

# EPPO Datasheet: *Choristoneura fumiferana*

Last updated: 2022-12-09

## IDENTITY

**Preferred name:** *Choristoneura fumiferana*

**Authority:** (Clemens)

**Taxonomic position:** Animalia: Arthropoda: Hexapoda: Insecta: Lepidoptera: Tortricidae

**Other scientific names:** *Archips fumiferana* (Clemens), *Cacoecia fumiferana* (Clemens), *Harmologa fumiferana* (Clemens), *Tortrix fumiferana* Clemens

**Common names:** spruce budworm

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**EPPO Categorization:** A1 list

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**EU Categorization:** A1 Quarantine pest (Annex II A)

**EPPO Code:** CHONFU



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## Notes on taxonomy and nomenclature

*Choristoneura fumiferana* (Clemens, 1865) is a member of a larger species complex (=spruce budworm complex) that includes eight or nine species delimited by combinations of morphological, ecological and geographic traits (Freeman, 1967; Volney & Fleming, 2007; Lumley & Sperling, 2011). Overlapping morphological trait variation and genetic similarities between species complicate species delimitation among members of this complex (Freeman, 1967; Lumley & Sperling, 2011; Dupuis *et al.*, 2017). However, recent examination of ecological and molecular evidence show that *C. fumiferana* is a distinct species (Brunet *et al.*, 2016; Dupuis, 2017; Nelson *et al.*, 2022), although there is limited gene flow between *C. fumiferana* and *C. occidentalis biennis* (Blackburn *et al.*, 2017).

## HOSTS

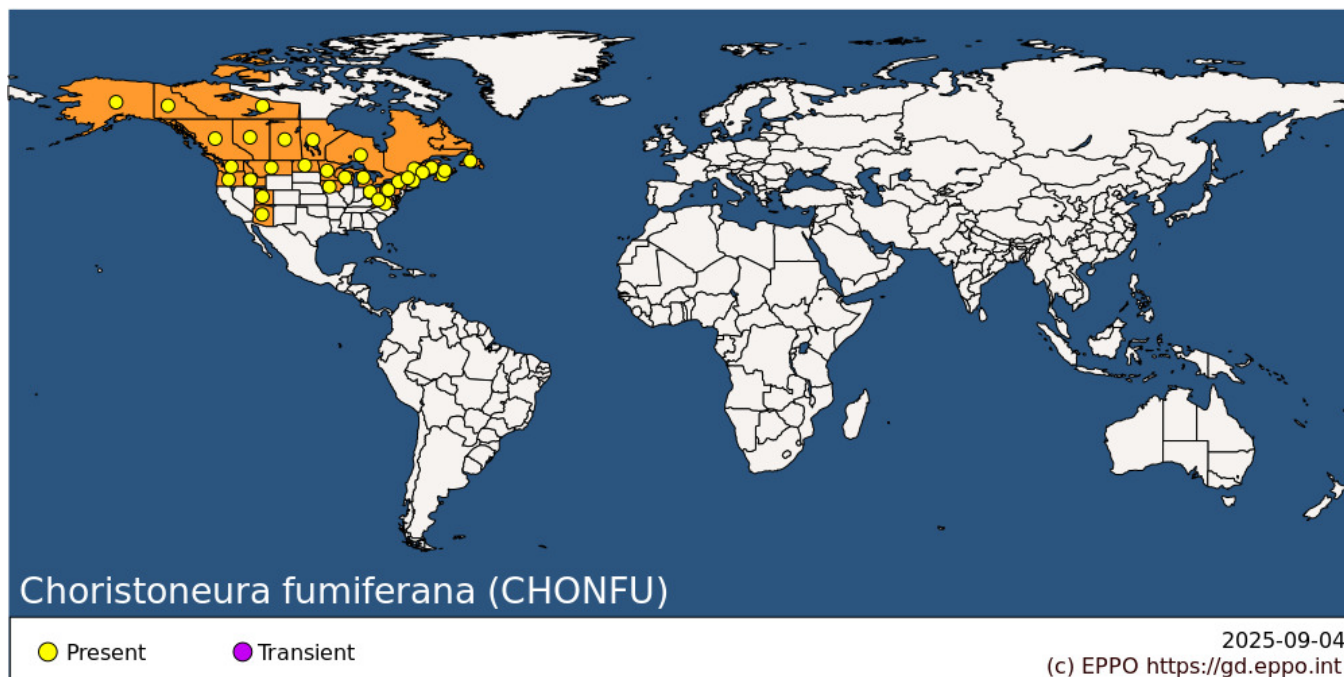
In North America *C. fumiferana* is a major defoliator of coniferous trees. This pest primarily occurs on *Picea* and *Abies*, but has also been recorded on *Pseudotsuga*, *Pinus* and occasionally on *Tsuga* and *Larix* (Brown *et al.*, 2008). Stand-level defoliation is well described on *Abies balsamea*, white spruce (*Picea glauca*) and *P. rubens* in Eastern North America and *A. lasiocarpa*, *Picea engelmannii*, *P. glauca* and *Pseudotsuga menziesii* in the West.

