Application of Nosema disstriae and Pleistophora schubergi (Microsporidia) against the forest tent caterpillar in Ontario, 1977

by

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Abstract

A combination of two microsporidian parasites, Nosema disstriae (Thom.) and Pleistophora schubergi Zwölfer were tested against the forest tent caterpillar, Malacosoma disstria, in Ontario during the summer of 1977. A packsack-type mist blower was used to apply suspensions of microsporidian spores on individual trembling aspen (Populus tremuloides Michx). An application rate of 1.8×10^{11} spores/tree consisting of mixtures of P. schubergi and N. disstriae significantly increased the incidence of P. schubergi, but not N. disstriae.

Résumé

Au cours de l'été 1977, en Ontario, on a fait l'essai d'une combinaison de deux parasites microsporidiens, Nosema disstriae (Thom.) et Pleistophora schubergi Zwölfer, contre la Livrée des forêts, Malacosoma disstria. Un vaporisateur à dos a été utilisé lors de l'application de suspensions de spores microsporidiennes sur un Peuplier faux-tremble (Populus tremuloides Michx.). Une application au taux de 1.8×10^{11} spores/arbre mélangées de P. schubergi et N. disstriae a augmenté significativement l'incidence de P. schubergi, mais non celle de N. disstriae.

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Introduction

Outbreaks of the forest tent caterpillar, Malacosoma disstria Hübner occur on an average of every ten years, although there have been intervals as short as six and as long as sixteen years between outbreaks (Brown, 1966). Trembling aspen Populus tremuloides Michx.) is the principal host tree, but larvae also feed on sugar maple (Acer saccharum Marsh) birch (Betula sp) and many other species of broad-leaved trees and shrubs. Although tree mortality is rare, defoliation results in a loss in radial growth. Migrating larvae are also a nuisance and can have a serious impact on the camping and tourist industry (Sippell and Ewan, 1967).

The forest tent caterpillar is the host of a protozoan, Nosema disstriae (Thom.) described by Thomson (1959) and is also susceptible to Pleistophora schubergi Zwölfer (Kaya 1973; Wilson 1977). It has been shown that these protozoans decrease the vigour and longevity of the host. Feeding spores of these parasites to larvae in the laboratory significantly increased larval and pupal mortality when compared to the control insects (Wilson, 1977).

Our study was initiated to determine if N. disstriae and P. schubergi could be successfully introduced into a field population of the forest tent caterpillar.

Materials and Methods

Production of microsporidian spores

The production of spores commenced three months prior to field spraying. The forest tent caterpillar was used as the host insect. Propagation of the microsporidia was the same as that used for Nosema fumiferanae (Wilson and Kaupp 1975, 1976). The forest tent caterpillars are often naturally infected with N. disstriae; therefore, the use of these insects to mass produce P. schubergi resulted in a mixture of the two microsporidians.

Experimental plots

The experimental plot was located 4 km south of Echo Bay, Ontario, in the corporate Township of MacDonald, Meredith and Aberdeen Additional. The infestation of forest tent caterpillars in the experimental area was in its second year. The spray area consisted of trembling aspen with trees ranging in height from 7 to 9 m. Nine trees were selected for application of the microsporidian spores. Check trees were selected in a suitable site in close proximity to the treatment area to ensure similar levels of natural microsporidian infection.

Formulation and application rate

All sample trees were sprayed with 1500 ml of an aqueous formulation consisting of 50% (v/v) molasses and 30 g/l of IMC 90-001 sunlight protectant*. Each tree received a total of 1.8×10^{11} spores. The first five trees were sprayed with a suspension containing a mixture of approximately 50% N. disstriae and 50% P. schubergi spores;

*Sandoz, Inc., Homestead, Florida.

the four remaining trees were treated with a mixture of approximately 96% P. schubergi and 4% N. disstriae spores. All formulations were prepared in the field immediately prior to spraying.

Spray operation and larval development

The formulations were applied to sample trees with a packsack-type mist blower (KWH 2677 Kem San Ltd.). Spraying took place the morning of May 20, with light to moderate winds (average about 8 km/hr.); light rain occurred the night following the spray application. Most insects were in the 3rd instar at the time of spraying.

