EVALUATION OF THREE TYPES OF BARRIERS TO TRAP WINTER MOTH (LEPIDOTPERA:GEOMETRIDAE) ADULTS

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ABSTRACT

Three types of barrier traps, Tanglefoot®, fiberglass and fiberglass sprayed with the insecticide Raid®, were tested at three locations, on eight trees each per treatment and location for a total of 72 trees, to determine their efficiency in preventing the flightless winter moth females from crawling higher up the tree to oviposit. The efficiency of the barrier was evaluated by counting the number of female winter moth adults caught 10-15 cm above the test barrier. Tanglefoot® was the most effective barrier. An average of 67.1 winter moth females managed to crawl over the fiberglass barrier compared to 3.6 females over the fiberglass barrier sprayed with Raid® and 1.1 females over the Tanglefoot® barrier. The differences among the average catches were significant ($P<0.01$) for the fiberglass barrier but not between the fiberglass barrier with Raid® and the Tanglefoot® barrier. We recommend that Tanglefoot® applied over a polyethylene strip, after the bark crevices have been plugged, be used to prevent winter moth females from crawling under the barrier. The Tanglefoot® barrier has the added advantages that it is cheap, non-toxic and, since it reduces or eliminates the need for insecticide application, it is fully compatible with biological control measures.

RESUMÉ

Trois barrières (Tanglefoot®, de fibre de verre et de fibre de verre vaporisé d'insecticide Raid®) ont été mises à l'essai à trois endroits, chacune sur huit arbres à chaque endroit, pour un total de 72 arbres. Le but de ces essais consistait à déterminer dans quelle mesure ces barrières pouvaient empêcher les arpenteuses tardives femelles, aptères, de grimper dans les arbres pour y pondre. L'efficacité des barrières a été évaluée en fonction du nombre de femelles adultes capturées à 10 à 15 cm au-dessus de l'obstacle. C'est la barrière Tanglefoot® qui a été jugée la plus efficace. En moyenne, 67,1 arpenteuses ont réussi à franchir la barrière de fibre de verre; 3,6 la barrière vaporisée au Raid®; et 1,1 la barrière Tanglefoot®. L'écart entre ces moyennes était significatif ($P<0,01$) pour la barrière de fibre de verre, mais non pour les deus autres barrières. Nous recommandons que la barrière Tanglefoot® repose sur une bande de polyéthylène, après obturation des crevasses de l'écorce pour empêcher les arpenteuses de s'y faufiler. La barrière Tanglefoot® possède également les avantages d'être bon marché, non toxique et, puisqu'elle réduit ou élimine la nécessité d'appliquer un insecticide, d'être tout à fait compatible avec les moyens de lutte biologique.

INTRODUCTION

The winter moth, *Operophtera brumata* (Linnaeus) (Lepidoptera:Geometridae), an important defoliator of deciduous forest, shade and fruit trees in Europe, was accidentally introduced into Nova Scotia in the early 1930s (Embree 1966) and on southern Vancouver Island before 1972 (Gillespie *et al.* 1978). By 1977, the winter moth had reached outbreak proportions on the Saanich Peninsula of Vancouver Island, causing severe defoliation on many shade and fruit trees.

In British Columbia, winter moth adults start emerging from pupae in the ground in November and may be found until early January. Male moths have functional wings and locate and mate with the flightless females on the trunks of trees. Females climb up the trunks and lay eggs singly or in small clusters under lichens, in bark crevices, on twigs or similar concealed places. Each female can produce up to 220 eggs (Embree 1966). The eggs hatch from late March to April and newly hatched larvae disperse by spinning silken threads and drifting on the wind. The larvae feed on leaves of a wide range of deciduous host plants. Fully developed larvae drop from the trees in late May to early June to pupate in the ground.

One method of winter moth control is to prevent the females from crawling up the trunk of trees to oviposit. For years, Tanglefoot bands applied around the tree trunks have been used (Embree 1966) and other types of

banding and combinations thereof have been tried. The trees, however, can still be infested by the young larvae as they disperse on silken threads from tree to tree by wind.

In British Columbia, a program was jointly initiated in 1978 by the federal and provincial governments to investigate control measures against the winter moth.

Biological control has been the main thrust of the program. The same two species of parasitoids, *Agrypon flaveolatum* (Gravenhorst) (Hymenoptera:Ichneumnidae) and *Cyzenis albicans* (Fallén) (Diptera:Tachiidae), that are credited with the control of the winter moth in Nova Scotia were introduced into British Columbia (Embree and Otvos 1984). Both species became established in British Columbia and appear to be spreading (I.S. Otvos unpubl. data).

Other controls evaluated were the use of a bacillus, or of petrochemical insecticides alone (Tonks *et al.* 1978) or in combination with insecticidal soap (Puritch and Condrascholl 1985) against the feeding larvae (N.V. Tonks unpubl. data) besides various barriers to trap adult females thus preventing them from ovipositing higher in the tree. The efficacy of some barrier tests is reported here.