Several primary host plants of *C. fumiferana* are widely grown in European forests and plantations (e.g. *Pseudotsuga menziesii*, and for Northern Europe *Abies lasiocarpa*, *Picea engelmannii* and *P. glauca*). In addition, growth and development of spruce budworm on Norway spruce (*Picea abies*) in North American plantations was equivalent to that on white spruce (Berthiaume *et al.*, 2020), highlighting the risks posed to this Norway spruce.

**Host list:** *Abies balsamea*, *Abies grandis*, *Abies lasiocarpa*, *Abies*, *Juniperus*, *Larix laricina*, *Larix*, *Picea abies*, *Picea engelmannii*, *Picea glauca*, *Picea mariana*, *Picea rubens*, *Picea sitchensis*, *Picea*, *Pinus contorta*, *Pinus*, *Pseudotsuga menziesii*, *Tsuga heterophylla*, *Tsuga*

## GEOGRAPHICAL DISTRIBUTION

*C. fumiferana* is found throughout coniferous forests in Eastern North America and its distribution extends west through the boreal forest, and as far north as Alaska, Yukon, and the Northwest Territories. Host plant availability and seasonal temperatures determine northern and southern limits of the pest (Régnière *et al.* 2012, Gray 2008; Marshall & Sinclair 2015; Buttersson *et al.*, 2021). Climate change is expected to alter these range limits (Régnière *et al.*, 2012, Candau & Fleming, 2011; Pureswaran *et al.*, 2015), changing the defoliation risk in northern forests that have not historically experienced *C. fumiferana* outbreaks (Bognounou *et al.*, 2017).



**North America:** Canada (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Northwest Territories, Nova Scotia, Ontario, Prince Edward Island, Québec, Saskatchewan, Yukon Territory), United States of America (Alaska, Arizona, Idaho, Iowa, Maine, Michigan, Minnesota, Montana, New Hampshire, New York, North Dakota, Ohio, Oregon, Pennsylvania, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin)

## BIOLOGY

*C. fumiferana* is typically univoltine, with a single generation per year. Adults appear in July or August and mate soon after eclosion. Females lay egg masses on the undersides of needles on their host trees, with up to 20 eggs per mass (Nealis, 2016). Eggs hatch in 8-12 days, and the larvae forgo feeding to seek overwintering locations in bark crevices, under bark scales, lichen mats, or old staminate flower scars (Nealis and Régnière, 2016). Larvae spin silken structures (=hibernacula) in these sites, molt, and enter diapause (Marshall and Roe, 2020). Larvae remain in diapause until late winter and then enter a period of quiescence and resume development in the spring (Han and Bause, 1996; Marshall and Roe, 2020).

