BOX TREE MOTH - BEST MANAGEMENT PRACTICES

Box tree moth, *Cydalima perspectalis,* is a foliar pest of boxwood (*Buxus* spp.) and is found in the Crambidae family. Box tree moth (BTM) was first confirmed in Toronto, ON, in the fall of 2018. Since then, significant monitoring has taken place to determine the scope of the infestation. The CFIA, OMAFRA, University of Toronto, University of Guelph, Landscape Ontario, Canadian Nursery Landscape Association, and the City of Toronto worked collaboratively to survey the pest and to develop programs to maintain export opportunities to the USA. However, in May 2021, USDA-APHIS updated their Federal Order for this pest: all species and cultivars (including any plant parts for production) within the *Buxus, Euonymus and Ilex* genera[1] are now prohibited from Canada. The moth is now a regulated pest in Canada[3]; host plants moving out of Ontario require a Domestic Movement Certificate (DMC) from CFIA starting April 3, 2023. The following information and best management practices (BMPs) are provided to reduce the risk of moving BTM through the nursery pathway.

Insect Epidemiology and Diagnosis

Life Cycle

- To access the *Box Tree Moth Biology and Detection Webinar*, visit: https://horttrades.com/box-tree-moth-webinar-and-online-discussion
- There are two generations of adult moths per year in Ontario, with outdoor adult emergence starting as early as mid-June and finishing by late September. Recommended adult monitoring period is therefore from May through to September inclusive. While there may be two distinct flight periods with the two generations, the timing of the second generation will vary, and significant overlap of larval and adult stages is anticipated. Therefore, it is best to assume one prolonged flight period covering both generations.
- Active larval stages can occur between mid-April and late September (temperature dependant) on infested boxwood plants in outdoor-grown crops.
- For host plants grown indoors (either in a greenhouse or in a poly-covered cold frame), active larval stages may occur between April and September (OMAFRA observed that >12h day length is required for pest activity).
- Dormant, overwintering larvae (~5mm long) can be found in a protected hibernarium or cocoon of webbing, up against a leaf, from early September to early May.

Infestation Evidence & Diagnostics

- On host plants, leaves will be the main sites of damage.
- Young larvae are small and can only consume the epidermis of the leaves.
- Older larvae can chew entire leaves, leaving only the leaf margin behind.
- When left unmanaged, established, and severe larval populations can consume up to 100% of the plant foliage; larvae may also chew on branches and stems, causing plant mortality.
- In addition to chewing damage, webbing of foliage with pellet-shaped frass and empty exoskeletons may be observed on host plants.
- The CFIA must be contacted if BTM is detected outside of the regulated area or within an area designed to exclude the pest under an approved certification program.

[1] APHIS federal order: https://www.aphis.usda.gov/import_export/plants/plant_imports/federal_order/downloads/2021/da-2021-11.pdf

[3] CFIA RMD-22-02: Pest risk management decision for the regulation of *Cydalima perspectalis* in Canada

Administrative Management of BTM at the Nursery

Traceability and Documentation

For traceability, records should be maintained for at least three years. Addresses and maps of all production facilities should indicate where activities associated with host plants take place (e.g., receiving, shipping, propagation, potting, etc.). A modified Google map can be used. Other records include receiving, movement, and shipping documents, and scouting & trapping, pest management, and control/eradication activities.

Incoming Plants

The history of received host plants should include the supplier source and information regarding the BTM program under which the plants have been grown (e.g., BMPs followed, under an approved BTM pest module within a systems approach program *or* produced in areas where BTM is not known to occur). This information should be included on or with the receiving documentation.

Training

- Early pest detection by nursery staff is critical to minimize potential spread of infested plant hosts prior to being moved around the production facility areas.
- Train appropriate staff regarding BTM pest biology, identification & detection, and pathways of spreading the pest (i.e., natural means, staff, equipment, pruning tools, plants, and plant debris). The *Box Tree Moth Biology and Detection Webinar*, mentioned in the Life Cycle section, is a useful resource. Check with your local association for additional training opportunities.
- Ensure staff know who to contact in the case of a suspected BTM find.
- Designated staff should be trained on setting up and maintaining pheromone lure and traps specific to BTM.

