



Box Tree Moth & Caterpillar

How did it get here?

Learn about the history and reasons behind how the pest has ended up in the UK.

[Learn how](#)

Where is it?

A map updated with data from gardeners and enthusiast around the country will let you know if there is moth or caterpillar in your area and how bad it is.

[See map](#)

What Can I Do?

Learn how to deal with and eliminate the hungry critters.

[Find out](#)



[Download Fact Sheet](#)

Quick Summary

- The moth lays pale yellow eggs on the underside of box leaves

- When the eggs hatch the greenish yellow caterpillars eats the leaves and produces a cobwebbing & a trail of pellets in it's wake
- Caterpillars can survive over winter down to -30c
- Becomes a pupae in a chrysalis before emerging as a white semi-transparent moth
- The season for *Cydalima perspectalis* is from late March to the end October
- In the UK 3-4 life cycles each per year depending on temperature, these last around 45 days
- Preferred temperature 21-33c
- Box moth can fly 10km/year
- Box trees can survive being attacked as long as the larvae don't eat the bark of the main stems
- In Northern Europe, the caterpillars have no natural predators that control their spread as they have toxins in them that taste bad to birds and other animals



How Did It Get Here?

The Pests Impact

Since 2007 box moth caterpillars have been devastating parterres and other topiary in domestic, commercial and historic gardens across Europe. However, the impact is not just in gardens. The caterpillar is decimating large areas of Europe's natural box woodlands. The Northern Caucasus as well as Bulgaria, NW Italy, Romania and southern France have all been badly affected. In the UK wild box is now under threat with small infestations reported at Box Hill, though currently no reports at other large areas of natural box such as the Chilterns.

Wild Box - Tarn Valley, France

Wild Box - Tarn Valley France

The severity of the infestations is demonstrated dramatically in Germany's Grenzarch-Whylen Nature Reserve which contains the country's largest box tree forest. Between 2009 and 2010, the caterpillars attacked all the box trees causing more than 90% defoliation and 27% lost all their leaves. Although the population of moths then decreased, having eaten most of its food source, by 2012 the trees that had been fully defoliated died as their bark had also been eaten and thus exposed the trees to fungal infection. Observations show the eco-system in the forest is beginning to change with new ground cover taking the place of the *B. sempervirens* which will likely now only remain in smaller clumps. [1]

Where did the pest come from?

The origin of the moth is recorded as North China, but it has spread a long way since 1859 when it was first identified and now covers large areas of the continent of Europe.

The consensus is that the wide scale spread is not caused by the flight of the moths, but by commercial movement of infected plants where leaves are carrying undetected eggs. An example of this was at the 2012 Sochi Winter Olympic Games. During the build-up, Italian box was imported for planting in the Olympic village where Russian experts then found *Cydalima perspectalis* in the site. Control measures using Aktelik, a non-systemic organophosphorus insectoacaricide product with enteric-contact action, failed, resulting in a rapid spread into the natural boxwood in the territory of yew-box grove in the Caucasian Biosphere Reserve. It has since spread further across Georgia and where all the *Buxus* plants have suffered from the caterpillar. Damage has also been observed on *Rubus* spp., *Ruscus colchicus*, *Ruscus fruticosus* and *Smilax excelsa*. [2]



Map data from 'Cydalima perspectalis (Walker, 1859) (Lepidoptera, crambidae) and the threats for the nature 2000 habitat 5110 in Liguria (NW Italy)'

Box Moth were first categorised as *Cydalima perspectalis* in 1859 by Francis Walker (1809-1874) when he was working for the British Museum collating their specimens. They were recorded in the *List of the specimens of lepidopterous insects in the collection of the British Museum*. Without the aid of modern technology to cross-reference specimens, Walker gave it more than one name, so box moth was also called *Phakellura perspectalis*, *Diaphania perspectalis* and *Glyphodes perspectalis*.

Francis Walker
(1809-1874)
Wikipedia

Life Cycle

This lasts around 45 days depending on temperature and light levels as each stage requires a number of degree days (a value based on hours of sunlight and temperature).



By Cosmin Mancu -
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Eggs - 0.8-1.0mm diameter are laid on the underside of leaves in a flat sheet and coloured greenish yellow at first with black dots appearing as the larval head capsule is formed.