MATERIALS AND METHODS

Three types of barriers (treatments) were tested: a) Tanglefoot band, b) fiberglass insulation alone, and c) fiberglass insulation sprayed with commercially available Raid.[1] At each of the three locations in Greater Victoria (Cattle Point, Summit Park Reservoir, and Burnside Rd. at Mackenzie Ave.) eight randomly selected Garry oak trees, *Quercus garryana* Dougl., received an upper band of Tanglefoot and a lower band of one of the three treatment barriers (Fig. 1) for a total of 24 trees per location. The diameter of the trees at breast height averaged 27.8 cm and ranged from 16.2-43.6 cm.

On all trees receiving the Tanglefoot barrier, an inexpensive, butyl-flex caulking compound was applied to the bark crevices, in a band around the circumference of the tree with a caulking gun. Then a 6 mil. thick, 20-25 cm wide polyethylene strip was pulled tightly around the tree over the caulking and fastened with staples. Care was

[1]For convenience of the public, brand or trade names are used in this paper, identified by capitalization. Their use does not constitute an endorsement of the product nor a suggestion that like products are not effective.

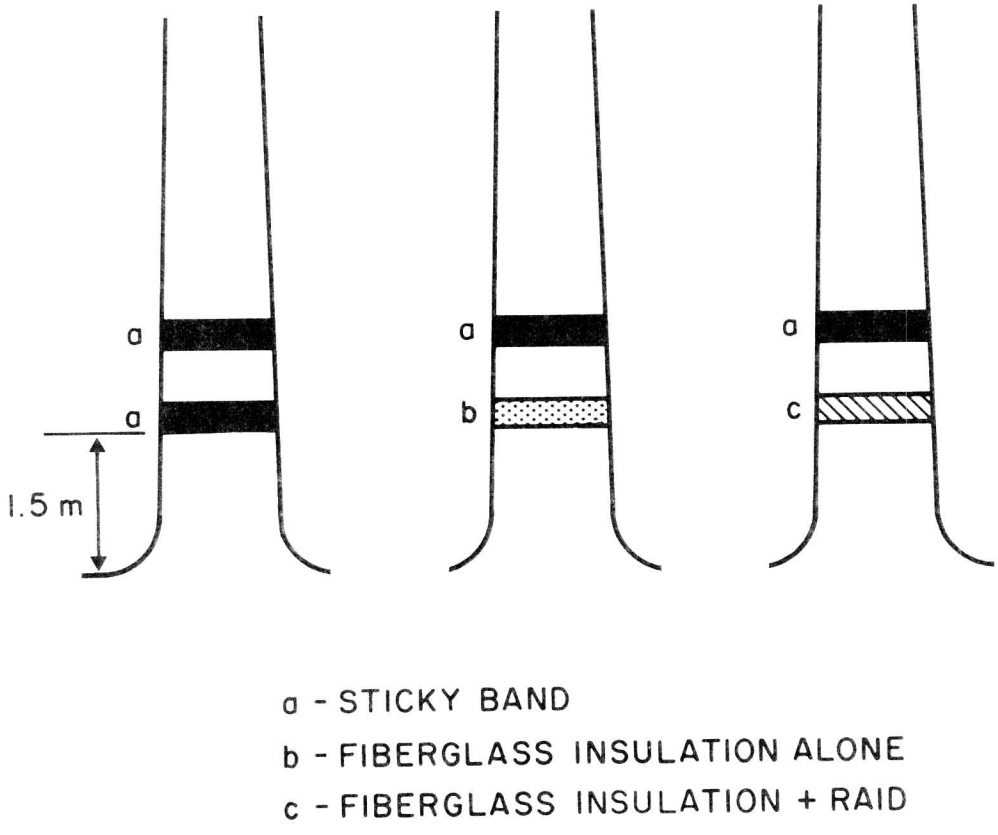

Fig. 1 Schematic drawings of the three types of barriers and Tanglefoot bands applied to the sample trees.

taken to "fill" all the crevices to prevent winter moths from crawling underneath the polyethylene. Tanglefoot was applied on the polyethylene with a spatula in a band 10-15 cm. wide.

In the second treatment, a band of commercially available fiberglass insulation without paper backing (about 20 cm wide by 7.6 cm thick) was secured by string to the trees.

In the last treatment, a similar fiberglass barrier was sprayed until dripping with Raid every 4-5 days. The commercially available Raid in pressurized cans, manufactured for house and garden use, according to the label contained: pyrethrins 0.176%, tetramethrin 0.09%, technical piperonyl butoxide 1.25%. All treatment barriers were 1.5 m above the ground.

All trees received a sticky band in an identical manner to the first treatment, 10-15 cm. above the first barrier (Fig. 1). In order to prevent adults from crossing the bands by "walking" over the bodies of the trapped moths, the sticky bands were replaced whenever the number of winter moth adults caught came close to saturating the band.

TABLE 1. Means and standard errors of the numbers of winter moth females caught on sticky bands above the barrier treatments (n = 8).