Spring temperatures cue larval emergence, and this occurs prior to budburst in its host plants (Nealis and Régnière, 2016; Régnière and Nealis, 2018). Larvae disperse to branch tips to initially mine old needles, unopened buds, or feed upon the early-opening staminate flowers in advance of host budburst. Once vegetative buds begin opening, larvae move to these new buds and begin feeding within a protective silken cover. Larvae typically have six instars and pupate in their feeding webs or within nearby branches. While one generation per year is typical for *Choristoneura* species, *C. fumiferana* can have a life cycle which takes two-years to complete or one year (if diapause does not occur) (Harvey 1957, 1961).

For more information on the biology of *C. fumiferana* refer also to Furniss and Carolin (2002).

## DETECTION AND IDENTIFICATION

### Symptoms

In low to moderate population densities, defoliation is restricted to new buds and foliage, especially in the upper crown. Partially consumed needles on the webbed branch tips turn bright reddish-brown by midsummer. At high population densities, host plants can experience severe defoliation, growth reductions and mortality, particularly over successive years (MacLean and Ostaff, 1989).

## Morphology

### *Eggs*

The light-green eggs are oval and laid in overlapping shingles along the underside of needles. Egg masses typically contain 20 eggs (Nealis and Régnière, 2004).

### *Larva*

Newly hatched larvae are 1-2 mm in length, pale yellow with a dark head capsule. As they feed and moult, larvae become dark-brown with a black head and light dots along their back.

### *Pupae*

Pupae are dark green and brown, and the sexes can be discriminated by their abdominal morphology (Jennings and Houseweart, 1978). Larvae will pupate in branches near their final feeding structures.

### *Adult*

Adults are predominantly grey with mottled dark-brown markings; their wingspan is approximately 20 mm. A rare brown female morph has also been described (Stehr, 1955).

## Detection and inspection methods

### *Visual detection*

Eggs are laid on the underside of needles and can be difficult to detect visually.

Second instar larvae form silken overwintering structures within crevices within branches and the trunk of host plants. While difficult to observe, this stage can be effectively extracted from foliage using a 2% sodium hydroxide wash and counted following separation from plant material with hexane flotation and filtration (Allen *et al.*, 1984).

Developing larvae of *C. fumiferana* are found on buds and foliage of coniferous host trees, however they will vacate feeding structures on silken threads when disturbed. Larvae can be identified using available keys and morphological descriptions (Harvey and Stehr, 1967; Lindquist, 1982).

### *Pheromone traps*

Pheromone chemistry is well described for male spruce budworm (Silk *et al.*, 1980) and is commercially available. Pheromone trapping is an important management tool to monitor populations within North America (e.g. Carleton *et al.*, 2020).

### *Molecular detection*

Molecular identification of specimens from all life stages can be performed using Sanger Sequencing of mitochondrial genes (Lumley and Sperling, 2011). Separation of *C. fumiferana* is predominantly successful, however some complexity arises where *C. fumiferana* populations are genetically very close to other members of the budworm complex (see notes on taxonomy and nomenclature). The EPPO-Q-bank database (<https://qbank.eppo.int/arthropods/>) notes issues in separating *C. fumiferana* from related North American species. The non-European *Choristoneura*, as a group, can be reliably detected with the standard DNA barcoding region of mitochondrial DNA. Extensive molecular resources are available for *C. fumiferana* and related North American species on Genbank and the DNA Barcoding of Life database ([www.boldsystems.org](http://www.boldsystems.org)).

## PATHWAYS FOR MOVEMENT

Extensive dispersal occurs during population outbreaks of *C. fumiferana*. Adults are strong fliers and can fly 20 km (Greenbank *et al.*, 1980), with mated females showing greater dispersal capacity than virgin females (Elliott and Evenden, 2009). When combined with strong winds, *C. fumiferana* can disperse over 450 km (Anderson & Sturtevant, 2011). Wind dispersal also occurs in first instar larvae in late summer and second instar larvae during spring emergence, aided by their habit of ballooning on silken threads (Nealis, 2016).

However, international movement is most likely to occur with diapausing second instar larvae that occur on plants or cut foliage of hosts.