Sampling and microscopic examination

Later instars of the forest tent caterpillars wander considerably; therefore, many larvae had left the treated trees. Sampling consisted of a random hand picking of larvae in colonies or individuals within a 4 m radius of the treated trees six days after spraying. Larvae from each treated area were reared in groups in the laboratory for a further 12 days and then frozen until examined microscopically under phase contrast optics for the presence of microsporidian spores.

Results and Discussion

The incidence of N. disstriae and P. schubergi in forest tent caterpillars before application of the spray on trembling aspen trees is shown in Table 1. No P. schubergi infection was observed, and the average per cent incidence of N. disstriae based on the examination of 894 individual larvae was 2.6%.

Spraying with a 50% - 50% mixture of N. disstriae and P. schubergi spores resulted in a significant increase in the levels of P. schubergi, but not N. disstriae when compared to the checks. The average level of infection for P. schubergi was 76.1% in the treated areas and 0% for the check (Table 2).

A second area was treated with a spore mixture containing 96% P. schubergi and 4% N. disstriae. The average level of infection was 85.0% for P. schubergi and 25.0% for N. disstriae, with 0% and 22.5% respectively in the check area. This again is a highly significant increase for P. schubergi but not for N. disstriae (Table 3).

The treatment consisting of 96% P. schubergi spores produced significantly greater levels of infection; in the forest tent caterpillars than the 50% mixture. This indicates that the higher spore dosage produced better results, although the level of infection varied somewhat from tree to tree. This variation (52.5% to 100%) could be due to a number of factors, such as differences in spray coverage by the mist blower and feeding habits of the insects. Some larvae may have left the sprayed trees before consuming the foliage. Also non-infected larvae may have wandered into the collection area.

The results for N. disstriae are somewhat discouraging. However no final conclusions on the possible use of this protozoan in biological control should be made until it is tested free of contamination by other microsporidia.

Preliminary laboratory studies indicate that both N. disstriae and P. schubergi have a detrimental effect on the development and survival of the forest tent caterpillars (Wilson 1977). This preliminary

field test suggests that P. schubergi can be successfully applied against the forest tent caterpillar and, therefore, offers promise in the biological control of this insect.

Table 1

Incidence of Nosema disstriae and Pleistophora schubergi in forest tent caterpillars collected from trembling aspen trees before treatment.[1]

Tree number	Number of larvae examined	Per cent incidence of N. disstriae	Per cent incidence of P. schubergi
ta 1	100	2.0	0
ta 3	88	0	0
ta 4	72	2.7	0
ta 6	100	5.0	0
ta 7	100	3.0	0
ta 8	75	0	0
ta 10	100	7.0	0
ta 11	59	0	0
ta 13	100	4.0	0
Mean ta 1-13	-	2.6	0
Check	100	5.0	0

1. = Larvae were collected on May 19, the day before spraying.

Table 2

Incidence of Nosema disstriae and Pleistophora schubergi in forest tent caterpillar collected from trembling aspen trees sprayed with 1.8×10^{11} spores/tree consisting of a mixture of 50% N. disstriae and 50% P. schubergi spores[1].

Tree number	Number of larvae examined	Per cent incidence of N. disstriae	Per cent incidence of P. schubergi
ta 1	40	27.5	100
ta 3	40	12.5	77.5
ta 4	36	33.3	58.3
ta 6	40	22.5	97.5
ta 7	40	2.5	47.5
Mean ta 1-7	-	19.6	76.1**
Check	36	22.5	0

1. = Spraying occurred May 20, larvae were collected May 26 reared in the laboratory until June 6, then frozen until examined.

** = Significantly different from the checks at the 1% level; statistical analysis was performed using "t" test as applied to percentages.

Table 3

Incidence of Nosema disstriae and Pleistophora schubergi in forest tent caterpillar collected from trembling aspen trees sprayed with 1.8×10^{11} spores/tree consisting of 96% P. schubergi and 4% N. disstriae.[1]

Tree number	Number of larvae examined	Per cent incidence of N. disstriae	Per cent incidence of P. schubergi
ta 8	40	17.5	90.0
ta 10	40	22.5	97.5
ta 11	40	12.5	100
ta 13	40	47.5	52.5
Mean ta 8-13	-	25.0	85.0**
Check	36	22.5	0

1,** = see footnote Table 2.

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