



Department
for Environment
Food & Rural Affairs

Plant Pest Factsheet

Cucurbit moths

Diaphania species



Figure 1. Adult *Diaphania indica*. © Ian McMillan
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Background

Diaphania indica Saunders (cotton caterpillar), *D. hyalinata* Linnaeus (melonworm) and *D. nitidalis* Stoll (pickleworm) (Lepidoptera: Crambidae) are moths that are considered to be serious pests of plants within the Cucurbitaceae family across much of the Americas, as well as Africa and Asia in the case of *D. indica*. They are currently restricted to tropical and sub-tropical regions and seem unable to establish in cooler climates. The moths are therefore unlikely to establish outdoors in the UK. However, transient populations have the potential to cause damage throughout the summer, and the moths may be able to establish within protected environments. There is also a risk of introduction into the UK with imported plant material: *Diaphania indica* is intercepted regularly in England and Wales, primarily from Africa and Asia; *D. nitidalis* has been intercepted seven times from

the Dominican Republic; *D. hyalinata* has yet to be intercepted, but has a very similar biology to *D. indica* and so is also covered here.

Geographical Distribution

Diaphania indica, *D. hyalinata* and *D. nitidalis* are distributed in the tropical and sub-tropical regions of South America, Central America and the Caribbean, and in Florida, USA. Although *D. hyalinata* and *D. nitidalis* are unable to overwinter in states outside of Florida and, possibly also, Texas, transient populations are recorded spreading further north of Florida in spring and summer.

Unlike *D. hyalinata* and *D. nitidalis*, *D. indica* is not restricted to the Americas, and is also found across the tropical and sub-tropical regions of Africa, Asia and Oceania. The moth is also present in Madeira (Portugal), but is not recorded in the rest of Europe. While there has been a record of the moth in the UK, this was likely a vagrant, and it is fairly certain that the moth has not established in the UK.

Host Plants

Diaphania indica, *D. hyalinata* and *D. nitidalis* primarily feed on plants within the Cucurbitaceae family, including economically important crops such as cucumber (*Cucumis sativus*), melon (*Cucumis melo*), pumpkin (*Cucurbita moschata*) and watermelon (*Citrullus lanatus*). *Diaphania nitidalis* also feeds on the cucurbit weeds, such as wild balsam apple (*Momordica charantia*), which may act as reservoirs for the pest during times when cultivated crops are unavailable.

While *D. hyalinata* and *D. nitidalis* are confined to the Cucurbitaceae family, *D. indica* has also been recorded on plants within the Leguminosae and Malvaceae.

Description

Eggs are white or whitish in colour, and sometimes green for those of *D. hyalinata*. In *D. hyalinata* and *D. nitidalis*, they also turn yellow as they develop. They are small, usually laid in very small clumps of around 2–6 eggs, and are roughly 0.7-0.95 mm long and 0.3-0.6 mm wide in *D. indica* and *D. hyalinata*, and 0.4-0.8 mm in diameter in *D. nitidalis*.

Diaphania indica, *D. hyalinata* and *D. nitidalis* all have five **larval** instars, with mature larvae growing up to 25 mm. In *D. indica* and *D. hyalinata*, young larvae are transparent, and change to green or yellow-green as they develop, respectively. Upon maturity, two white dorsal stripes can be seen to run the length of their bodies (Fig. 2) and they may have 4 very small black spots in a square just behind the head. In *D. nitidalis*, instars 1-4 are covered with tubercles (or nodules) that contain a long bristle, and appear as dark spots (Fig. 3). The fifth instar of this species is white to yellowish-green, depending on what it has eaten, and turns pink prior to pupation.

Pupae are 12-20 mm long and around 3-4 mm wide, and are often found in a loose cocoon formed by spinning leaves together with silk. The pupae turn from white (*D. indica*)

or green (*D. nitidalis*) to brown as they develop. Pupae of *D. hyalinata* are also light to dark brown in colour.

Adults are about 13-16 mm long, with a wingspan of 24-33 mm. Their wings have a white (*D. indica* and *D. hyalinata*) (Fig. 4) or central yellow patch (*D. nitidalis*) (Fig. 5) that is banded by brown, and exhibit a purple iridescence. The adults are also marked by a tuft of orange/brown hair at the tip of the abdomen, though this may not always be displayed. Looking at the dorsal side or back of the moth, the head and body is predominantly brown in *D. nitidalis*, with the exception of a section of yellow close to the tuft of hair at the tail end. The head, first two thoracic segments and a section further down the body are also brown in *D. indica*, but the central portion and section near to the tuft of hair is generally white. The body colour of *D. hyalinata* is similar to *D. indica*.



Figure 2. *Diaphania hyalinata* mature larva.
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Figure 3. *Diaphania nitidalis* larva.
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Figure 4. *Diaphania hyalinata* adult.
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Figure 5. *Diaphania nitidalis* adult.
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Biology

Diaphania indica, *D. hyalinata* and *D. nitidalis* undergo multiple generations per year, possibly over 10 in some regions, as for *D. indica* populations in Hainan Province, China. Active populations of the moths can occur throughout the year, but tend to peak between April and September. Adults of *D. nitidalis* are nocturnal, with most individuals actively flying around midnight. Mating occurs three days after emergence and is induced by a female produced sex pheromone. This behaviour is likely to be similar in both *D. indica* and *D. hyalinata*.

