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Data Sheets on Quarantine Pests

Helicoverpa armigera

IDENTITY

Name: *Helicoverpa armigera* (Hübner)
Synonyms: *Heliothis armigera* Hübner
Chloridea armigera Hübner
Taxonomic position: Insecta: Lepidoptera: Noctuidae
Common names: Old World (African) bollworm, corn earworm, cotton bollworm (English)
Noctuelle des tomates (French)
Altweltlicher Baumwollkapselwurm (German)
Oruga (gusano) de las mazorcas (Spanish)
Notes on taxonomy and nomenclature: The taxonomic situation is complicated and presents several problems. Hardwick (1965) reviewed the New World corn earworm species complex and the Old World African bollworm (Noctuidae), most of which had previously been referred to as a single species (*Heliothis armigera* or *H. obsoleta*), and pointed out that there was a complex of species and subspecies involved. Specifically he proposed that the New World *H. zea* (first used in 1955) was distinct from the Old World *H. armigera* on the basis of male and female genitalia. And he described the new genus *Helicoverpa* to include these important pest species, Some 80 or more species were formerly placed in *Heliothis* (*sensu lato*) and Hardwick referred 17 species (including 11 new species) to *Helicoverpa* on the basis of differences in both male and female genitalia. Within this new genus the *zea* group contains eight species, and the *armigera* group two species with three subspecies. See also Hardwick (1970).

Because the old name of *Heliothis* for the pest species (four major pest species and three minor) is so well established in the literature, and since dissection of genitalia is required for identification, there has been resistance to the name change (e.g. Heath & Emmet, 1983), but Hardwick's work is generally accepted and so the name change must also be accepted (see Matthews, 1991).

The first issue of the CIE distribution map (CIE, 1952) included the American continent, but the species there is now known to be *Helicoverpa zea* (Boddie), the New World bollworm (EPPO/CABI, 1996).
Bayer computer code: HELIAR
EPPO A2 list: No. 110
EU Annex designation: I/A2 - as *Heliothis armigera*

HOSTS

Primarily ornamental plants and flowers. Among the numerous other economically important hosts are: cotton, tobacco, tomatoes, potatoes, maize, flax, soyabeans, sorghum, lucerne, *Phaseolus*, chickpeas, other Leguminosae, and a number of fruits (*Prunus*, *Citrus*) and forest trees. See Matthews (1991) for a full list.

GEOGRAPHICAL DISTRIBUTION

EPPO region: Widespread in Albania, Algeria, Bulgaria, Croatia, Egypt, Greece, Israel, Lebanon, Libya, Macedonia, Morocco, Portugal (including Madeira), Romania, Spain (including Canary Islands), Syria; locally established in Cyprus, France, Hungary, Italy, Malta, Russia (European, Siberia), Switzerland, Tunisia, Turkey, Yugoslavia; found but not established in Germany, Netherlands; found but eradicated in UK; intercepted only in the Czech Republic and Denmark.
Asia: Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Cambodia, China (widespread), Cyprus (locally established), Georgia, Hong Kong, India (widespread), Indonesia (widespread), Iran, Iraq, Israel, Japan, Jordan, Kazakhstan, Korea Democratic People's Republic, Korea Republic, Kuwait, Kyrgyzstan, Lao, Lebanon, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Saudi Arabia, Singapore, Sri Lanka, Syria, Taiwan, Tajikistan, Thailand, Turkey, United Arab Emirates, Uzbekistan, Viet Nam, Yemen.
Africa: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Côte d'Ivoire, Egypt, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Réunion, Rwanda, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, St. Helena, Sudan, Tanzania, Togo, Tunisia, Uganda, Zaire, Zambia, Zimbabwe.
Oceania: American Samoa, Australia (north of 17°S and along the east coast), Cocos Islands, Fiji, Guam, Kiribati, Marshall Islands, Micronesia, New Caledonia, New Zealand, Norfolk Island, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu.
EU: Present.
Distribution map: See IIE (1993, No. 15).

