EPPO Datasheet: *Spodoptera litura*

Last updated: 2023-03-15

IDENTITY

Preferred name: *Spodoptera litura*
Authority: (Fabricius)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Lepidoptera: Noctuidae
Other scientific names: *Prodenia litura* Fabricius
Common names: cluster caterpillar, cotton leafworm, cotton worm, rice cutworm, tobacco caterpillar, tobacco cutworm, tobacco leaf caterpillar, tropical armyworm
view more common names online...
EPPO Categorization: A1 list
view more categorizations online...
EU Categorization: Quarantine pest ((EU) 2019/2072 Annex II A)
EPPO Code: PRODLI

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Notes on taxonomy and nomenclature

Spodoptera litura and *S. littoralis* were regarded as the same species when Aurivillius synonymized *Noctua litura* (Fabricius, 1775) and *Prodenia littoralis* (Boisduval, 1833) under the name *Prodenia litura* Fabricius in 1897. Viette (1963) reviewed the species and suggested that there are two distinct species.

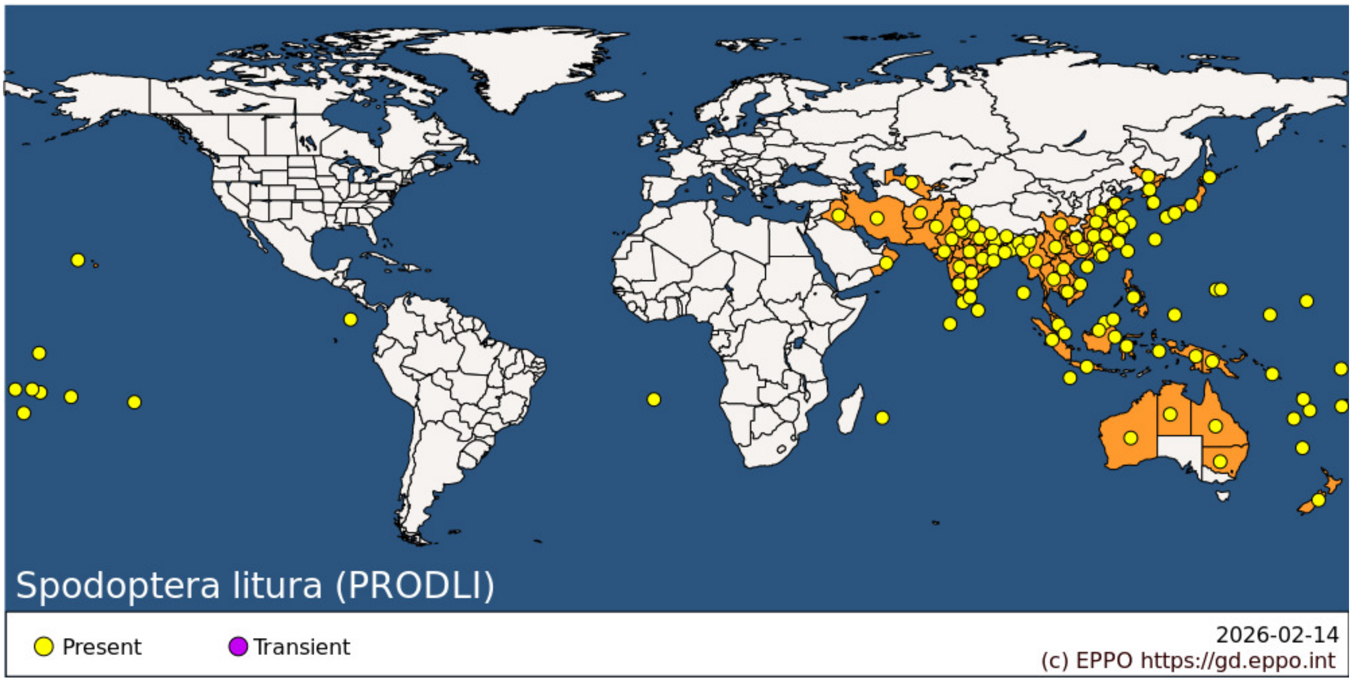
HOSTS

S. litura is highly polyphagous (Brown & Dewhurst, 1975, Holloway, 1989). Its host range covers over 40 plant families and at least 120 plant species. Some of the main crop species attacked by *S. litura* are taro (*Colocasia esculenta*), cotton, flax, groundnut, jute, lucerne, maize, potato, sweet potato, rice, soybean, tea, tobacco. Vegetables and fruits, including several *Brassica* species, bell pepper, cucurbitaceous vegetables, eggplant, *Phaseolus*, citrus, *Vigna* etc. (Ahmad *et al.*, 2013, Sang *et al.*, 2016, Ullah *et al.*, 2016) and aromatic and medicinal plants (such as sage, rosemary, mint, marjoram and coriander (Meena *et al.*, 2017, Wen *et al.*, 2007) are also important crops attacked by this pest. Other hosts include ornamentals and wild plants. In most of the EPPO region, outdoor crops are not likely to be attacked and most of the potential hosts are ornamentals and vegetables under protected cultivation. In the south of the region, cotton, lucerne, soybean, *Trifolium* and several vegetables are potential hosts for *S. litura*.

