Department
for Environment
Food & Rural Affairs

Army worms (*Spodoptera* spp.)

Plant Pest Factsheet

Figure 1. An adult *Spodoptera littoralis* © Crown Copyright

Background

Spodoptera species (armyworms) are a group of moths that contain some major global plant pests and a number of these are regulated as quarantine pests. Many species are destructive pests of tropical and subtropical agriculture and have the potential to be serious pests of glasshouse crops in temperate regions. The caterpillars of these moths feed on a wide range of plants. Caterpillars of the genus *Spodoptera* are known as "armyworms", because of the behaviour of the caterpillars of certain species that move in large numbers from one location to another when searching for food. Under the right conditions' certain species of *Spodoptera* can reach very high population levels. Certain populations can also be resistant to pesticides and, if they become well established, can be difficult to eradicate or control. Recently the genus *Spodoptera* has gained a lot of publicity due to the rapid spread and high levels of damage caused by the fall armyworm (*S. frugiperda*) across Africa and Asia.

Geographical Distribution

Spodoptera species have a global distribution and can be found on all continents except Antarctica. Some species such as *Spodoptera exigua* are cosmopolitan in their distribution due to movement by trade. Out of the current 30 species of *Spodoptera* described, the majority, 18, are found in the Americas. Three species are present in Europe, seven in Africa and two in Asia. A few species do overlap in distribution throughout Europe, Africa and Asia. In the UK, one species is a regular natural migrant (small mottled willow or beet armyworm, *S. exigua*) and another two species are suspected to occasionally migrate from mainland Europe (dark mottled willow, *S. cilium,* and Mediterranean brocade, *S. littoralis*).

Host Plants

The genus *Spodoptera* is extremely polyphagous, with individual species feeding on a wide range of plant species and families. The species *S. frugiperda* has been reported feeding on 353 different plant species from 76 families, these are mainly grasses and cereals such as maize, sorghum and rice, but it also feeds on members of the Asteraceae (daisies and sunflowers) and Fabaceae (peas and beans). Due to this ability to feed on a wide range of plants *Spodoptera* species are some of the most important Lepidopteran (moths and butterflies) pests in many countries around the world.

Description

The caterpillars of *Spodoptera* are very similar in appearance and are difficult to tell apart without laboratory examination. Individuals are extremely variable; it is not uncommon for individual caterpillars from the same egg mass to look completely different from one another (Fig 2). The eggs are laid in clusters, usually on the underside of a leaf, but also occasionally other surfaces and structures. The female covers the eggs with hairs and scales from her underside giving them a yellow to light brown furry “felt-like” appearance (Fig 3). Upon hatching, the newly emerged caterpillars are very similar in appearance to many other newly hatched caterpillars. They are 2–3 mm long with white/clear bodies and black heads and are very difficult to see (Fig 4). At this stage they are very mobile and after a quick initial feed they disperse. The overall colour of the later stages of the caterpillars can vary from green to a light or dark brown, and the body is usually strongly speckled with tiny white spots. Caterpillars soon develop characteristic markings on their backs. These often include: a square of four yellow spots, each on a black patch, located just behind the head. The four yellow spots are very characteristic for species that are most likely to be encountered such as the Asian cotton leafworm (*S. litura*) and *S. littoralis*. A further pair of black “trapezoidal” patches can be found just behind these, and another pair of patches towards the end of the caterpillar can also be characteristic. Some species may have a continuation of these “trapezoidal” patches down the whole body (Fig 5). The caterpillars can grow up to 4.5 cm long. Typically, there are three orange-brown lines, punctuated with dashes of black and yellow along the body. Another characteristic marking for Spodoptera caterpillars is the light inverted “Y” marking running down the front of the head in most commonly encountered species (Fig 6). Depending on the initial colour of the caterpillar, these markings may be more evident on some caterpillars than others. Some species such as *S. exigua* often lack any of the characteristic markings described above and appear unicolour with white speckles across the body (Fig 7). Adult moths are up to 2 cm long with a wingspan of approximately 4 cm. The forewings are fawn/ light brown and are covered with a variety of pale cream streaks and dashes (Fig 1). Newly emerged adults can often have a violet tint to the forewing. The hindwings are a translucent white, with brown edges. The adults are nocturnal, so are rarely seen but as with other moths they are attracted to light.

As distinctive and complex as *Spodoptera* caterpillars are, there are several native species that could be confused, A couple are shown below the figures on the next page (Figs 8-9).