Temperature threshold for egg development >10.9c



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Caterpillars/Larvae - When they hatch are greenish yellow in colour, developing black heads and light & dark strips with spots along their length as they grow. Fully grown they are about 4cm long, living for about 2 weeks.

Temperature threshold for this state is >8.4c



By Cosmin Manciu-
Shutterstock.com

Pupae/Chrysalis - The pupae are cocooned in white webbing spun around leaves and are between 1.5-2.0cm long.

Temperature threshold for this state is >11.5c



Moths - Have a wing span of about 4cm and either has a thick dark brown border around a white coloured wing with distinctive dots halfway down the leading edge of the wings (common variant) or less commonly the wings are almost entirely brown with white dots (Melanic variant). The moths start laying eggs 2-3 days after they start flying.



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In Central & South Europe, the life cycle of *C. Perspectalis* is repeated three and sometimes four depending on the combination of temperature and light as they need a specific number of 'degree days' for each stage of their cycle. When the day-length drops below about 13.5hrs the larvae will 'diapause' (the dormant stage of a developing insect) so that it can overwinter in a web spun on *Buxus* leaves. In this state, it can survive temperatures down to -30c. In spring it will come out of diapause and continue it's development, eating the new box leaves, before changing into the pupae stage.



What Can I Do?

Quick Guide

If your box bushes have been attacked by the caterpillars, just follow these instructions and your plants will almost certainly grow back again.

- Spray your plants with a biological insecticide (see list below) or if you don't like using sprays pick off the remaining caterpillars by hand (kill them off by dropping them in a jar of water with few drops of washing up liquid in it)
- Carefully comb through the plants with a small hand claw/rake to remove the cob-webbing and green balls of frass and clear away the debris under the plants - sometimes easiest to put a cloth under the plant to catch the debris
- Water the plants at their base, avoiding wetting the leaves as this can cause the conditions that allow blight to take hold
 - EBTS UK does not recommended using a pressure hose/jet wash to remove caterpillars/debris as it will cause damage to the plants and could cause the conditions for blight
- Keep your eyes peeled for any returning caterpillars and re-spray as necessary
- Setup a pheromone trap (see details below) to catch the male moths thus reducing the number of fertilised eggs that get laid by the females

Getting Rid Of The Moths

Pheromones

Pheromone traps have tended to be used in scientific research for recording numbers of specific insects. They work by using a lure impregnated with a synthetic pheromone of the female insect to entice the male into a trap so that numbers can be assessed. The RHS website, under 'Non chemical control' measures, only suggests traps be used for monitoring adult activity. However, experiments in France as part of the SaveBuxus project (2014-18) have looked at their use as a control measure, on the basis that trapping the males reduces the number of fertilised eggs and thus disrupts the breeding cycle. So far, their research has established that the funnel-type trap is the most effective design for catching male box moths. Other types such as sticky traps, where the moths become stuck to a surface, need replacing to regularly to be effective in high pressure infestations. They also tested different lure types which come in a variety of forms from impregnated rubber tips, plastic vials to a thick sticky liquid - all work in the same way by slowly defusing the synthetic pheromone. Different lures last for differing times with the earlier forms lasting from five to six weeks whilst the latest designs can last up to eight months before the pheromone is depleted and needs to be replaced.



Sticky gel in a syringe



Impregnated rubber bung



New long life vial

Example of a
pheromone trap
from Bayer the
BuxaTrap

In a test over a 5km² area of the Val-de-Marne rose garden, outside Paris, which has large amounts of box hedging round its rose beds, 50 BUXatrap® traps equipped with GinkoBuxus lures were arranged with a trap per 100 m². This showed there were only 23% of caterpillars present compared to the control area, similar results were found in the other test sites at Castle Park of Champs-sur-Marne, Vieux Moulin, Gradignan & Château Haut-Brion in Pessac. However, just using the pheromone traps didn't protect the rose garden and in Autumn 2016 the boxwood was totally defoliated.

