.

Key Diagnostics/Identification

CAPS-Approved Method*:

Confirmation of *Helicoverpa armigera* is by morphological examination. *Helicoverpa armigera* and the native, abundant species, *Helicoverpa zea,* are very similar in appearance. *Helicoverpa armigera* cannot be visually distinguished from *H. zea*; all specimens require dissection. Final identification requires dissection of adult male genitalic structures. Instructions for preparing and dissecting the specimens are available at Brambila (2009b); see below for link.

For field level screening, use:
Brambila, J. 2009a. *Helicoverpa armigera* - Old World Bollworm, Field Screening Aid and Diagnostic Aid.

Instructions for dissecting *H. armigera* are available at:
Brambila, J. 2009b. Dissection instructions for identifying male *Helicoverpa amigera* and *H. zea*.

A guide to larval identification is available at:
Passoa, S. 2007. Identification guide to larval Heliothinae (Lepidoptera: Noctuidae) of quarantine significance.

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Easily Confused Species

Several noctuid pests can be confused easily with *H. armigera*, including *H. assulta* and *H. punctigera* (both are not known in the United States), and *H. zea* and *Chloridea virescens* (formerly *Heliothis virescens*) (both are present in the United States) (Kirkpatrick, 1961; CABI, 2007). A morphological study of *H. assulta, H. punctigera,* and *Chloridea virescens* compares similarities and differences between species; a key is provided for identifying adults (Kirkpatrick, 1961).

Commonly Encountered Non-targets

The native species *Helicoverpa zea* is strongly attracted to the *H. armigera* pheromone lure. Differentiation between *H. armigera* and *H. zea* is very difficult; identification is by dissection of internal structures of adult males (Pogue, 2004). Cahill et al. (1984) provide morphological information to distinguish third/fourth and sixth instars of *H. armigera* and *H. punctigera*. Brambila (2009a) and Brambila (2009b) should be used to screen for or identify adult *H. armigera* males.

In addition, some native *Spodoptera* species frequently occur in *H. armigera* traps, including male and female *Spodoptera frugiperda* and *S. ornithogalli*. To the untrained observer, these moths may look similar to the target (all are brownish colored moths); however, on closer inspection, the *Spodoptera* moths can be screened out of the samples. *Spodoptera frugiperda* is smaller with narrower wings and tends to be grey.

Spodoptera ornithogalli is similar in size but its wings are banded in cream and dark brown.

Another species that is commonly found in *H. armigera* traps is *Leucania adjuta* (J. Brambila, personal communication, 2014). This non-target may occur in large numbers in traps. *Leucania adjuta* males (Fig. 6) are generally similar in size and color to *Helicoverpa zea* and *H. armigera* but have various differences on wing color patterns (Brambila, personal communication, 2014). Surveyors should screen these moths out if possible; however, the specimens may be submitted if the moths are in poor condition or the surveyor does not feel comfortable screening these non-target out of the traps.

Figure 6. *Leucania adjuta*. Photo courtesy of Mark J. Dreiling.

For images of genitalia of the native moth, *Leucania adjuta* see:
Brambila, J. 2010. Images of *Leucania adjuta* genitalia.

For additional images of *Leucania adjuta*, see:

http://www.nearctica.com/leucania/sysfly/Ladjuta.htm

http://mothphotographersgroup.msstate.edu/species.php?hodges=10456

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Revisions

April 2014
1) Revised the **Key Diagnostics/Identification** section.
2) Revised the **Easily Confused Species** section.
3) Added the **Commonly Encountered Non-targets** section.
4) Added Figure 6 and link to Brambila, J. 2010. Images of *Leucania adjuta* genitalia.

July 2014
1) Revised the **Distribution** section.