BTM Management at Nurseries OUTSIDE of the Regulated Area

Receiving Host Plants

- See 'Incoming Plants' above for sourcing recommendations.
- Incoming boxwood plants should be randomly sampled and visually scouted for signs of BTM or for symptoms of pest damage under adequate light levels and scouting conditions before moving the plants into the main production area.
- The inspection of incoming host plants should be recorded.
- Maintain purchasing records.

Returns

- No host plants should be returned to the nursery after leaving the farm property.

Production Practices

- A preventative spray program is recommended if there is a risk of BTM introduction at your facility (e.g., Québec or Atlantic provinces where natural spread is possible). Refer to provincial guidelines[3] for spray program information.
- If infested plants are suspected even in just one block, manage all production blocks as if they were infested until pest presence can be determined and delineated, or absence is confirmed.

Pest Monitoring

[3] Contact your provincial specialist for current spray guidelines for BTM. In Ontario, contact Cassie Russell, 1-519-835-5873, Cassie.Russell@ontario.ca.

- Practise regular and thorough inspections by trained staff of host plants (production and stock blocks) throughout production; keep records of each inspection, any damage observed, BTM detections, and resulting actions.
- Inspection frequency should be every other week during the anticipated flight period (for outdoor production May 1 to September 30, and April 1 and October 15 for greenhouse or polyhouse production), and every less frequently during remainder of the production period of the plants.
- Pheromone traps[4] are recommended to be placed around the perimeter of the host plant production area at a density of 4 traps per hectare or spaced at no less than one every 100m. Lures should be replaced according to manufacturer specifications and inspected weekly with documentation of results. Trap placement and removal should be coordinated with the weekly inspections; traps should be placed out by May 1 (outdoor) and remain until September 30. For indoor production traps should be set out April 1 through October 15. See more details about traps at the end of this bulletin.
- Maintain monitoring records, pheromone trap inspections, diagnostic reports, pest management records and any follow-up details for at least 3 years.

Biosecurity

- Establish entry, movement and sanitation protocols for visitors and workers in host plant production areas.
- Prepare a protocol for handling BTM infested material, including pest identification, confirmation, and treatment and/or disposal.
- Maintain areas relatively free of leaf litter and other host plant debris (e.g., production & shipping areas, delivery trucks) to reduce habitat that could harbour pests.

Movement and Shipping of Host Plants

- Inspections prior to shipping should be within 2 days of the expected ship date.
- Maintain records of the outbound visual inspection and relevant shipping documents.
- Clean all plant debris from trailers before loading host plants.

Procedures After a Suspected and/or Positive BTM Find Outside the Regulated Area

In the event of a suspected BTM find, assume the pest is BTM and follow these recommendations:

- The CFIA must be notified.
- Cease shipping of host plants until CFIA permits resumption.
- Take a sample for identification verification.
- Assess the severity of infestation (inspections, records, etc. to trace forward & back).
- Minimize traffic in/through the infested block.
- Determine the scope of actions required (eradication, etc., this is what your protocols developed in the previous section will help with). Trap monitoring, inspections and a spray program are recommended actions. Refer to OMAFRA guidelines for spray program information.
- Ensure complete cleanup and containment of plant debris, especially foliage.
- Manage or treat the infested material and debris as per CFIA instructions. Options may include chemical treatment, isolation, or destruction (by deep burial (at least 1m), incineration, or heat treatment) of host plants.
- Typically, domestic shipments may resume (pending CFIA authorization) after 18 days if:

[4] Göttig, S and A Herz. 2017. Observations on the seasonal flight activity of the box tree pyralid *Cydalima perspectalis* (Lepidoptera: Crambidae) in the Rhine-Main Region of Hessia. Journal Für Kulturpflanzen 69 (5): 157-165.

i. no adult box tree moths are caught in the traps for 14 days after first adult detection,
ii. larvicidal treatments are applied starting on day 15, and
iii. inspections 3 days after larval treatment reveal no live larvae (i.e., by day 18)

- OMAFRA is currently recommending a minimum of an 18-day window post-adult detection before domestic shipping can resume (see above, "Movement and Shipping of Host Plants").
- Keep a record of the actions taken.