A new version of the Ginko Buxus lure produced by Sumi Agro was released in 2017 which use the same pheromone used in earlier versions but has a slow release mechanism that make it effective for eight months. This means you don't have to remember to change the lures during the season making it much easier for users as they then only have to empty the traps. The lures are widely available in France but are not currently easy to purchase elsewhere (it is now available in the UK from greengardener.co.uk following work by EBTS UK to connect the makers with retailers).

Pheromone traps are a useful tool in reducing the box moth problem and should be used in conjunction with spraying or biological controls.

Setting up a pheromone trap

Emptying a pheromone trap

Buy Long Life Pheromone Lures from
GreenGardener.co.uk

Getting Rid Of The Caterpillars

Biological insecticide

Most reports consider *Bacillus thuringiensis* (Bt) to be the best option for killing box tree caterpillars as they stop eating within an hour of ingesting a treated leaf. The US Environment Protection Agency has not found any human health hazards and has no known effect on wildlife such as mammals, birds, and fish. In some countries, including Australia, Canada and the USA a number of products have organic certification. [5]

XenTari & Dipel are both based on the Bt bacterium which contains protein endotoxin crystals and living spores. There are fifty subspecies, the most commonly used for caterpillars are subsp. *Kurstaki* (in Dipel) & *aizawai* (in XenTari). When the targeted insect eats a treated leaf, the toxins dissolve in the high pH of the pest's stomach, causing holes in the lining which allow the spores into the gut. These then germinate causing the death of the insect within a couple of days.

Spray plants as soon as caterpillars are spotted. Bt doesn't stay active on leaves for more than ten days as it breaks down under UV light and needs to be ingested to work.

Note: Currently Bt based products are not registered for domestic use in the UK, they are available to professionals.

Chemical Insecticide

There are a large range of different types of chemical insecticides available from garden centres, though many are not safe to use around bees, fish and other garden beneficial insects - so always read the instructions carefully before use.

Pyrethrum based products...

- Py Spray Garden Insect Killer
- Bug Clear Gun for Fruit and Veg
- Defenders Bug Killer
- Growing Success Fruit & Veg Bug Killer
- Growing Success Shrub & Flower Bug Killer

Deltamethrin based products such as...

- Bayer PROVADO Ultimate Bug Killer
- Bayer Sprayday Greenfly Killer

Lambda-cyhalothrin products such as...

- Westland Resolva Bug Killer

Note: Make sure you treat the affected area thoroughly and be careful not to spray whilst plants are flowering so you don't affect bees and insects that are pollinating the plants. This is best done during still weather, preferably in the morning before insects become active.

Nematodes

These are small worms that are supplied as a powder that is mix with water and apply with a watering can or hose attachment and repeated 2 more times at 7 day intervals. The nematodes need to be sprayed directly onto the caterpillars as they work by contact. It kills by entering through natural openings in the bodies of the larvae and producing bacteria that disrupts their digestive system. Having made contact they then reproduce in the dead caterpillars and spreading to others until they have nothing left to eat, at which point they die. However they also die if the surroundings aren't moist or the temperature drops below 12c. As nematodes are a live product they can only be stored for a maximum of 4 weeks and must be kept in a refrigerator during this time. They can be very effective if applied at the right time.

Use a Professional?

Professional spraying can be done using pesticides such as DECIS (active ingredient: deltamethrin) which lasts for around 5-6 weeks and is in a stronger concentrations than is available to domestic gardeners (needs to be used with care around bees).

Search Google for suitably qualified professional in your area.

Prospects for the Future

Here are some of the current things in development that haven't yet made it to commercial products or are just becoming available on the market in the UK.

Essential Oils & Plant Extracts

In her dissertation, Stefanie Gabriele Göttig, details tests that were carried out using six plant extracts, seven essential oils and one seed oil.[3] The tests looked at the repellent effect of different concentration of the extracts and oils when applied to *Buxus* leaves and therefore the number of egg laid by the female moths. A second observation was made on the toxicity of treatment on the caterpillars when they eat the leaves that had been treated. The plant that was most effective was Elder *Sambucus nigra* followed by *Thymus vulgaris* which reduced egg laying significantly. However, when also looking at the toxicity of the treatment, the *S. nigra* had no effect on the caterpillars whereas only 7% survived with the *T. vulgaris* at 5% concentration which was mixed with distilled water & Tween 20 (1%) as an emulsifier.