## PEST SIGNIFICANCE

### Economic impact

*C. fumiferana* is one of the most widely distributed forest insects in North America and is a highly destructive pest of spruce-fir forests in the USA and Canada. This species undergoes regionally synchronized population outbreaks (Boulanger *et al.*, 2012) that cause widespread defoliation and tree loss. Outbreaks persist for 10 years or more and recur about every 30 to 40 years (Jardon *et al.*, 2003). At the peak of an outbreak, spruce budworm repeatedly defoliates *Abies* and *Picea*, leading to growth reduction and mortality, which negatively impacts the forest industry and forest-dependent communities. During the last major outbreak in the 1970s, spruce budworm damaged more than 50 million hectares of forest.

### Control

Spruce budworm populations have been typically managed using approaches aimed at protecting high-value stands (= foliage protection). Foliage protection can be achieved via aerial spraying of *Bacillus thuringiensis* var. *kurstaki* (*Btk*) and tebufenozide, which are ingested control products that target larval Lepidoptera (Fleming and Van Frankenhuyzen, 1992; Cadogan *et al.*, 1998). Recently, proactive ‘early intervention’ strategies are being tested as a means of stopping spruce budworm populations from reaching epidemic levels by focusing aerial spraying on expanding population hotspots (Johns *et al.*, 2019).

Mating disruption using sex pheromones has been explored extensively for this species (Rhainds *et al.*, 2012). The success of this tool may be limited to low-density populations at the start of an outbreak (Rhainds *et al.*, 2012), however the impact of disruption can be reduced by adult dispersal into the forest stands that are being treated using mating disruption (Régnière *et al.*, 2019).

Spruce budworm populations also have a large range of natural enemies (Fernández-Triana and Huber, 2010) which are considered to be an important source of mortality during development (Royama *et al.*, 2017). Inundative releases of *Trichogramma minutum* successfully reduce regional larval populations (Smith *et al.*, 1990). The relative role of natural enemies (parasitoids and diseases) and bottom-up effects of host plant and weather on population dynamics is not clear and all likely combine to generate the irruptive, cyclical population behaviour observed in *C. fumiferana* (Royama *et al.*, 2017).

Silvicultural methods such as thinning can increase stand resistance to spruce budworm outbreaks (Bauce and Fuentealba, 2013).

### Phytosanitary risk

*C. fumiferana* has been added to the EPPO A1 List, but is not regarded as a quarantine pest by any other regional plant protection organization. Of the North American *Choristoneura* species, spruce budworm presents the greatest risk to European forests as it attacks a large number of conifer species and high population densities can lead to tree mortality.

## PHYTOSANITARY MEASURES

Requiring that plants for planting or cut branches of hosts (including Christmas trees) originate from a pest free area is an appropriate phytosanitary measure (EPPO, 2018). Other risk management options may be relevant, as recommended for similar Lepidoptera, but whether they are appropriate and feasible for the specific host and commodity should be determined (EPPO, 2021). Such measures include growing the plants under complete physical isolation (EPPO, 2016, 2021, 2022). Measures should be combined with requirements to avoid infestation of the consignments during storage and transport (EPPO, 2022). It is noted that plants for planting of some host species from North America are currently prohibited in the EU (EU, 2022).

