

Data Sheets on Quarantine Pests

*Spodoptera frugiperda***IDENTITY****Name:** *Spodoptera frugiperda* (J.E. Smith)**Synonyms:** *Laphygma frugiperda* (J.E. Smith)**Taxonomic position:** Insecta: Lepidoptera: Noctuidae**Common names:** Fall armyworm, corn leafworm, southern grassworm (English)

Légionnaire d'automne (French)

Heerwurm (German)

Cogollero del maíz (Spanish)

Bayer computer code: LAPHFR**EPPO A1 list:** No. 197**EU Annex designation:** I/A1**HOSTS**

A polyphagous pest which shows a definite preference for the Poaceae. It is most commonly recorded from grasses and from maize, rice, sorghum and sugarcane. Also recorded on cotton, Brassicaceae, Cucurbitaceae, groundnuts, lucerne, onions, *Phaseolus*, sweet potatoes, tomatoes and other Solanaceae (aubergines, *Capsicum*, tobacco) and various ornamental plants (chrysanthemums, carnations and *Pelargonium*). Most larvae are conditioned to the host on which they first feed, usually the plant on which the eggs were laid.

S. frugiperda is a tropical and subtropical species that regularly migrates to cooler regions in the summer. The Mediterranean region would be suitable for the establishment of this pest and there is a wide range of suitable hosts available. It could have potential as a glasshouse pest, but this seems less likely.

GEOGRAPHICAL DISTRIBUTION**EPPO region:** Absent.**North America:** Bermuda, Canada (eastern provinces to Manitoba), Mexico, USA. *S. frugiperda* is established in southern regions where conditions are warmer, but annual migrations take it throughout the USA and into southern Canada. It only becomes abundant in northern states in late summer and autumn.**Central America and Caribbean:** Anguilla, Antigua and Barbuda, Bahamas, Barbados, Belize, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Guatemala, Honduras, Haiti, Jamaica, Martinique, Montserrat, Nicaragua, Panama, Puerto Rico, St. Lucia, St. Kitts and Nevis, St. Vincent and Grenadines, Trinidad and Tobago, United States Virgin Islands.

South America: Throughout most of the continent south to about 36°S, including Argentina, Bolivia, Brazil (widespread), Chile, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela.

EU: Absent.

Distribution map: See CIE (1985, No. 68).

BIOLOGY

Eggs are laid at night on the leaves of the host, stuck to the lower surface of the lower part of the lower leaves, in tight clusters of 100-300 and sometimes in two layers, usually covered with a protective layer of abdominal bristles. Hatching requires 2-10 days (usually 3-5). The young larvae feed deep in the whorl; the first two instars feed gregariously on the underside of the young leaves causing a characteristic skeletonizing or 'windowing' effect, and the growing point can be killed. Larger larvae become cannibalistic and thus one to two larvae per whorl is usual. Rate of larval development through the six instars (or five) is controlled by a combination of diet and temperature conditions, and usually takes 14-21 days. Larger larvae are nocturnal unless they enter the armyworm phase when they swarm and disperse, seeking other food sources. Pupation takes place inside a loose cocoon in an earthen cell, or rarely between leaves on the host plant, and 9-13 days are required for development. Adults emerge at night, and they typically use their natural pre-oviposition period to fly for many kilometres before they settle to oviposit, sometimes migrating for long distances. Details of development requirements are provided by Ramirez Garcia *et al.* (1987). On average, adults live for 12-14 days.

This is a tropical species adapted for life in the warmer parts of the New World; temperature optimum for larval development is reported to be 28°C, but is lower for both oviposition and pupation. In the tropics, breeding can be continuous with four to six generations per year, but in northern regions only one to two generations develop; at lower temperature, activity and development cease, and when freezing occurs all stages are usually killed. In the USA, *S. frugiperda* usually overwinters only in southern Texas and Florida. In mild winters, pupae will survive in more northerly locations.

DETECTION AND IDENTIFICATION

Symptoms

Maize leaves are eaten and the whorl (funnel) may be a mass of holes, ragged edges and larval frass. Young larvae skeletonize the leaf lamina. Plants up to an age of 30 days can be cut through at the base by large larvae acting as cutworms. Older plants may have the cobs attacked by larvae boring through the kernels. On tomato plants, buds and growing points may be eaten and fruits pierced. At high densities, large larvae may act as armyworms and disperse in swarms, but they often remain on grasses, if available.

Morphology

Eggs

Subspherical in shape, stuck to the leaf surface in groups of 100-300, sometimes in two layers. The egg mass is usually covered with a protective, felt-like layer of grey-pink scales (setae) from the female abdomen. Up to 1000 eggs may be laid by each female.