BTM Management at Nurseries INSIDE the Regulated Area

Receiving Host Plants

- See 'Incoming Plants' above for sourcing recommendations.
- Wherever possible, avoid receiving host plants when adults are flying, and eggs may be present.
- Incoming host plants must be inspected for BTM before being moved into production areas.
- A separate holding area should be prepared to receive host plants originating from within the regulated area. The area should be separated from the production facility to protect from potential larval movement between hosts by a three (3) metre (canopy to canopy) host-free buffer. Host plants from different suppliers/sources should be separated from each other, until thorough inspections are completed and documented to verify the plants are BTM-free. Screening or other pest-exclusion practices (see the following section "Information on Pest Exclusion Barriers") are necessary for prevention of adult BTM movement during the flight period.
- Host plants should be randomly sampled and visually scouted for signs of BTM or for symptoms of pest damage under adequate light levels and scouting conditions.
- The inspection of incoming host plants should be recorded.
- Maintain purchasing records.

Returns

- No host plants should be returned to the nursery after leaving the farm property.

Production Practices

- A preventative spray program is strongly recommended. Refer to provincial guidelines[3] for spray program information.
- If infested plants are suspected even in just one block, manage all production blocks as if they were infested until pest presence can be determined and delineated.

Pest Monitoring

- Practise regular and thorough inspections by trained staff of host plants (production and stock blocks) throughout production; keep records of each inspection, any damage observed, BTM detections, and resulting actions.
- Inspection frequency should be at least weekly during the flight period (for outdoor production May 1 to September 30, and April 1 and October 15 for greenhouse or polyhouse production), and every two weeks during remainder of the production period of the plants.
- Pheromone traps[4] are strongly recommended to be placed around the perimeter of the host plant production area at a density of 4 traps per hectare or spaced at no less than one every

[3] Contact your provincial specialist for current spray guidelines for BTM. In Ontario, contact Cassie Russell, 1-519-835-5873, Cassie.Russell@ontario.ca.

[4] Göttig, S and A Herz. 2017. Observations on the seasonal flight activity of the box tree pyralid *Cydalima perspectalis* (Lepidoptera: Crambidae) in the Rhine-Main Region of Hessia. Journal Für Kulturpflanzen 69 (5): 157-165.

100m. Pheromone traps should also be placed within any pest exclusion areas. Lures should be replaced according to manufacturer specifications and inspected weekly with documentation of results. Trap placement and removal should be coordinated with the weekly inspections; traps should be placed out by May 1 (outdoor) and remain until September 30. For indoor production traps should be set out April 1 through October 15. See more details about traps at the end of this bulletin.

- Your facility should be able to provide evidence that host plants destined for shipment outside of the regulated area have been protected from infestation, and you should have scouting records to establish no evidence of BTM on the plants or adult presence in the traps.
- Maintain monitoring records, pheromone trap inspections, diagnostic reports, pest management records and any follow-up details for at least 3 years.

Biosecurity

- Establish entry, movement and sanitation protocols for visitors and workers in host plant production areas.
- Consider pest exclusion barriers (e.g., netting) to ensure saleable hosts are free from BTM.
- Implement a process for handling BTM infested material, including pest identification, confirmation, and management (which may include segregation, quarantine treatment, and/or disposal) protocols.
- Maintain areas relatively free of leaf litter and other host plant debris (e.g., production & shipping areas, delivery trucks) to reduce habitat that could harbour the pest.

Movement and Shipping of Host Plants

The intent of the regulations is to avoid shipping plants with BTM outside of the regulated area. Following the BMPs outlined in this document also ensures movement of host plants within the regulated area is not a pathway for BTM spread.