Host list: *Abelmoschus esculentus*, *Acaciella glauca*, *Allium cepa*, *Amaranthus blitum*, *Arachis hypogaea*, *Brassica juncea*, *Brassica oleracea*, *Brassica rapa subsp. chinensis*, *Camellia sinensis*, *Capsicum annuum*, *Chenopodiastrum murale*, *Chenopodium album*, *Citrus reticulata*, *Cleome viscosa*, *Colocasia esculenta*, *Convolvulus arvensis*, *Corchorus olitorius*, *Coriandrum sativum*, *Dahlia coccinea*, *Daucus carota*, *Eucalyptus sp.*, *Ginkgo biloba*, *Glycine max*, *Gossypium barbadense*, *Gossypium hirsutum*, *Hibiscus rosa-sinensis*, *Ipomoea batatas*, *Jatropha curcas*, *Linum usitatissimum*, *Medicago sativa*, *Melissa officinalis*, *Mentha sp.*, *Morus alba*, *Nicotiana tabacum*, *Ocimum basilicum*, *Origanum sp.*, *Oryza sativa*, *Phaseolus vulgaris*, *Pisum sativum*, *Plectranthus sp.*, *Raphanus sativus*, *Ricinus communis*, *Rosa sp.*, *Salvia rosmarinus*, *Sesbania sesban*, *Solanum lycopersicum*, *Solanum melongena*, *Solanum tuberosum*, *Sorghum bicolor*, *Spinacia oleracea*, *Theobroma cacao*, *Trianthema portulacastrum*, *Trifolium alexandrinum*, *Vigna angularis*, *Vigna unguiculata*, *Zea mays*

GEOGRAPHICAL DISTRIBUTION

S. litura currently occurs throughout most of South and East Asia, Oceania, some African islands and Hawaii. It is considered native to South-East Asia and has been introduced into Western Asia, Australia, New-Zealand and most of the Pacific islands. *S. litura* cannot survive freezing temperatures and it is considered unlikely that the few occurrences reported from Russia are related to establishment outdoors.



EPPO Region: Uzbekistan
Africa: Reunion, Saint Helena
Asia: Afghanistan, Bangladesh, Brunei Darussalam, Cambodia, China (Anhui, Aomen (Macau), Fujian, Guangdong, Guangxi, Guizhou, Hainan, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Shandong, Shanghai, Sichuan, Xianggang (Hong Kong), Yunnan, Zhejiang), Christmas Island, Cocos Islands, India (Andaman and Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Telangana, Uttarakhand, Uttar Pradesh, West Bengal), Indonesia (Irian Jaya, Java, Kalimantan, Maluku, Sulawesi, Sumatra), Iran, Islamic Republic of, Iraq, Japan (Hokkaido, Honshu, Kyushu, Ryukyu Archipelago, Shikoku), Korea, Democratic People's Republic of, Korea, Republic of, Lao People's Democratic Republic, Malaysia (Sabah, Sarawak, West), Maldives, Myanmar, Nepal, Oman, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Uzbekistan, Vietnam
North America: United States of America (Hawaii)
Oceania: American Samoa, Australia (New South Wales, Northern Territory, Queensland, Western Australia), Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia, Federated States of, New Caledonia, New Zealand, Niue, Norfolk Island, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu, Wallis and Futuna Islands