Figure 2. *Spodoptera littoralis* from the same egg batch showing different colour variations © Crown Copyright

Figure 3. *Spodoptera littoralis* egg mass, © Crown Copyright

Figure 4. 1st instar Spodoptera litura © Crown Copyright

Figure 5. *Spodoptera littoralis* caterpillar with characteristic trapezoidal shapes along the body and yellow spots back from the head © Crown Copyright

Figure 6. Characteristic inverted "Y" on the head of a *Spodoptera litura* caterpillar © Crown Copyright

Figure 7. Caterpillar of *Spodoptera exigua*, note the lack of yellow spots behind the head (Right) and trapezoidal shapes along the body © Crown Copyright

Figure 8. The angle shades (*Phlogophora meticulosa*) is a native moth from the same family as *Spodoptera* (Noctuidae), with green colour and white speckles with older caterpillars also having black triangular markings: it could easily be confused for Spodoptera exigua. It can also be found under glass or in the field on ornamentals. © Crown Copyright

Figure 9. The caterpillars of large yellow underwing (Noctua pronuba) a very abundant moth in the UK that can easily be mistaken for Spodoptera caterpillars, they have both brown and green forms and markings are similar. However, the black markings along the body are not as pronounced and trapezoidal in shape as that of Spodoptera, appearing more as a series of dashes than distinct shapes. © Crown Copyright

Biology

The life cycle of *Spodoptera* species is dependent on a variety of environmental factors such as humidity, temperature and the availability of food.

Spodoptera have a usual moth life cycle of egg, caterpillar, pupa and then adult. The whole life cycle is completed in about 30 days. *Spodoptera* species can have multiple generations a year in warmer climates, and in northern Europe they are limited to about 1-2 generations. In warm climates with favourable conditions numbers of caterpillars can rapidly build up and it is in these situations that *Spodoptera* species can become a real problem. The eggs of *Spodoptera* take approximately 2-3 days to hatch at between 13 to 36°C depending on the species. *Spodoptera* caterpillars go through several growth stages before they become an adult, these growth stages are known as instars. Typically, they will go thorough 5-6 depending on diet and temperature, and in some they can go through 7. Pupation takes place in the soil.

Spodoptera species are found in all areas of the world ranging from temperate to tropical climates. *Spodoptera* in temperate climates have to be able to survive the winter. Like most moths that live in temperate climates certain *Spodoptera* species will go into diapause (a period of suspended development). This is usually as a pupa and the following year adult moths will emerge to start the cycle again.

Dispersal and Detection

The caterpillars of *Spodoptera* can be very damaging. The caterpillars chew holes in the leaves and can completely defoliate plants if present in large numbers. Stems, buds, flowers and fruits may also be damaged. Finding caterpillars in the day can be difficult due to their cryptic feeding habits (Fig 10) (often feeding internally in fruits) and their nocturnal behaviour. However, the feeding damage caused by the caterpillars can be seen along with the frass (excrement) that's also left behind. The frass resembles a small pellet and will have a wet texture if it is fresh. The observable damage to the crop will depend on the life stage of the caterpillars. Early instars will cause windowing of the leaves. Due to the small size of the caterpillars, they cannot chew through the whole leaf so feed on either the top or bottom layer leaving behind the other transparent layer of the leaf (Fig 11). As the caterpillars grow and their mouth parts become larger, they are able to feed on more of the leaf and can strip leaves down to just the midrib (Fig 12). In some instances, they can behave as "cut worms" and chew through the stems of young plants at ground level. As the caterpillars reach their final instar, they move from feeding on foliage/leaves to buds and fruits. Some caterpillars bore into fruit and start feeding internally, making them harder to spot. Adult *Spodoptera* are strong fliers and can fly hundreds of kilometres at night and one species regularly migrates from continental Europe to the UK. Caterpillars of some species such as the fall armyworm (*S. frugiperda*) are capable of dispersing en-masse to find food but have a restricted dispersal of just tens of metres. The most likely method for wider dispersal is the transportation of eggs or caterpillars on produce or plants for planting. There is also a small risk of pupae being moved in soil associated with plants for planting.