- Perform a thorough inspection of host plants before moving host plants to a new production area or the shipping area.
- For facilities that had no detections of BTM in the prior season, harvesting outdoor-grown boxwoods outside of the flight period and protecting them with a pest exclusion barrier can provide assurance that these host plants are BTM-free.
- If possible, avoid shipping where there is an active adult population (i.e., during the flight period) as indicated by pheromone trap catch on the property (because eggs may be present but not be easily detected during the flight period).
- Inspections prior to shipping should be within 2 days of the expected ship date.
- Maintain host plants free of potential infestation after the shipping inspection:
  - Facilities in regulated areas should protect host plants destined for out of province movement with pest exclusion barriers or take equivalent measures (e.g., plants moved directly to a closed shipping vehicle).
- Maintain records of the movement of host blocks where relevant, outbound visual inspections, and relevant shipping documents.
- Clean all plant debris from trailers before loading host plants.

Information on Pest Exclusion Barriers

In general, pest exclusion barriers include natural or artificial buffer zones, barriers, or structures that prevent pests from reaching host plants. For example, screened areas or structures, separation of crops

by space or physical barriers, or other mechanisms that effectively accomplish prevent pest introduction.

For BTM, the current practice to exclude pests in infested, regulated areas includes a pest exclusion structure, i.e., a cold frame or other structure that is covered with screening sufficient to exclude flying BTM adults. Regular inspections of the structures should occur to ensure the screening is intact as well as having measures in place to prevent entry of BTM when facility staff are accessing the protected plants.

Screen choice must be made carefully – too large of an opening and the pest could squeeze through the holes and enter the protected area. If the mesh is too tight, it will certainly exclude BTM, but may have other impacts such as less light and ventilation that could impact crop quality. Knit materials are easier to repair if there are tears/rips over time.

Various products (white, black, knit or woven, range of mesh sizes) are available from shade suppliers in North America – just be sure to test the materials before investing! Dead insect specimens were able to be forced through mesh openings greater than 6mm across, however it is likely a much greater opening size to prevent live specimens from passing through. Future updates of this BMP will include this information as it becomes available.

Once a suitable screen is chosen, pheromone traps should be placed inside the pest exclusion area and carefully monitored for evidence of adult BTM presence. Finding an adult in the area essentially means failure of the pest-free production system, and you need to cease shipping outside of the regulated area. It is possible that host plants placed in the pest exclusion area contained egg or larval stages of the moth, or it is possible that there is a failure of the screen (e.g., a hole, the screening is stretched very tight and the mesh size is now large enough to allow BTM adults to get in, etc.). Ensure you have addressed the root cause of the failure and re-establish pest free status within the structure before resuming shipping.

Procedures After a BTM Find Within a Regulated Area

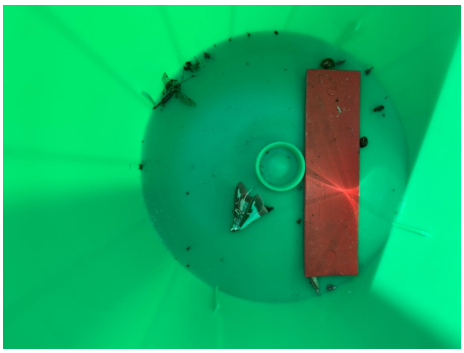
The following recommendations are specific to facilities shipping plants to customers located outside of the regulated area. Note, export shipments to the US are currently prohibited, and domestic movement outside of Ontario must follow regulatory requirements, including obtaining a Domestic Movement Certificate.

- If the detection was within a pest exclusion area that is being used to safeguard host plants for shipment outside of the regulated area, you must contact CFIA, make a record of the detection and follow your facility's protocols for managing BTM. At this stage, your facility should thoroughly inspect all plants certified under a BTM program to establish the scope of the issue.
- Cease shipping of host plants outside of the regulated area if BTM is found within the pest exclusion area or on plants staged for shipment outside of the regulated area.
- With the concurrence of CFIA, shipments outside of the regulated area may resume after 18 days if:
    iv. no adult box tree moths are caught in the traps for 14 days after first adult detection,
    v. larvicidal treatments are applied starting on day 15, and
    vi. inspections 3 days after larval treatment reveal no live larvae (i.e., by day 18)
- Keep a record of the actions taken.

