European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

Data sheets on quarantine pests
Fiches informatives sur les organismes de quarantaine

Strobilomyia viaria

Identity

Name: *Strobilomyia viaria* (Huckett)
Synonyms: *Lasiomma melaniola* Fan; *Strobilomyia melaniola* Fan
Taxonomic position: *Insecta*: *Diptera*: *Anthomyidae*
Common names: Canadian larch cone fly
Notes on taxonomy and nomenclature: Fan *et al*. (1982) considered *S. melaniola* as a distinct species but Michelsen (1988) synonymized it with *S. viaria*. Although Fan *et al*. (1990) gave new arguments to validate the taxon, recent mtDNA analyses confirm Michelsen's assumptions (Roques *et al*., 2003)
EPPO code: STRMVI
Phytosanitary categorization: EPPO A2 action list no. 333

Hosts

S. viaria attacks cones of larch species: *Larix gmelinii*, *Laris olgensis*, *Larix* × *lubarskii* and *Larix cajanderi* in Asia (Roques *et al*., 1996; Zhang & Li, 1994; Roques *et al*., 2003), and *Larix laricina* (tamarack) in North America (McClure *et al*., 1996).

Geographical distribution

S. viaria is a Trans-Beringian species, i.e. occurring on both sides of the Bering Strait.

EPPO region: Russia (Transbaikalia, north-eastern Siberia, southern Siberia, northern Far East)
Asia: China – north-eastern (Liaoning, Jilin, Heilongjiang, Neimenggu; Fan *et al*., 1982, 1990; Fang *et al*., 1989; Liu *et al*., 1994; Roques *et al*., 1996, 2003; Sun *et al*., 1994, 1996c; Yao *et al*., 1991, 1992) and central (Shanxi, Hebei; Zhang & Li, 1994); Republic of Korea; Russia (Transbaikalia, north-eastern Siberia, southern Siberia, northern Far East; Popova & Elberg, 1970; Michelsen, 1988; Roques *et al*., 2003)
North America: Canada (throughout), USA (Alaska, north-eastern states) (Michelsen, 1988; Turgeon & de Groot, 1992; McClure *et al*., 1996)
EU: absent

Biology

There is a close synchrony between larch cone development and the oviposition of the four to six species of cone fly developing in larch cones in the Far East (Roques *et al*., 2003). Among these species, that follow one another in a given order, *S. viaria* has an intermediate position (Fig. 1). Adults emerge from late April to early June depending on location but they need at least 2 weeks to mature before mating and oviposition begins (Yao *et al*., 1991; Skuhravá & Roques, 2000). Females of *S. viara* lay eggs as soon as the cone scales become externally visible but are still covered by the bracts, e.g. from May 15 to May 30 in northern China. The oviposition period lasts about

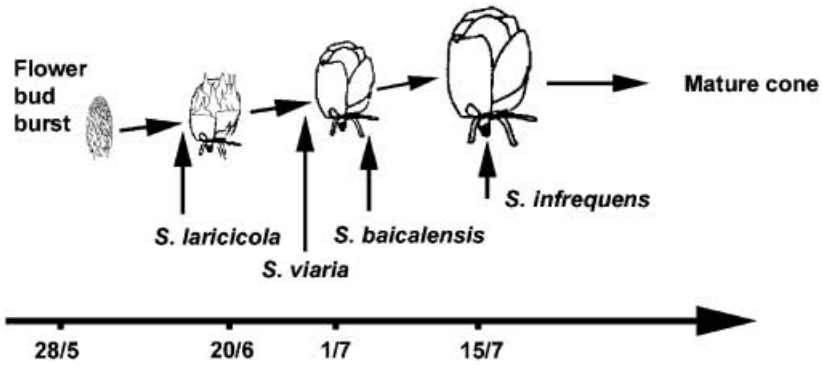

Fig. 1 Phenological relationships between cone development of *Larix cajanderi* and attack by *Strobilomyia viaria* and other larch cone flies in Kamchatka (modified from Roques *et al*., 2003).