BIOLOGY

In southern Bulgaria, there are two complete generations a year and a partial third, winter being passed in the pupal stage in the soil. Adults emerge in the first 3 weeks of May and, 2-6 days later (rarely 10), oviposition begins. This period lasts 5-24 days and, within this time, a female may lay up to 3180 eggs (up to 457 in 24 h), singly and mainly at night, on chickpeas, cotton, maize, okras, tobacco, tomatoes, *Phaseolus* and certain weeds. At 25°C, they hatch in 3 days, but in 10-11 days in colder weather. The first generation larvae (i.e. the larval progeny of the overwintering generation) appear in May and feed for 24-36 days; those of the second generation feed for 16-30 days, and those of the third generation (at 25-26°C) develop in 19-26 days. When fully fed, the larvae descend to the soil and, after 1-7 days, pupate in an earthen cell, 2-8 cm below the surface. The overwintering pupae remain in the soil for 176-221 days, whereas this stage lasts 13-19 days in the first generation, 8-15 days in August and up to 44 days in colder weather in September. Longevity of adults is about 3 weeks.

In southern France, adults appear from May until the end of October. Some are thought to be migrants and others to have overwintered there. A second generation occurs during summer, and third-generation adults appear in September. Second-generation adults from more northern regions migrate towards the south and Mediterranean Basin in autumn. The principal host on which eggs are laid is maize in south-western France, but tomatoes in the Rhône Valley.

In Tunisia, *Capsicum*, tomatoes, maize and cauliflowers are most frequently attacked. The eggs are laid on plants at or near flowering.

In Russia, eggs are laid on weeds during spring and early summer; the developing larvae attack cultivated crops and then cotton flowers in August. Larvae rarely move from

one plant to another. About 80% of pupae enter diapause at the beginning of October and overwinter in this state.

In Iran, *H. armigera* also overwinters as the pupal stage, under the soil surface. At the beginning of May, adults emerge and mate promptly. The females lay eggs on weeds and host plants of economic importance but, normally, the first generation feeds on weeds. The oviposition period lasts for about 20 days, during which time each female lays 500-2700 eggs. The incubation period takes 3-4 days in summer and about a week during spring and autumn. The larval period lasts 14-18 days in summer and 17-21 days in autumn. During the growing season, *H. armigera* produces two to six generations according to the climatic conditions. In the northern part of Iran, the most important cotton-growing area in the country, there are four to six generations annually.

In South Africa, the oviposition period is 10-23 days, with an average of 730 eggs per female (total 1600; maximum per night 480). Hairy surfaces are preferred for oviposition which is closely linked with the period of bud burst and flower production in most host plants. Eggs hatch in 3 days at 22.5°C, and in 9 days at 17.0°C. The larval period lasts 18 days at 22.5°C and 51 days at 17.5°C, development thresholds being 14 and 36°C; rate of development is also affected by food. Full-grown larvae leave the plant to pupate in the soil at a depth of 3-15 cm. In Zimbabwe, pupation may occur in the tip of a maize cob. The pupa may undergo a facultative diapause, which considerably extends the pupal period. In southern Africa, the minimum pupal period in summer is 12 days, increasing as temperature falls to about 57 days. Emerging female moths must feed before their ovarioles are mature. Average life-spans for males and females in South Africa are 9 and 14 days, respectively (8 and 11 days in Zimbabwe).

For further information, see Ditman & Cory (1931), Dominguez Garcia-Tejero (1957), Ibrahim *et al*. (1974), Pearson (1958), Cayrol (1972), Delatte (1973).

DETECTION AND IDENTIFICATION

Symptoms

On cotton

Bore holes are visible at the base of flower buds, the latter being hollowed out. Bracteoles are spread out and curled downwards. Leaves and shoots may also be consumed by larvae.

On tomatoes

Young fruits are invaded and fall. Secondary infections by other organisms lead to rotting.

On maize

Cobs are invaded and developing grain is consumed. Secondary bacterial infections are common.

Morphology

Eggs

Yellowish-white and glistening at first, changing to dark-brown before hatching; pomegranate-shaped, 0.4-0.6 mm in diameter; the apical area surrounding the micropyle is smooth, the rest of the surface sculptured in the form of approximately 24 longitudinal ribs, alternate ones being slightly shorter, with numerous finer transverse ridges between them; laid on plants which are flowering, or are about to produce flowers.