Göttig concludes that essential oils & plant extracts can act as a repellent causing a significant reduction in egg laying by the female moths. This could be because the leaves of the treated plants have a slightly different optical property and texture due to the 'obvious fatty spray layer'. Whilst this didn't affect the plant it did deter the moths from laying eggs and where caterpillars eat the treated leaves, they died in around twenty-four hrs.



Frass Vials

Green frass balls
(excrement from the
caterpillars) evident where
feeding is taking place

In June 2017, researchers in Hungary published a paper in the *Journal of Pest Science* (Vol.90 Issue 3 pp873-885) called '*Synthetic blend of larval frass volatiles repel oviposition in the invasive box tree moth, *Cydalima**' that looked at the 'frass', excrement produced by the caterpillars when eating box leaves. [4] They noticed that whilst the caterpillars were feeding on leaves, the female moth didn't lay eggs in the vicinity. They wondered why this might be and looked at various possibilities, from visual cues to smells. Given the amount of excrement (frass) produced by the caterpillars, they decided to do a chemical analysis using coupled gas chromatographic-electroantennographic detection and found three chemicals that when they did electrophysiological testing on the antenna of the male & female moths caused responses. These three compounds, guaiacol, (\pm)-linalool and veratrole, were present for a couple of days after the caterpillar had produced the frass. The next step was to produce a synthetic version of this chemical mixture and put it in a bottle with a wick and place it near some potted box plants. The results were impressive, reducing the laying of eggs by around 75% compared to the control environment. They concluded that the chemical mixture may pave the way 'to the development of successful control methods for the preservation of boxwood populations in Europe.' Now we have to hope that their trials can be reproduced on a large scale and that a company invests in producing a commercial product as soon as possible.

Trichogramma

These parasitoids in the form of small wasps that lay their own eggs inside the egg sacks of the box moth eggs and when they hatch they eat the box moth eggs. These can be very effective, however, as they are a live product they have to be purchased and applied in a timely manner normally within 48hrs. The distribution method is often a biodegradable cardboard carrier that is hooked onto a branch inside a box plant. Low emergence rates and a sex ratio unfavourable to females means they don't reliably sustain their population - generally treatment lasts about two weeks before it should be repeated.

If the trichogramma are applied as soon as eggs have been laid and a minimum of two consecutive treatments are applied to the first set of eggs in the year it is possible to achieve 90% efficiency.

A lot of work has been carried out in France on producing products to release these natural predators, which are native to the Drôme region (though not in numbers high enough to control the spread of the box moth). Bioline AgroSciences won first prize for innovation for its product Tricholine®Buxus. However, whilst effective, from an ease of use point of view, they require exact timing of orders, delivery and application as the trichogramma as it is a alive product.

Conclusion

There is a lot of research going on into box moth and it's caterpillars, but it has spread far and wide so it isn't going to be a simple matter to bring it under control. However, if a few of the items being researched make it to becoming a commercial product it is possible to imagine a lure/vial combination that repels female moths from laying eggs whilst even more effectively attracting male moths into a trap and a simple organic spray that kills any caterpillars that do emerge.

Chris Poole

Citations

[1] John R, Schumacher J (2013) Der Buchsbaum-Zünsler (*Cydalima perspectalis*) im Grenzach-Wyhlener Buchswald - Invasionschronik und Monitoringergebnisse. *Gesunde Pflanzen* 65:1-6

[2] Citation Assessment of Forest Pests and Diseases in Native Boxwood Forests of Georgia Final report by Dr. Iryna Matsiakh Forestry Department, Ukrainian National Forestry University.

[3] Stefanie Gabriele Göttig, Dipl.-Biol., Technische Universität Darmstadt *Development of eco-friendly methods for monitoring and regulating the box tree pyralid, *Cydalima perspectalis* (Lepidoptera: Crambidae), on invasive pest in ornamentals.* 14.07.2017

[4] Molnár, B.P., Tóth, Z. & Kárpáti, Z. *J Pest Sci* (2017)

[5] USA *Bacillus thuringiensis*: A Cornerstone of Modern Agriculture, by Matthew Metz CRC Press, 24 Nov 2003



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