2 weeks. The eggs are inserted between the scales and bracts, and they are externally, conspicuously visible in Asia (Skuhravá & Roques, 2000; Roques *et al*., 2003). By contrast, the eggs are found on the inner side of cone scales in Canada (McClure *et al*., 1996). The larvae pass through 3 instars but only two are free-living, the 1st-instar larva remaining within the eggshell. The 2nd-instar larva enters the cone tissues at the place where the egg was laid. It tunnels down the corresponding scale, reaches the scale base and destroys the basal seeds. Then, the larva spirals round the cone axis, feeding on seeds during its course. The second instar lasts about 10–15 days. The 3rd-instar larva generally develops in a similar way, and makes larger galleries tunnelling round the axis but never entering the axis (Skuhravá & Roques, 2000). The full-grown larvae finally bore a hole and drop to the ground, generally during days of rainfall. Larvae vacate the cones from early to late June, depending on latitude and weather conditions. In Canada, they exit the cone from mid-June to early July (McClure *et al*., 1996). When on the ground, larvae build a puparium in the upper soil layer where they overwinter. Some adults may emerge the following year but a variable part of the population extends the winter diapause for an additional 1–3 year period (Skuhravá & Roques, 2000).

Detection and identification

Symptoms

No damage is visible externally. When cones are sliced, larval damage is indicated by galleries spiralling around the cone axis, which usually begin in the middle part of the cone, but it is often difficult to distinguish damage from that of other cone fly species especially in case of multiple occupancy of cones (Skhuravá & Roques, 2000).

Morphology

Eggs

The egg of *S. viaria* is oval-elongate, 1.18 mm long and 0.31 mm wide (McClure *et al*., 1996). Ivory white in colour, the egg chorion shows a characteristic raised network of columnar pentagonal cells (Sun *et al*., 1996a).

Larva

The larva resembles that of other larch cone flies with an elongated, legless body (Fig. 2) but some specific features have been described. The sclerified cephalopharyngial skeleton present at the apical extremity shows strong mandibles with small accessory teeth at the base. The hypopharyngeal sclerite is elongate with a distinct dorsal process, and the ocular depression is not sclerotized. The dorsal tentopharyngeal cornua are distinctly prolonged forwards, and the ventral cornua are curved on the anterior margin (Skhuravá & Roques, 2000). Anterior spiracles each have 11 stigmae. Posterior spiracles each have 3 radially arranged stigmae, and the distance between the spiracles is quite equal to the width of the spiracular process. Papillae of the last abdominal segment are large, conical, the 2 ventro-apical being distinctly bifurcate. The distance between the 2 supra-anal papillae is much smaller than the width of the anal plate (Fan *et al*., 1990; Fan & He, 1995). Fully developed larvae are 4–6 mm long (Skhuravá & Roques, 2000).

Pupa

Puparium reddish-brown, nearly ovoid, 3.0–6.0 mm by 1.3–1.5 mm (Fig. 3).

Adult

Adults are typical, small anthomyiid flies of blackish colour with light grey pruinose on thorax and abdomen in Eastern Asia. In North America, adults are darker, with brownish grey pruinose on thorax and abdomen and brownish grey infuscated on wing bases and calyptrae. The base of wings is yellowish-brown in Asia. Wing length is 3.8–4.6 mm in Eastern Asia, 3.3–4.0 mm in North America (Michelsen, 1988). Sexual dimorphism is noticeable, males being easily identified by the adjacent eyes whereas female eyes are separated by a broad stripe. The species is difficult to separate from other cone flies by external examination of adults, and genitalia dissection must be systematically used for accurate identification, especially

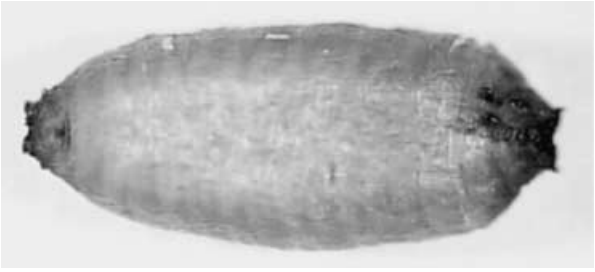

Fig. 3 Puparium of *Srobilomyia viaria* (Roques).