BIOLOGY

Between 2 and 5 days after emergence, females lay between 200 and 4000 eggs, depending on host plant, temperature and relative humidity. The eggs are laid on the underside of the leaves of the host plant in egg masses covered by bristles (scales) from the end of the mother's abdomen. Eggs cannot develop at temperatures below 8°C (Rao *et al*., 1989), larvae require a minimum of 0.9 degree-days to properly develop and daily minimum temperatures below -5°C are lethal (Matsuura & Naito, 1997). Development speed and fecundity increases towards higher temperatures and higher humidity up to a maximum of 35°C (at 75% RH) when oviposition stops (Garad *et al.*, 1984, Hardik & Dolly, 2020).

The eggs hatch within ca. 4 days under warm conditions (around 25°C), or up to 11-12 days at 15°C. The larvae pass through six instars in 16 days at 30°C. At lower temperatures maturation may take up to 3 months. The young larvae (first to third instar) feed in groups, leaving the epidermis on the other side of the leaf intact. Later, the (4th to 6th instar) larvae disperse and spend the day among leaf litter or in the ground under the host plant, feeding at night and early in the morning.

The pupal stage is spent in earthen cells in the soil and lasts about 8 days at 30°C. Longevity of female adults is about 4-10 days with males living up to 16 days (Etman & Hooper, 1980). Adult longevity reduces at higher temperature and lower humidity. Under optimal conditions, the life cycle can be completed in about four weeks. In Japan (Nakasiju & Matsuzaki, 1977), four generations develop between May and October, while in the humid tropics there may be eight to twelve annual generations (Fand *et al.*, 2015). In the seasonal tropics, several generations develop during the rainy season, while the dry season is spent in the pupal stage.

For more information, see Etman and Hooper (1980), Garad *et al.* (1984), Hardik and Dolly (2020), Miyahara *et al.* (1971), Rao *et al.* (1989).

DETECTION AND IDENTIFICATION

Symptoms

On most crops, damage arises from extensive feeding by larvae, leading to complete stripping of the plants. Some examples of symptoms include: on cotton, leaves are heavily attacked, and cotton bolls have large holes in them from which yellowish-green to dark-green larval excrement protrudes; on tobacco, leaves develop irregular, brownish-red patches and the stem base may be gnawed off; on maize, larvae damage whorl leaves, bracts and young kernels.

Morphology

Eggs

Spherical, somewhat flattened, 0.6 mm in diameter, laid in tight batches and usually covered with hair-like scales from the tip of the abdomen of the female. These typical noctuid eggs contain many ribs (35-65) as goes for all taxa within this genus. The micropylar rosette is flat. Eggs are white at first and usually change colour to pale orange-brown or pink with a pearly shimmer.

Larva

First instar larvae are 1–2.5 mm long, the final instar larvae may attain 40–45 mm in length. Larvae are variable in overall colour (blackish-grey to dark-green, becoming reddish-brown or whitish-yellow) and markings. Typically, older larvae have a Y-shaped-marking across the head capsule and thorax shield. Late instars often have dark and light longitudinal bands and two dark semilunar spots dorsolaterally on each abdominal segment, of which the spots on the first and eighth abdominal segments are larger than the others. The spot on the first abdominal segment often interrupts the lateral line running across the spiracula. *S. litura* and *S. littoralis* have a small yellow dot at the base of the black patch dorsolaterally on the second and third thoracic segment, which distinguishes them from other *Spodoptera* species.

Pupa

15-20 mm long, red-brown; cremaster with two small spines. This trait is shared with at least *S. littoralis*, *S. eridania* and *S. frugiperda*. *Spodoptera exigua* has an extra pair of smaller spines anterodorsally of the cremaster. The spines that make up the cremaster are variable in size, fragile and prone to breakage.