Larva

On hatching they are green with black lines and spots, and as they grow they either remain green or become buff-brown and have black dorsal and spiracular lines. If crowded (by a high population density and food shortage) the final instar can be almost black in its armyworm phase. Fully grown larvae are 35-40 mm in length. Large larvae are characterized by an inverted Y-shape in yellow on the head, black dorsal pinaculæ with

long primary setae (two each side of each segment within the pale dorsal zone) and four black spots arranged in a square on the last abdominal segment. There are usually six larval instars, occasionally five. A full description of the larvae is given in Crumb (1956). Diagnostic features are given by Levy & Habeck (1976), and good colour plates are provided by King & Saunders (1984).

Pupa

A typical brown, shiny noctuid pupa, 18-20 mm in length.

Adult

A sturdy grey-brown moth of wing-span 32-38 mm; the forewings are grey to grey-brown in the female, but in the male they are darker with dark markings and pale streaks; the hindwings are white. Adults of *S. frugiperda* might be confused with those of *S. exempta* and *S. littoralis*. In *S. frugiperda* the veins of the hindwing are brown and distinct, and in the male forewing the pale orbicular stigma has a pronounced pale 'tail' distally. In the male genitalia the valve is almost rectangular and there is no marginal notch at the position of the tip of the harpe; the female bursa lacks a signum. Details of the African species of *Spodoptera* are given by Brown & Dewhurst (1975), and keys to moths of the genus *Spodoptera* in the Western Hemisphere are given by Todd & Poole (1980).

MEANS OF MOVEMENT AND DISPERSAL

This species is a regular annual migrant in the Americas, dispersing throughout the USA and flying up into southern Canada virtually every summer. It is suggested that, in this species, migration has evolved as a major component in the life history strategy. The use of the pre-oviposition (maturation) period for widespread dispersal seems to be very effective. In the USA, adult moths have been recorded using a low-level jet stream which took them from Mississippi to Canada in 30 h.

Larvae frequently act as armyworms in late summer or early autumn and local dispersal is thus effected successfully, which helps to reduce larval mortality.

In most years larvae arrive in Europe carried by air-freight on vegetables or fruit from the New World; sometimes they also come on herbaceous ornamentals (Seymour *et al.*, 1985). A useful review of this topic was produced by Johnson (1987).

PEST SIGNIFICANCE

Economic impact

S. frugiperda is found widely throughout the warmer parts of the New World, but is of variable importance. Locally severe infestations occur sporadically, and some areas seem to be more at risk than others. Damage results from leaf-eating, and healthy plants usually recover quite quickly, but a large pest population can cause defoliation; the larvae then migrate to adjacent areas in true armyworm fashion. Large larvae sometimes act as cutworms and can cause extensive destruction of seedlings and young plants by cutting the stem. On larger plants the ears of maize may be attacked by larvae boring through the kernels; similarly tomato fruits may be bored.

Control

On maize, if 5% of seedling plants are cut or 20% whorls of small plants (during the first 30 days) infested, it is recommended that an insecticide be applied (King & Saunders, 1984); on sorghum the pest threshold level is regarded as one (or two) larvae per leaf whorl and two per head (Pitre, 1985). In some areas resistance to insecticides may be widespread and control can be difficult (Pitre, 1985).

A large number of parasitic Hymenoptera, as larval parasitoids, have been reared from *S. frugiperda*, and many predators are recorded; thus it appears that natural control is

usually of considerable importance. Natural levels of larval parasitism are often very high (20-70%), mostly through the agency of braconid wasps. 10-15% are often killed by pathogens.

Maize is being successfully bred for resistance to a wide range of pests, including defoliating caterpillars, and several types of cultural control can be applied to help minimize pest populations. Cultural aspects can be important since vigorous plants will recover after partial defoliation, and various basic techniques can help to minimize damage and aid plant recovery.

The literature on this pest is very extensive, partly because of the importance of maize as a crop in the New World, the importance of larval Lepidoptera as crop pests, the quest for alternative methods of control following the development of insect resistance to pesticides, and the development of plant breeding programmes which include studies on host selection and insect feeding. The bibliography by Ashley *et al.* (1989) includes 1309 references.

Phytosanitary risk

S. frugiperda was recently added to the EPPO A1 list of quarantine pests, but is not listed as a quarantine pest by any other regional plant protection organization. This pest is intercepted occasionally in Europe on imported plant material (Seymour *et al.*, 1985) so it is obvious that it could be introduced to the EPPO region by trade. The addition to the EPPO list harmonizes it with EU Directive Annex I/A1.

PHYTOSANITARY MEASURES

Plants for planting should come from a place of production inspected and found free from the pest during the previous months. Certain types of plants (e.g. cuttings) may be treated by being held at low temperatures (less than 1.7°C for 2-4 days) followed by fumigation (OEPP/EPPO, 1984).

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