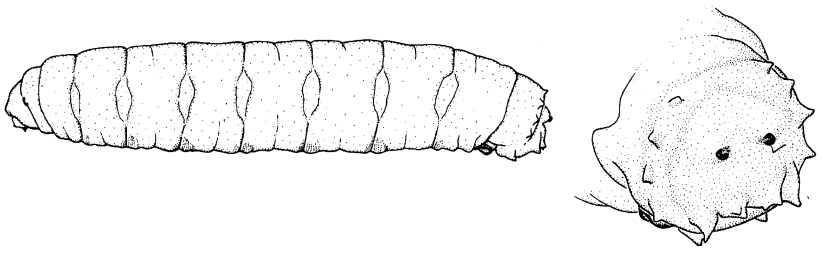

Fig. 2 Typical 3rd-instar larva of larch cone fly (*Strobilomyia* spp.) with enlarged view of hind end on right (from Hedlin *et al*., 1980; modified) and cephalopharyngian skeleton of *S. viaria* (*S. melaniola*) on left (from Fan & He, 1995; modified).

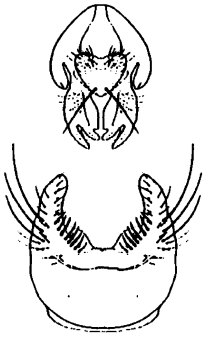

Fig. 4 Male genitalia of *S. viaria* (lower part: sternite V; upper part: epandrium, surstylus and cercal plate) (from Michelsen, 1988; modified).

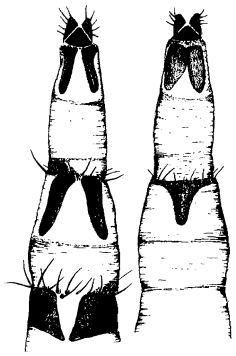

Fig. 5 Ovipositor (left: tergites VII–IX; right: sternites VII–IX) of *Strobilomyia viaria* (*S. melaniola*; from Roques *et al*., 1996; modified).

of trapped flies. (Figs 4 and 5; see also for comparison with other cone flies Fan *et al*., 1982, 1990; Michelsen, 1988; Roques *et al*., 1996, 2003; Sun *et al*., 1996b).

Pathways for movement

Pupae can be disseminated with soil of potted larch seedlings. Adults can fly over rather long distances to colonize new stands. Eggs and larvae are unlikely to be disseminated because they occur on immature cones.

Pest significance

Economic impact

S. viaria is a major seed pest of larch cones in northern China where it often dominates the cone fly complex, accounting for 40–70% of the total damage (Yao *et al*., 1991, 1992; Roques *et al*., 1995; Sun *et al*., 1996c). The impact severely reduces the seed crops expected in seed orchards of Heilongjiang. In other areas of the Far East, cone damage was for a long time confused with that of other cone flies (e.g. Efremova, 1971) but recent surveys showed that *S. viaria* is the dominant species of larch cone fly in Kamchatka where it attacks 25–40% of the cones (Battisti *et al*., 1998; Roques *et al*., 2003). Cone damage was lower in Canada (16.1%; McClure *et al*., 1996). In China and Kamchatka, a larva destroys up to 20 seeds per cone, i.e. 60–100% of the seed yield depending on the cone size. As soon as 2–3 larvae, possibly belonging to different species, are observed in a cone, the whole seed content is destroyed (Roques *et al*., 2003). In Canada, the mean number of scales eaten per cone was 8.4–10.7 (McClure *et al*., 1996). Seed damage due to larch cone flies largely limit the potential of natural regeneration of larch forests in the Far East.