Figure 10. *Spodoptera frugiperda* feeding inside a Capsicum fruit © Crown Copyright

Figure 11. 1st instar *Spodoptera* spp feeding on the underside of a leaf causing windowing of the leaf © Crown Copyright

Figure 12. Late instar *Spodoptera litura* feeding on a leaf leaving behind just the midrib © Crown Copyright

Economic impact

Spodoptera spp. damage crops by the feeding of caterpillars on leaves, stems and fruits. The impact of the different species in their current area of distribution is variable depending on season and crop. This group of moths are highly polyphagous and damaging and as a result are one of the main pest groups that cause significant monetary losses to agriculture worldwide. *Spodoptera litura* can be a serious pest to both field and protected crops in both temperate and tropical Asia. In India *S. litura* is a well-known pest of field crops and can cause losses of up to 23% on tomato crops in monsoon season. Under the right conditions *S. litura* can also cause losses of up to 100% on sugar beet and potato crops. The fall armyworm (*S. frugiperda*) pose a more global threat to crops and as such has a higher economic impact. Originating in the Americas, *S. frugiperda* was first detected in Africa in December 2015. In the intervening six years it has spread right across Sub-Saharan Africa and into South East Asia and Australia. This rapid spread of *S. frugiperda* has also been followed by crop losses especially in maize and sorghum across its current distribution in Africa. It has been estimated that it has caused a reduction in annual maize production in Kenya of 33% resulting in a loss of one million tons of maize for Kenya alone. Scaling this up across other maize producing countries with similar climates to Kenya, total yield losses of between 4.1 and 17.7 million tons have been estimated.

In Europe *Spodoptera* are known to be pests of field, ornamental and protected crops. In Europe, the impacts caused by *Spodoptera* were minimal until the 1930's when *S. littoralis* was first recorded attacking crops, it has occurred sporadically ever since. In countries such as Spain, France and Italy *S. littoralis* is particularly important and has been reported attacking a wide range of commercial and ornamental crops such as: artichoke, cabbages, banana (Canary Islands), celery, lucerne, mint, pepper, potatoes, tomato, and watercress. It is also a pest of ornamentals both in the field and those grown under protection, and it is known to attack lawn grass and turf so much so that the pitch of Real Betis football team in

Seville had to be re-sown in the first week of September 2013. Of the *Spodoptera* species, *S. littoralis*, is one of the more commonly intercepted in the UK and Europe, for example on imported ornamental plants and fresh produce.

In the UK in the 1960's, large numbers of outbreaks of *S littoralis* occurred in glasshouses linked to the beginning of the trade in importing *Dendranthema* cuttings for flower production. Further outbreaks occurred in the 1970s, 1980s and 1990s and were related to the imports of a wide range of pot plants. There have been occasional outbreaks of *S. litura* in UK glasshouses in the 21st century. *Spodoptera littoralis*, *litura* and *frugiperda* are still intercepted on imports to the UK. *Spodoptera exigua* while often intercepted is not a species that we take action on. As an occasional migrant this species reaches the UK mainland naturally, while caterpillars have been recorded, numbers do not reach pest levels and the larvae do not survive the winter in the UK. *Spodoptera* species still pose a real threat to ornamentals and crops in the UK and still have the potential to be a serious pest of glasshouse crops in northern Europe.

Advisory Information

Suspected outbreaks of *Spodoptera* spp (other than *S. exigua*) or any other non-native plant pest should be reported to the relevant authority:

For **England and Wales**, contact your local **APHA Plant Health and Seeds Inspector** or the **PHSI Headquarters**, York.

Tel: 0300 1000 313 (please select option 3 when calling)

Email: planthealth.info@apha.gov.uk

For **Scotland**, contact the **Scottish Government's Horticulture and Marketing Unit:**

Agricultural crops contact the local RPID officer:
http://www.gov.scot/Topics/farmingrural/Agriculture/AOcontacts/contacts

For non-agricultural crops, email: hort.marketing@gov.scot

For **Northern Ireland**, contact the **DAERA Plant Health Inspection Branch:**

Tel: 0300 200 7847 Email: planthealth@daera-ni.gov.uk

Web: https://www.daera-ni.gov.uk/topics/plant-and-tree-health

For additional information on UK Plant Health please see:

https://planthealthportal.defra.gov.uk/pests-and-diseases/uk-plant-health-risk-register/

https://planthealthportal.defra.gov.uk/

https://www.gov.uk/plant-health-controls

http://www.gov.scot/Topics/farmingrural/Agriculture/plant/PlantHealth/PlantDiseases

https://www.daera-ni.gov.uk

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Date March 2023