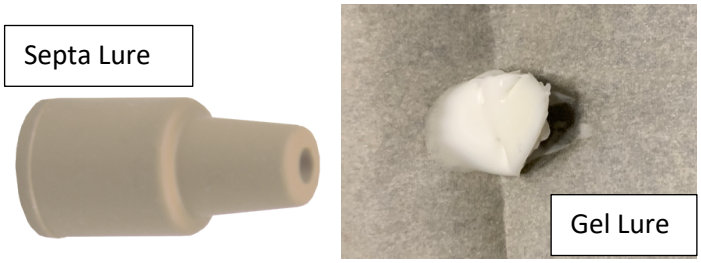
Information on Pheromone Traps for BTM

Traps with BTM pheromones are effective at attracting adult males. There are two traps available (milk carton with sticky trap liner, or the UniTrap with VaporTape) but the UniTrap is the preferred choice. It is important to use the correct pheromones and replace them at the appropriate time. Supplies can be ordered from Solida.ca as well as Royal Brinkman (1-877-821-1684). See below for details, modified from the ONnursery Blog 2021-05-06 (OMAFRA): https://onnurserycrops.com/2021/05/06/box-tree-moth-larvae-are-starting-to-feed-in-toronto/#more-5295.

On the left is the **milk carton style** trap used for Spongy Moths. The re-usable plastic **Unitrap** (right photo) is preferred; it is very effective for catching adult box tree moths (Solida.ca item #301Y602). Inside, use a Box Tree Moth Box T Pro Gel Lure (3 months, inject gel pheromone inside trap to attract BTM the beginning of May through mid-July, Item # 40M2001). Then after 3 months, drop in a Box Tree Moth Septa Lure (1 month, drop septa impregnated with pheromone, Item #40IPS04) every 30 days to attract BTM adults until the end of September ***or*** use a second 3-mo lure. Note: you can use the 3- and 1-mo lures interchangeably.



A sticky card inserted inside the milk carton traps will capture the moths but ensure that the cards are replaced before they are full of insects. VaporTapes can be used (VaporTape II, Item #301H800) to kill the moths in lieu of sticky cards where crop control products are eligible for use but must be replaced after 16 weeks. Do not use these traps with any other pest lures once they have been used for BTM.



The 3-month lure comes as a creamy-looking gel in a small syringe. The compound in the syringe cures and hardens when exposed to air. While the gel lures are soft, they shouldn't leak out of the basket or trap. Even exposure to a bit of rain through the 3 months won't be an issue for the lure - it stiffens and shrinks fully after about 1-2 days and will not be affected by water from a sprinkler.

1. Plan ahead – prepare the lure a day or two in advance.
2. Cut off the tip of the syringe.
3. Empty the contents of the syringe onto a piece of plastic or waxed paper and let it cure for at least 12h.
4. Once firm, place the lure into the milk carton trap or trap basket on the UniTrap (you can remove the septa lure if there's one there).

Optimal trap location: Install trap 1 meter from the ground within the boxwood production areas, or immediately surrounding the blocks. Use a shepherd's hook or mounting pole or hang the trap from a purlin of a hoop house.

For traps mounted where they get excessive irrigation water entering, you can:

a) paper clip the VaporTape to the side of the bucket so it's not submerged, or

b) cut or drill a couple small drain holes in the bottom of the trap to drain away any collected water

Disclaimer

These BMPs are recommendations for nursery growers to enable rapid identification and eradication of any potential BTM finds in wholesale nursery production facilities. Implementation of these measures cannot guarantee that nurseries will remain free of BTM. This document is based upon the most current information available. As the science of box tree moth management evolves and new control measures are introduced, these BMPs will change.

For further information about BTM in your area, contact your provincial government agricultural ministry office, your regional office of the Canadian Food Inspection Agency, or your local nursery growers' association.