Location	Barrier treatments		
	Tanglefoot	fibreglass	fibreglass with Raid
	$\bar{x} \pm$ S.E.	$\bar{x} \pm$ S.E.	$\bar{x} \pm$ S.E.
Cattle point:	1.4 ± 0.5 (752)[a]	45.3 ± 12.9	2.0 ± 0.8
Summit Park:	1.1 ± 0.5 (578)[a]	49.8 ± 11.7	2.9 ± 0.9
Burnside Rd.	0.8 ± 0.3 (606)[a]	106.4 ± 21.3	6.0 ± 1.1
Total	1.1 ± 0.2 (1936)[a]	67.1 ± 10.5	3.6 ± 0.6

a Total numbers of moths caught on the treatment (lower) Tanglefoot bands.

All treatments were put in place between November 16 and 19 just as adult winter moth emergence started. The traps were left in place until January 10, 1985, by which time emergence had been completed. The numbers of winter moth females caught in the upper sticky band as well as those caught in the lower band of (treatment a) were counted on November 22, 28, December 3, 12, 19 and January 10.

The counts of winter moth adults, trapped in the upper sticky bands, were transformed to $\log_{10}$ (count + 1) to stabilize the variance. The transformed data were subjected to analyses of variance and Student-Newman-Keul's multiple range test (Zar 1974).

RESULTS AND DISCUSSION

There was high density of winter moth adults at all three test areas. Totals of 752, 578 and 606 female moths were trapped on the lower band of the Tanglefoot treatment at Cattle Point, Summit Park and Burnside Road, respectively (Table 1). Preventing these females from crawling up the tree trunks to oviposit reduced potential larval numbers considerably when one considers that a female lays up to 220 eggs (Embree 1966).

Tanglefoot was the most effective treatment. Based on counts from the upper sticky band, significantly higher mean numbers of winter moth females (Table 1) managed to crawl over the fiberglass barriers (67.1) than over the fiberglass barrier sprayed with Raid (3.6) or the Tanglefoot barriers (1.1) ($P<0.01$). The difference in the average number of winter moth females caught on the sticky bands above the latter two barriers was not statistically significant at the 5% level. Nevertheless, the sticky barrier in this test (treatment a) let through two-thirds fewer females than the fiberglass barrier sprayed with Raid (treatment c) (Table 1).

When the moth flight was over, all the traps were easily removed. Tanglefoot application to the polyethylene had an advantage over application directly to the bark because it facilitated the removal of the sticky bands. Caulking bark crevices eliminated the need for smoothing or scraping of the bark prior to applying the Tanglefoot and the caulking was easily removed from the crevices, thus restoring the bark to its natural condition.

The Tanglefoot band applied to polyethylene strips secured to the tree over caulked bark crevices is the recommended, and the most efficient of the barriers tested in preventing winter moth females from crawling up the trunks of trees to oviposit. Although the Tanglefoot is somewhat messy to apply, it is non-toxic to humans and pets, and is easily removed with paint thinner. Only 17 of the 96 sticky bands used needed to be replaced and this was easily done by placing a second band of polyethylene strip over the first.

The fiberglass barrier sprayed with commercially available Raid was easier to apply than the sticky band but it appeared somewhat less effective and was more costly. Raid had to be reapplied at intervals of 4-5 days during the whole trapping season and it might need to be applied more frequently still following heavy rain.

The cost of plastic, Tanglefoot and caulking applied to a tree was $0.84 vs. $0.98 for Raid applied to a fiberglass barrier.

None of the three barriers tested here is harmful to the introduced parasitoids as they are in the host pupae in the soil until the following spring when they emerge to lay their eggs.

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REFERENCES

Gillespie, D.R., T. Finlayson, N.V. Tonks and D.H. Ross. 1978. Occurrence of the winter moth, *Operophtera brumata* (Lepidoptera:Geometridae), on southern Vancouver Island, British Columbia. Can. Ent. 110: 223-224.

Graham, A.R. 1958. Recoveries of introduced species of parasites of the winter moth, *Operophtera brumata* (L.) (Lepidoptera:Geometridae), in Nova Scotia. Can. Ent. 90: 595-596.

Ebree, D.G. 1966. The role of introduced parasites in the control of the winter moth in Nova Scotia. Can. Ent. 98: 1159-1168.

Embree, D.G. and I.S. Otvos. 1984. *Operophtera brumata* (L.), winter moth (Lepidoptera:Geometridae). Ch. 61, pp. 353-357. *In* J.S. Kelleher and M.A. Hulme (eds.). Biological Control Programmes Against Insects and Weeds in Canada 1969-1980. Commonwealth Agricultural Bureaux, Farnham Royal, England.

Puritch, G.S. and S.F. Condrashoff. 1985. Insecticide mixture containing fatty acids. Canadian patent no. 1187409.

Tonks, N.V., P.R. Everson and T.L. Theaker. 1978. Efficacy of insecticides against geometrid larvae. *Operophtera* spp., on southern Vancouver Island, British Columbia. J. Entomol. Soc. Brit. Columbia 75: 6-9.

Zar, J.H. 1974. Biostatistical analysis. Prentice-Hall, Englewood Cliffs, N.J. 620 pp.