Females of *D. indica* and *D. nitidalis* have been recorded laying hundreds of eggs, with as many as 1053 eggs reported for the former. In both species, there is a preference for egg laying on leaves (hairy leaves in *D. nitidalis*), though eggs of *D. nitidalis* are also deposited on stems, buds and flowers. *Diaphania hyalinata* has similarly been observed laying its eggs on leaves, stems and buds. Eggs of all three species are laid in clusters, as well as singly in *D. indica*, and hatch within around 2-5 days.

All three species feed on leaves, flowers, fruit, and stems. *Diaphania indica* larvae have been observed binding leaves together with silk and feeding from within. The larval period lasts roughly 8-10 days in *D. indica* and 14 days in *D. hyalinata* and *D. nitidalis*. Towards the end of this period, mature larvae spin a silky cocoon either on the leaves or among leaf debris on the ground. In South Korea, *D. indica* also overwinters as pupae 5-10 cm below the soil surface. The pupal period generally lasts 7-12 days if the pupa is not overwintering.

Damage and Detection

Leaf feeding by *D. hyalinata* and *D. indica* often results in skeletonization (or lace like patches of intact small leaf veins; see fig. 6), and in serious outbreaks, leads to much of the foliage on plants being destroyed. *Diaphania nitidalis* also tunnels into stems, resulting in impeded plant growth. However, more serious damage tends to occur on flowers and in fruit in all three species. Damage to the inner portions of flowers can prevent fruit developing. While entry of larvae into soft fruit and feeding on the rind of hard fruit often leaves the fruit unmarketable, particularly after suffering from secondary infection by pathogens. Characteristic signs of fruit feeding in *D. nitidalis* include entry holes (Fig. 7), greenish/brown/white frass (Fig. 8), and silk webs, which are formed over entry holes to block the path of natural enemies. *Diaphania hyalinata* has also been observed producing frass on leaves and fruit.

Economic Impact

Diaphania indica is considered a serious pest in Africa and Asia, and greatly reduces fruit yield on some hosts in some years. *Diaphania hyalinata* and *D. nitidalis* are also considered serious pests in South and North America, and although these two moths are only able to successfully overwinter in the extreme southern parts of USA, considerable damage is still seen further north later in the summer (e.g. Reid and Cuthbert, 1956).



Figure 6. Skeletonization of snake cucumber leaf by the larvae of *D. hyalinata*. © Suliman Ali, Huazhong Agricultural University



Figure 7. Entry hole in squash blossom, caused by the larvae of *D. nitidalis*. © John L. Capinera, University of Florida



Figure 8. Frass excreted by the larvae of *D. nitidalis* on pumpkin. © John L. Capinera, University of Florida

Control Measures

Because *D. nitidalis* spends much of its lifecycle within fruit, it is difficult to control using contact insecticides. Growers therefore tend to spray insecticides on a scheduled basis, regardless of whether the moth is present, to catch it before it enters the fruit. *Diaphania indica* and *D. hyalinata* also feed within fruit. However, they spend more of their lifecycle feeding on leaves outside of the plant, making insecticide application more feasible. Deltamethrin, for instance, which is available in the UK on cucurbits, has proved effective against *D. indica*. The biological pesticide, *Bacillus thuringiensis* var. *kurstaki*, has also given some success.

It should be noted that pesticide approvals are constantly changing and should be checked on The Chemicals Regulation Directorate (CRD) website. The conditions listed on pesticide labels should be read and followed. If a plant protection product is being used on

a crop for the first time, it is advisable to treat a limited number of plants initially to test for phytotoxic effects.

Many natural enemies, including predators and parasitoids, have been identified for all three species. However, only a few have shown any promise as effective biological control agents. One of these is the entomopathogenic nematode, *Steinernema carpocapsae*, which is available for use in the UK.

In the absence of effective chemical and biological controls, some control has been achieved in its current range in three ways: 1) By planting early, before the moths have arrived; 2) By placing row covers and mulches over plants, which can either be removed after flowering or can be kept on only during the night when the moths are active, but allowing for activity by daytime pollinators; and 3) By planting trap crops, such as summer squash, which are preferred and deter moths from feeding on more valuable crops. Once moths have established within the crop, destruction of infested plants is the best means of eradication. This can be followed by a crop rotation or crop break, and removal of debris and wild hosts, to prevent the potential build-up of the moths.

Advisory Information

Suspected findings of *D. indica*, *D. hyalinata* or *D. nitidalis*, 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**, Sand Hutton, York. Tel: 01904 405138

Email: planthealth.info@apha.gsi.gov.uk

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

Email: hort.marketing@gov.scot

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

Tel: 0300 200 7847 Email: planthealth@dardni.gov.uk

For additional information on UK Plant Health please see:

<https://secure.fera.defra.gov.uk/phiw/riskRegister/>

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

<https://www.dardni.gov.uk/>

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