Adult

Moth with grey-brown body, 15–20 mm long; wingspan 30–38 mm. The forewings are grey to reddish-brown with a strongly variegated pattern and paler lines along the veins. Males usually have an ochreous patch on the forewing and more bluish areas at the wing base and tip. The hindwings are greyish-white with grey margins, often with contrasting dark veins (unlike *S. littoralis*, which usually has lighter veins). The variability and similarity of the two species often makes it difficult to distinguish them visually and a genital dissection is needed. Females are characterized by a completely sclerotized and elongate ductus bursae (length more than three times the width). The juxta in males is triangular with a narrow base and a pointed process, the ampulla is slightly curved.

For more information on the morphological discrimination between the common *Spodoptera* pest species and a detailed description of the different stages, see the EPPO Standard PM 7/124 (EPPO, 2015). (Pogue, 2002) reviews the *Spodoptera* genus.

Detection and inspection methods

Pheromone traps can be used to detect the presence of adults and are the primary method for detecting Lepidoptera. Adults are nocturnal and therefore difficult to detect during the day. Eggs and larval stages can be found on a host plant or commodity, as well as feeding damage to the leaves. Older larvae tend to feed at night and rest on or in the soil at the base of the plant during the day. Pupae cannot be detected on the plant since pupation takes place in the soil. Methods to identify *S. litura* exist, see EPPO Standard PM 7/124 and references therein (EPPO, 2015). However, reliable morphological identification of immature stages either requires additional information (e.g. origin and host plant) or molecular analysis (van de Vossenberg & van der Straten, 2014).

PATHWAYS FOR MOVEMENT

In colder climates, *S. litura* migrates to avoid the cold season. Adults can fly over 30 km over 12 h (in laboratory conditions; Tu *et al.*, 2010), facilitating dispersion. In international trade, eggs or larvae may be present on planting material, cut flowers or vegetables. Recent findings of the species in the EPPO region originated from glasshouses stocked with plants introduced from South-East Asia.

PEST SIGNIFICANCE

Economic impact

S. litura is an extremely harmful pest, the larvae of which defoliates many economically important crops in Southern Asia and the Pacific. In controlled experiments on soybeans in India, crops chemically protected from *S. litura* and other pests yielded over 42% more than crops which were not sprayed (Srivastava *et al.*, 1971). On tobacco, it was estimated that two, four and eight larvae per plant reduced yield by 23-24, 44.2 and 50.4%, respectively (Patel *et al.*, 1971). 5, 10, 20 and 40 larvae per 100 Chinese cabbage plants resulted in yield losses of 7.6, 16.4, 36.2 and 66.3% respectively (Choi *et al.*, 2011). On taro, an average of 4.8 4th-instar larvae per plant reduced yield by 10%, while an average of 2.3 and 1.5 larvae per plant reduced yield of aubergines and *Capsicum* in glasshouses also by 10% (Nakasiju & Matsuzaki, 1977).

Control

Chemical control of *S. litura* has been reported in relation to various crops in India. Numerous organophosphorus, synthetic pyrethroid and other insecticides have been used, followed by the occurrence of multiple resistance in the target pest (Armes *et al.*, 1997, Ramakrishnan *et al.*, 1984, Zaka *et al.*, 2014) and a continued search for other chemical control methods including other insecticides (Ahmad & Gull, 2017) and insect and plant growth regulators (Khatun *et al.*, 2017, Ray *et al.*, 2013, Singh, 2001). There is an interest, especially in India, in various antifeedant compounds or extracts (such as azadirachtin) and endophytic fungi.

Numerous studies have been carried out on possible biological control methods. Natural enemies (parasitoids, predators and diseases) have been extensively documented (e.g. see Rao *et al.*, 1993). A nucleopolyhedrosis virus (NPV) has been evaluated against *S. litura* (Bhutia *et al.*, 2012), certain *Bacillus thuringiensis* (*Bt*) isolates are effective as a microbial pesticide (Patel *et al.*, 2018), fungi and microsporidia have been recorded as parasites (e.g. see Anand & Tiwary, 2009), and entomopathogenic nematodes have been evaluated (Acharya *et al.*, 2020, Yan *et al.*, 2020). The NPV against *S. litura* is commercially available. The same goes for *Bt* and several nematode species (such as *Steinernema carpocapsae*, which is effective against *S. litura*). However, it is unclear whether these biocontrol agents have been implemented as control measures against *S. litura* in practice.