## REFERENCES

- Allen DC, Dorais L & Kettela EG (1984) Survey and detection. In *Spruce budworm handbook: managing the spruce budworm in eastern North America*. Agricultural Handbook 620, 21-36.
- Bauce É & Fuentealba A (2013) Interactions between stand thinning, site quality and host tree species on spruce budworm biological performance and host tree resistance over a 6 year period after thinning. *Forest Ecology and Management* **304**, 212-223. <https://doi.org/10.1016/j.foreco.2013.05.008>
- Berthiaume R, Hebert C, Dupont A, Charest M & Bauce É (2020) The spruce budworm, a potential threat for Norway spruce in eastern Canada? *The Forestry Chronicle* **96**(1), 71-76.
- Blackburn GS, Brunet BMT, Muirhead K, Cusson M, Beliveau C, Levesque RC, Lumley LM & Sperling FAH (2017) Distinct sources of gene flow produce contrasting population genetic dynamics at different range boundaries of a *Choristoneura* budworm. *Molecular Ecology* **26**, 6666-6684. <https://doi.org/10.1111/mec.14386>
- Bognounou F, De Grandpré L, Pureswaran DS & Kneeshaw D (2017) Temporal variation in plant neighborhood effects on the defoliation of primary and secondary hosts by an insect pest. *Ecosphere* **8**. <https://doi.org/10.1002/ecs2.1759>
- Brown JW, Robinson G & Powell JA (2008) Food plant database of the leafrollers of the world (Lepidoptera: Tortricidae) (Version 1.0). <http://www.tortricidae.com/foodplants.asp>
- Brunet BMT, Blackburn GS, Muirhead K, Lumley LM, Boyle B, Lévesque RC, Cusson M & Sperling FAH (2016) Two's company, three's a crowd: New insights on spruce budworm species boundaries using genotyping-by-sequencing in an integrative species assessment (Lepidoptera: Tortricidae). *Systematic Entomology* **42**, 317-328. <https://doi.org/10.1111/syen.12211>
- Butterson S, Roe AD & Marshall KE (2021) Plasticity of cold hardiness in the eastern spruce budworm, *Choristoneura fumiferana*. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology* **259**, 110998. <https://doi.org/10.1016/j.cbpa.2021.110998>
- Cadogan BL, Thompson D, Retnakaran A, Scharbach RD, Robinson A & Staznik B (1998) Deposition of aerially applied tebufenozide (RH5992) on balsam fir (*Abies balsamea*) and its control of spruce budworm (*Choristoneura fumiferana* [Clem.]). *Pest Management Science* **53**, 80-90.
- Carleton RD, Owens E, Blaqui re H, Bourassa S, Bowden JJ, Candau J-N, DeMerchant I, Edwards S, Heustis A, James PMA, Kanoti AM, MacQuarrie CJK, Martel V, Moise ERD, Pureswaran DS, Shanks E, Johns RC & Kerr J (2020) Tracking insect outbreaks: a case study of community-assisted moth monitoring using sex pheromone traps. *Facets* **5**, 91-104. <https://doi.org/10.1139/facets-2019-0029>
- Candau J-N & Fleming RA (2011) Forecasting the response of spruce budworm defoliation to climate change in Ontario. *Canadian Journal of Forest Research* **41**, 1948-1960. <https://doi.org/10.1139/x11-134>
- CIE (1971) *Distribution Maps of Pests, Series A* No. 283. CAB International, Wallingford, UK.
- Dupuis JR, Brunet BMT, Bird HM, Lumley LM, Fagua G, Boyle B, Levesque R, Cusson M, Powell JA & Sperling FAH (2017) Genome-wide SNPs resolve phylogenetic relationships in the North American spruce budworm (*Choristoneura fumiferana*)



) species complex. *Molecular Phylogenetics and Evolution* **111**, 158-168.

<https://doi.org/10.1016/j.ympev.2017.04.001>

EPPO (2016) EPPO Standards. PM 5/8 Guidelines on the phytosanitary measure 'Plants grown under complete physical isolation'. *EPPO Bulletin* **46**, 421-423.

EPPO (2018) EPPO Standards. PM 8/2 (3) Coniferae. Commodity-specific phytosanitary measures. *EPPO Bulletin* **48**(3), 463-494.

EPPO (2021) EPPO Technical Document No. 1082. Pest risk analysis for *Orgyia leucostigma*. EPPO, Paris. Available at <https://gd.eppo.int/taxon/HEMELE/documents>

EPPO (2022) EPPO Standards. PM 8/13(1) *Acer*. Commodity-specific phytosanitary measures. *EPPO Bulletin* **52** (1), 100-110.

EU (2022) Commission Implementing Regulation (EU) 2019/2072 of 28 November 2019 establishing uniform conditions for the implementation of Regulation (EU) 2016/2031 of the European Parliament and the Council, as regards protective measures against pests of plants, and repealing Commission Regulation (EC) No 690/2008 and amending Commission Implementing Regulation (EU) 2018/2019. Consolidated version 32019R2072, 14/07/2022. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R2072>

Fleming RA & Van Frankenhuyzen K (1992) Forecasting the efficacy of operational *Bacillus thuringiensis* Berliner applications against spruce budworm, *Choristoneura fumiferana* Clemens (Lepidoptera: Tortricidae), using dose ingestion data: initial models. *Canadian Entomologist* **124**, 1101-1113.