Control

Several predictive models have been developed in north-eastern China to forecast overall damage by cone flies (Liu & He, 1994) but they did not forecast the specific part played by *S. viaria*. Visual traps were used for specific monitoring of *S. viaria* in north-eastern China (Roques *et al*., 1995; Yan *et al*., 1997), and Kamtchatka (Battisti *et al*., 1998). Traps coloured in yellow with or without purple stripes were used to capture males whereas blue traps hung at the periphery of tree crown were used to capture sexually immature females (Roques *et al*., 1995; Yan *et al*., 1997). Larch cone volatiles, especially terpenoids, were proposed to be used as attractants or repellents (Sun *et al*., 2000) but field spraying of cones with the suggested blends did not yet conclusive (Yan *et al*., 1999). Foliar and soil applications of systemic insecticides have been effective in reducing damage in Canada (Turgeon & de Groot, 1992). No specific information is yet available about natural enemies.

Phytosanitary risk

S. viaria is considered as a serious larch pest all over north-eastern Asia. Because most *Strobilomyia* cone flies are known to be capable of shifting on new hosts congeneric to the original one, it is very likely that *S. viaria* can establish in all the EPPO countries where *Larix* spp. grow naturally or are planted. There is no native larch cone fly of the same importance.

Phytosanitary measures

S. viaria was added in 2005 to the EPPO A2 action list, and endangered EPPO member countries are thus recommended to regulate it as a quarantine pest. To prevent introduction of *S. viaria* to other countries, the effective measure would be to require seedlings of *Larix* spp. imported with soil from countries where the pest occurs to be found free from puparia. In practice, this can be ensured by growing the seedlings according to EPPO Standard PM 3/54 Growing plants in growing medium prior to export (OEPP/EPPO, 1994).

Acknowledgements

This data sheet was originally drafted by A. Roques, INRA, Nancy (FR).

References

Battisti A, Gourov A, Khomentovsky P & Roques A (1998) *Phytophagous Insects in Ecotones and their Impact upon Forest Ecosystems Stability and Regeneration*. Final report of the INTAS European Union project no. INTAS-94–0930. Padova University, Padova (IT).

Efremova LS (1971) [Biological features and entomophages of the larch fly in Kamtchatka.] In: [*Biology Resources of Dry-Land Areas of the Far East*], Vol. 2, pp. 247–252. Vladivostok (RU) (in Russian).

Fan ZD, Chen ZZ & Fang SY (1990) [Further description of *Strobilomyia melaniola* Fan.] *Journal of Northeast Forestry University* **18**, 29–37 (in Chinese).

Fan ZD, Ge FW, Zhang RS & Fang SY (1982) [On Chinese species of *Lasiomma* especially those injurious to the coniferous cones.] *Journal of Northeast Forestry University* **1**, 1–12 (in Chinese).

Fan ZD & He XY (1995) [Notes on the identification of puparia of three species of the genus *Strobilomyia*.] *Contributions Shanghai Institute of Entomology* **10**, 149–153 (in Chinese).

Fang SY, Roques A & Sun JH (1989) Results of a survey of cone and seed insects in some conifer forests of Northeast China. In: *Proceedings of 3rd International Conference of IUFRO WP S2 07–01* (Ed. Miller G), pp. 64–81. Forestry Canada, Victoria (CA).

Hedlin AF, Yates HO, Cibrian-Tovar D, Ebel BH, Koerber TW & Merkel EP (1980) *Cone and Seed Insects of North American Conifers*. Environment Canada/Canadian Forestry Service, Ottawa (CA).

Liu HF & He XY (1994) [The fuzzy-cluster analysis of occurence and prediction model for larch cone fly.] *Journal of Northeast Forest University* **22**, 92–100 (in Chinese).

Liu ZL, Wang HQ & Ding XQ (1994) [A preliminary study on bionomics and control of *Strobilomyia melaniola*.] *Journal of Shenyang Agricultulral College* **1**, 37–45 (in Chinese).

McClure M, Quiring DT & Turgeon JJ (1996) Oviposition, temporal distribution and potential impact of *Strobilomyia laricis* and *S. viaria* on *Larix laricina*. *Canadian Entomologist* **128**, 67–78.

Michelsen V (1988) A world revision of *Strobilomyia* Generaln. the anthomyiid seed pests of conifers. *Systematic Entomology* **13**, 271–314.