Integrated pest management techniques are gradually being adopted in *S. litura* control. In these, a combination of the abovementioned chemical and biological control agents are used alongside pheromone lures and traps to catch adults and monitor the population. Additional measures include clean cultivation to expose pupae to natural enemies and the planting of trap crops such as sunflower and taro to attract *S. litura* (Zhou, 2009). Thakur *et al.* (2022) found that a combination of entomopathogens (fungi, bacteria and nematodes) can have a synergistic effect on the mortality of *S. litura*. Das and Roy (1985) reviewed the use of pheromones against *S. litura*. Irradiation has also been proposed as a control measure. Irradiated, sterile adult males are added to a population of *S. litura* and could be a viable component in integrated pest management (Seth *et al.*, 2016). However, this technique does not appear to have been implemented in practice so far.

Phytosanitary risk

S. litura has been introduced into several countries outside its native range where it has become a major pest to many economically important crops. For example, in northern parts of New Zealand it causes damage to pastures, and it is also known to be a pest in protected cultivation in colder areas of China, India and Japan where it could potentially sustain a viable population for most of the year (Hardik & Dolly, 2020, Matsuura *et al.*, 1992, Vashisth *et al.*, 2012). *S. litura* cannot survive cold (freezing) winters and requires high humidity to successfully complete its life cycle, limiting the potential of establishment in the EPPO region to a few areas in the Mediterranean. Establishment in the EPPO region under glass may be possible. The species could also exploit outdoor food plants during warmer months and re-enter greenhouses where to avoid adverse conditions during colder periods. It has strong dispersal capabilities, increasing the possibility of (re)introduction into colder areas in summer and potentially rapidly expanding its range with increased temperatures due to climate change. More details on the risk of introduction can be found in the EFSA Pest Categorization (EFSA, 2019).

Spodoptera littoralis, which is similar to *S. litura* in terms of biology and host plant range, is already fairly widespread in Mediterranean countries and has not spread further north (outside of greenhouses). If introduced, *S. litura* would likely have a similar distribution range in the Mediterranean, where it would be in direct competition with already established populations of *S. littoralis*. This could imply that *S. litura* cannot easily establish itself outdoors in the presence of *S. littoralis*, though further research would be needed to confirm this. Therefore the main phytosanitary risk for the EPPO region from *S. litura* is its possible introduction into glasshouses, which could occur in most parts of Europe, where it may damage many ornamental and vegetable crops.

PHYTOSANITARY MEASURES

The introduction of *S. litura* in the EPPO region is to be avoided regardless of the host plant concerned. Although control with insecticides is possible, there have been many cases of resistance. Biological control alternatives are available and are increasingly being included and tested in integrated pest management plans e.g. see Thakur *et al.* (2022). Several additional control measures associated to unregulated hosts and pathways could be implemented against *S. litura*. This includes growing potential hostplants in isolation from areas with *S. litura* for at least three months prior to international transportation and temperature treatment of host plants. An existing cold-storage treatment of cut flowers (10 days at < 1.7°C) could be extended to other host plants (EFSA, 2019).

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CABI and EFSA resources used when preparing this datasheet

CABI Datasheet on *Spodoptera litura*. https://www.cabi.org/isc/datasheet/44520

EFSA Pest survey card on *Spodoptera litura*. https://efsa.onlinelibrary.wiley.com/doi/10.2903/j.efsa.2019.5765

ACKNOWLEDGEMENTS

This datasheet was extensively revised in 2023 by Jan E.J. Mertens and Tom H. van Noort of the NPPO of the Netherlands, their valuable contribution is gratefully acknowledged.

How to cite this datasheet?

EPPO (2026) *Spodoptera litura*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int

Datasheet history

This datasheet was first published in the EPPO Bulletin in 1979 and revised in the two editions of 'Quarantine Pests for Europe' in 1992 and 1997, as well as in 2023. It is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', ‘Hosts’, and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

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Co-funded by the European Union