Freeman TN (1967) On coniferophagous species of *Choristoneura* (Lepidoptera: Tortricidae) in North America: I. Some new forms of *Choristoneura* allied to *C. fumiferana*. *The Canadian Entomologist* **99**, 449-455. <https://doi.org/10.4039/Ent99449-5>

Furniss RL & Carolin VM (2002) *Western forest insects*, pp. 168-173. Miscellaneous Publication No. 1339. Forest Service, USDA, Washington, USA.

Gray DR (2008) The relationship between climate and outbreak characteristics of the spruce budworm in eastern Canada. *Climatic Change* **87**, 361-383. <https://doi.org/10.1007/s10584-007-9317-5>

Han E-N & Baucé E (1996) Diapause development of spruce budworm larvae, *Choristoneura fumiferana* (Clem.) (Lepidoptera: Tortricidae), at temperatures favouring post-diapause development. *The Canadian Entomologist* **128**, 167-169.

Harvey GT (1957) The occurrence and nature of diapause-free development in the spruce budworm, *Choristoneura fumiferana* (Clem.) (Lepidoptera: Tortricidae). *Canadian Journal of Zoology* **35**, 549-572.

Harvey GT (1961) Second diapause in spruce budworm from eastern Canada. *The Canadian Entomologist* **93**, 594-602. <https://doi.org/10.4039/Ent93594-7>

Harvey GT & Stehr G (1967) On coniferophagous species of *Choristoneura* (Lepidoptera: Tortricidae) in North America III. Some characters of immature forms helpful in the identification of species. *The Canadian Entomologist* **99**, 464-481.

Jennings DT & Houseweart MW (1978) Sexing spruce budworm pupae. In *Research Note*, NE-255, pp. 1-2. U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station, Broomall, PA.

Johns RC, Bowden JJ, Carleton DR, Cooke BJ, Edwards S, Emilson EJS, James PMA, Kneeshaw D, MacLean DA, Martel V, Moise ERD, Mott GD, Norfolk CJ, Owens E, Pureswaran DS, Quiring DT, Régnière J, Richard B & Stastny M (2019) A conceptual framework for the spruce budworm early intervention strategy: can outbreaks be stopped? *Forests* **10**. <https://doi.org/10.3390/f10100910>

Lindquist OH (1982) Keys to lepidopterous larvae associated with the spruce budworm in northeastern North

America. Environment Canada, Canadian Forestry Service, Great Lakes Forestry Centre, Sault Ste. Marie, ON.

Lumley LM & Sperling FAH (2011) Utility of microsatellites and mitochondrial DNA for species delimitation in the spruce budworm (*Choristoneura fumiferana*) species complex (Lepidoptera: Tortricidae). *Molecular Phylogenetics and Evolution* **58**, 232-243. <https://doi.org/10.1016/j.ympev.2010.11.023>

MacLean DA & Ostaff DP (1989) Patterns of balsam fir mortality caused by an uncontrolled spruce budworm outbreak. *Canadian Journal of Forest Research* **19**, 1087-1095.

Marshall KE & Roe AD (2021) Surviving in a frozen forest: the physiology of eastern spruce budworm overwintering. *Physiology* **36**, 174-182. <https://doi.org/10.1152/physiol.00037.2020>

Marshall KE & Sinclair BJ (2015) The relative importance of number, duration and intensity of cold stress events in determining survival and energetics of an overwintering insect. *Functional Ecology* **29**, 357-366. <https://doi.org/10.1111/1365-2435.12328>

Nealis VG (2016) Comparative ecology of conifer-feeding spruce budworms (Lepidoptera: Tortricidae). *The Canadian Entomologist* **25**, 1-25. <https://doi.org/10.4039/tce.2015.15>