Larva

The first and second larval instars are generally yellowish-white to reddish-brown in colour, without prominent markings; head, prothoracic shield, supra-anal shield and prothoracic legs are very dark-brown to black, as are also the spiracles and tuberculate bases to the setae, which give the larva a spotted appearance; prolegs are present on the third to sixth, and tenth, abdominal segments. A characteristic pattern develops in subsequent instars. Full-grown larvae are about 30-40 mm long; the head is brown and

mottled; the prothoracic and supra-anal plates and legs are pale-brown, only claws and spiracles remaining black; the skin surface consists of close-set, minute tubercles. Crochets on the prolegs are arranged in an arc. The final body segment is elongated. Colour pattern: a narrow, dark, median dorsal band; on each side, first a broad pale band, then a broad dark band; on the lateral line, a broad, very light band on which the row of spiracles shows up clearly. The underside is uniformly rather pale. On the basic dorsal pattern, numerous very narrow, somewhat wavy or wrinkled longitudinal stripes are superimposed. Colour is extremely variable and the pattern described may be formed from shades of green, straw-yellow, and pinkish- to reddish-brown or even black.

Pupa

Mahogany-brown, 14-18 mm long, with smooth surface, rounded both anteriorly and posteriorly, with two tapering parallel spines at posterior tip.

Adult

Stout-bodied moth of typical noctuid appearance, with 3.5-4 cm wing-span; broad across the thorax and then tapering, 14-18 mm long; colour variable, but male usually greenish-grey and female orange-brown. Forewings have a line of seven to eight blackish spots on the margin and a broad, irregular, transverse brown band. Hindwings are pale-straw colour with a broad dark-brown border that contains a paler patch; they have yellowish margins and strongly marked veins and a dark, comma-shaped marking in the middle. Antennae are covered with fine hairs.

For more information, see Dominguez Garcia-Tejero (1957), Hardwick (1965), Cayrol (1972), Delatte (1973).

Detection and inspection methods

The feeding larvae can be seen on the surface of plants but they are often hidden within plant organs (flowers, fruits etc.). Bore holes may be visible, but otherwise it is necessary to cut open the plant organs to detect the pest.

Identification of all stages in the EPPO region will be difficult should very similar American (*H. zea*) or Australian (*H. punctigera*) species be introduced and become established. Separation of the adult from similar species is most reliably done by reference to the male genitalia (Hardwick, 1965).

MEANS OF MOVEMENT AND DISPERSAL

Adults can migrate over long distances, borne by wind, for example from southern Europe to the UK (Pedgley, 1985). Movement in international trade is mainly on ornamental plants and on cut flowers; also in cotton bolls and in tomato fruits.

PEST SIGNIFICANCE

Economic impact

H. armigera has been reported causing serious losses throughout its range, in particular to cotton, tomatoes and maize. For example, on cotton, two to three larvae on a plant can destroy all the bolls within 15 days; on maize, they consume grains; on tomatoes, they invade fruits, preventing development and causing falling. An outbreak of this noctuid occurred on young *Pinus radiata* in New Zealand in 1969 and 1970, when the larvae consumed more than 50% foliage of about 60% trees. Damage has been reported in India on potatoes, sunflowers, *Guizotia abyssinica*, pigeon peas and cotton.

In the EPPO region, *H. armigera* is of great economic importance in Israel, Morocco, Portugal, Russia and Spain and of lesser importance in the other countries where it is established. Despite extensive spread in Greece, *H. armigera* only causes periodic damage to cotton.

Control

Efforts are being made in many countries to control *H. armigera*, using both biological and chemical means. Economic thresholds in cotton have been established in Russia.

Phytosanitary risk

H. armigera is listed as an A2 quarantine pest by EPPO (OEPP/EPPO, 1981). Although it is certainly a serious outdoor pest in Mediterranean countries, it has most probably reached the limits of its natural distribution in the EPPO region. Quarantine status arises from the risk of introduction into glasshouse crops in northern Europe.

PHYTOSANITARY MEASURES

EPPO recommends (OEPP/EPPO, 1990) that imported propagation material should derive from an area where *H. armigera* does not occur or from a place of production where *H. armigera* has not been detected during the previous 3 months. Consignments can be treated against this pest by refrigeration for 2-4 days at 1.7°C followed by fumigation with methyl bromide at 13.5 g/m^3 for 4 h (OEPP/EPPO, 1984).

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