OEPP/EPPO (1994) EPPO Standards PM 3/54 Growing plants in growing medium prior to export. *Bulletin OEPP/EPPO Bulletin* **24**, 326–327.

Popova AA & Elberg KJ (1970) Specific composition of the genus *Lasiomma* – pests of larch seeds and cones from the Baikal territory. *Entomology Reviews* **49**, 340–365.

Roques A, Sun JH, Sachet JM & Pan YZ (2003) Review of cone fly species, *Strobilomyia* spp., affecting conifer natural regeneration in the Far East. *Acta Entomologia Sinica* **46**, 363–381.

Roques A, Sun JH, Zhang XD, Pan YZ, Xu YB & Delplanque A (1996) Cone flies, *Strobilomyia* spp., attacking larch cones in China, with description of a new species. *Mitteilungen Schweizerische Entomologische Gesellschaft* **69**, 417–429.

Roques A, Sun JH, Zhang XD, Turgeon JJ & Xu SB (1995) Visual trapping of larch cone maggots, *Strobilomyia* spp., damaging Siberian larch cone in the Da Khinggan mountains of Northeastern China. *Journal of Applied Entomology* **119**, 659–665.

Skuhravá M & Roques A (2000) Palaearctic dipteran forest pests. In: *Contributions to a Manual of Palaearctic Diptera*, Vol. 1. *General and Applied Dipterology*. (Eds Papp L & Darvas B), pp. 651–692. Science Herald, Budapest (HU).

Sun JH, Roques A, Zhang XD & Xu SB (1994) [Larch and spruce cone and seed insect damage in Northeast China.] *Journal of Northeast Forest University* **22**, 1–5 (in Chinese).

Sun JH, Roques A, Zhang XD & Xu SB (1996a) Egg morphology and oviposition patterns of the *Strobilomyia* spp. flies damaging larch cones in Northeastern China. *Entomologia Sinica* **3**, 145–152.

Sun JH, Roques A, Zhang XD & Delplanque A (1996b) [Genitalia of female cone flies of genus *Strobilomyia* spp. damaging larch cones in northeastern China.] *Entomological Knowledge* **33**, 182–184 (in Chinese).

Sun JH, Roques A & Fang SY (1996c) [Some biological and ecological characteristics of *Strobilomyia melaniola*.] *Scientia Silvae Sinica* **32**, 238–242 (in Chinese).

Sun JH, Roques A & Yan SC (2000) Behavioural manipulation methods and forest pest management. *World Forestry Research* **13**, 24–30.

Turgeon JJ & de Groot P (1992) *Management of Insect Pests of Cones in Seed Orchards in Eastern Canada*. Forestry Canada, Toronto (CA).

Yan SC, Sun JH, Hu YY, Chi DF & Sun F (1999) Response tests of cone flies (*Strobilomyia* spp.) to Dahurian larch cone volatiles. *Entomologia Sinica* **6**, 329–335.

Yan SC, Zhang XD, Hu YY, Sun JH, Feng CX & Li W (1997a) [Visual trapping experiment of the flies, *Strobilomyia* spp., damaging larch cones.] *Journal of Northeast Forest University* **25**, 29–33 (in Chinese).

Yao WS, Fang SY & Roques A (1991) Specific composition, bio-ecological characteristics and population dynamics of the larch cone fly (*Strobilomyia* spp.) complex in the Da Khingan and Xiao Khingan mountains in China. *Journal of Applied Entomology* **112**, 454–463.

Yao WS, Fang SY, Liu KY, Yan SC, Liu CY & Yang YF (1992) [Population dynamics and forecast of *Strobilomyia melaniola* in the Da Xingangling Mts.] *Journal of Northeast Forestry University* **20**, 83–87 (in Chinese).

Zhang SM & Li GW (1994) [The occurrence and damage of larch cones flies (genus *Strobilomyia*) in Pangquangou natural reserve, Shanxi Province.] *Forest Research* **7**, 12–15 (in Chinese).