Nealis VG & Régnière J (2004) Fecundity and recruitment of eggs during outbreaks of the spruce budworm. *The Canadian Entomologist* **136**, 591-604. <https://doi.org/10.4039/n03-089>

Nealis VG & Régnière J (2016) Why western spruce budworms travel so far for the winter. *Ecological Entomology* **41**: 633-641. <https://doi.org/10.1111/een.12336>

Nelson TD, MacDonald ZG & Sperling FAH (2022) Moths passing in the night: phenological and genomic divergences within a forest pest complex. *Evolutionary Applications* **15**(1), 166-180. <https://doi.org/10.1111/eva.13338>

Pureswaran DS, De Grandpre L, Pare D, Taylor A, Barrette M, Morin H, Régnière J & Kneeshaw D (2015) Climate-induced changes in host tree–insect phenology may drive ecological state-shift in boreal forests. *Ecology* **96**, 1480-1491.

Régnière J, St-Amant R & Duval P (2012) Predicting insect distributions under climate change from physiological responses: spruce budworm as an example. *Biological Invasions* **14**: 1571-1586. <https://doi.org/10.1007/s10530-010-9918-1>

Régnière J, Delisle J, Dupont A & Trudel R (2019) The impact of moth migration on apparent fecundity overwhelms mating disruption as a method to manage spruce budworm populations. *Forests* **10**, 775. <https://doi.org/10.3390/f10090775>

Régnière J & Nealis VG (2018) Two sides of a coin: host-plant synchrony fitness trade-offs in the population dynamics of the western spruce budworm. *Insect Science* **25**, 117–126. <https://doi.org/10.1111/1744-7917.12407>

Royama T, Eveleigh ES, Morin JRB, Pollock SJ, McCarthy PC, McDougall GA & Lucarotti CJ (2017) Mechanisms underlying spruce budworm outbreak processes as elucidated by a 14-year study in New Brunswick, Canada. *Ecological Monographs* **87**, 600-631. <https://doi.org/10.1002/ecm.1270>

Silk PJ, Tan SH, Wiesner CJ, Ross RJ & Lonergan GC (1980) Sex pheromone chemistry of the eastern spruce budworm, *Choristoneura fumiferana*. *Environmental Entomology* **9**, 640–644. <https://doi.org/10.1093/ee/9.5.640>

Smith SM, Wallace DR, Howse G & Meating J (1990) Suppression of spruce budworm populations by *Trichogramma minutum* Riley, 1982-1986. *Memoirs of the Entomological Society of Canada* **153**, 56-81.

Stehr, G (1955) Brown female – a sex-linked and sex-limited character in the spruce budworm. *Journal of Heredity* **46**, 263-266.

Volney WJA & Fleming RA (2007) Spruce budworm (*Choristoneura* spp.) biotype reactions to forest and climate

characteristics. *Global Change Biology* **13**, 1630-1643. <https://doi.org/10.1111/j.1365-2486.2007.01402.x>

### **CABI and EFSA resources used when preparing this datasheet**

CABI Datasheet on *Choristoneura fumiferana*: <https://www.cabi.org/isc/datasheet/13074>

EFSA Pest survey card on non-European *Choristoneura*:  
<https://efsa.onlinelibrary.wiley.com/doi/10.2903/j.efsa.2019.5671>

### **ACKNOWLEDGEMENTS**

This datasheet was extensively revised in 2022 by Amanda Roe, Research Scientist with the Canadian Forest Service, Natural Resources Canada. Her valuable contribution is gratefully acknowledged.

### **How to cite this datasheet?**

EPPO (2025) *Choristoneura fumiferana*. EPPO datasheets on pests recommended for regulation. Available online. <https://gd.eppo.int>

### **Datasheet history**

This datasheet was first published in 1997 in the second edition of 'Quarantine Pests for Europe', and revised in 2022. 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.

CABI/EPPO (1997) *Quarantine Pests for Europe* (2<sup>nd</sup> edition). CABI, Wallingford (GB).



Co-funded by the  
European Union