REFINEMENT OF A SPRAY TIMING TECHNIQUE FOR THE NANTUCKET PINE TIP MOTH (LEPIDOPTERA: TORTRICIDAE)

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(Accepted for publication 1 December 1987)

ABSTRACT

Application of dimethoate on various spray dates enabled a refinement of a spray timing technique for control of the third generation of Nantucket pine tip moth. Two spray applications were necessary for adequate control but proper timing of the first application was found to be more critical. Optimal control was achieved when the first spray was applied at 520 degree days after the onset of male moth flight. Optimal dates generally coincided with peak egg densities.

Although a few eggs and early instar larvae were found after the completion of the third generation of tip moth, no extended survival, damage or other indication of a fourth generation was recorded.

Key Words: Nantucket pine tip moth, spray timing, dimethoate, fenvalerate, *Rhyacionia frustrana*.

J. Entomol. Sci. 23(2): 180-186 (April 1988)

INTRODUCTION

The Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock), is an indigenous pest of most yellow pines in the eastern United States. This moth frequently attacks Virginia pines, *Pinus virginiana* L., which are widely grown in the Southeast for sale as Christmas trees. Tip moth feeding can cause extreme height and form damage, resulting in aesthetically inferior trees and/or increased market age. Dimethoate and fenvalerate are currently widely used for control of tip moths in Christmas tree plantations. Biological timing schedules for dimethoate and fenvalerate (Gargiullo et al. 1983, 1985) consistently produce good control and are now being used to time spray application with the most susceptible life stages of the insect. However, the third generation of *R. frustrana* in the piedmont region of Georgia presents special control problems to the Christmas tree grower. The period of adult moth activity is considerable longer than that in generations 1 and 2, resulting in each larval stadium spanning an extended period of time. One application of dimethoate is generally inadequate for acceptable control (Berisford et al. 1984). Fenvalerate, which has a longer residual, has not been adequately tested for control of third generation moths. Also, some growers have speculated that a fourth generation of moths may occur in the piedmont, resulting in additional late season damage. We report here a refinement of the spray timing model developed by Gargiullo et al. (1983), a determination of the possible existence of a fourth generation of tip moths and further evaluation of fenvalerate for tip moth control.

MATERIALS AND METHODS

Three randomized blocks were established in a heavily infested 3-year-old plantation of Virginia pines in Wilkes county, GA in 1984. Each block consisted of 12 rectangular plots of 10 trees each. Nine of the plots were sprayed with dimethoate at 1.06 lb. active ingredient per 100 gallons of water (1.27 g/1). The base spray timing (two applications) was determined following the schedule presented by Gargiullo et al. (1983) for dimethoate, and then spraying was done on all possible combinations of predicted optimum spray dates (Gargiullo et al., 1983), plus 3 days prior to optimum dates and 3 days after optimum dates (Table 1, and 2). Two plots in each block were treated with fenvalerate at 0.1 lbs. of active ingredient per 100 gallons of water (0.12 g/1). One of these plots was sprayed on or near peak egg density in the field, as determined by degree days associated with life stages of *R. frustrana*. The remaining fenvalerate plot was treated when the first tip moth eggs appeared in field samples, and then again 12 days later. One plot per block was left untreated as a check. Initiation of the third generation was determined by monitoring male moth flight using synthetic *R. frustrana* sex pheromone (Hill et al. 1981) in Pherocon 1 c® sticky traps. Trapping was continued throughout the 3rd generation. A 10 shoot sample was taken the first day that males were trapped and every 3 days thereafter until late October. Life stages of tip moths present on the shoots were recorded. Instars were separated using the nearest discriminate analysis. Calibration data were based on larval head capsule measurements, (Fox et al. 1953). Degree days were compiled using a continuously recording biophenometer (Omnidata T151®) starting on the first day of male trap catch. Sprays were applied with 10 liter pump pressure sprayers. Trees were sprayed with a fine mist until foliage was thoroughly covered. When tip moth damage became obvious and field collections showed that all tip moths had pupated, damage was assessed for each plot by counting the total number of infested shoots. Efficacy of each treatment was compared using ANOVA and Duncan's New Multiple Range Test at a significance level of alpha = .05, the dependent variable being the number of infested buds per tree.

A determination on the possible existence of a fourth generation was made by monitoring male moth flight (pheromone traps) and life stages present (shoot samples) beginning with the initiation of the 3rd generation and until prevalent temperatures prevented adult moth flight and/or larval development (Webb and Berisford 1978; Haugen and Stephen 1984).

RESULTS AND DISCUSSION

All treated plots had significantly fewer infested tips than the check plots (Table 1). Spray efficacy can be divided into three groups based on mean numbers of infested buds per tree (Table 1, Fig. 1). The first group averaged more than 1.5 infested buds/tree, the second group ca. one infested bud/tree and the third averaged less than 0.5 infested buds/tree. In the first group the initial spray was applied before the predicted optimum date, while in the 2nd and 3rd groups all initial sprays are either on or after the optimum date. The best timing of the second spray application varied in all groups. The initial spray application, applied at the first peak of egg deposition (Table 2, Fig. 3), is more critical for control although a second application is needed to insure adequate control. The data indicate a window of maximum efficacy of 61 degree days for the first spray (489-550 DD) and a window of 150 degre days (750-900 DD) for the second application. Best control occurs at 520 degree days for the first application and 831 for the second application. Fenvalerate apparently provides more control when applied at the same time or earlier than dimethoate as found by Gargiullo et al. 1985 in the coastal plain. Single applications of fenvalerate were slightly less effective than two dimethoate sprays.

Table 1. Schedule for application of insecticides relative to predicted optimum spray dates and mean numbers of infested buds per tree for each treatment.

Treatment No. and Compound 1	Relation Of First Spray To Optimum Date	Relation Of Second Spray To Optimum Date	Mean No. Of Infested Buds/Tree 1
1 Dimethoate	before*	before	1.07 A‡
2 "	after†	after	0.40 A
3 "	before	after	2.07 A
4 "	after	before	0.30 A
5 "	on	after	0.20 A
6 "	on	before	0.33 A
7 "	after	on	0.17 A
8 "	before	on	1.03 A
9 "	on	on	0.40 A
10 Fenvalerate	2 days after	no spray	1.87 A
11 "	5 days before	4 days before	1.00 A
12 Untreated	no spray	no spray	20.03 B

* (+) 3 days from optimum date.
† (-) 3 days from optimum date.
‡ Means with the same letter are not significantly different at P = 0.5 (DNMRT).

Table 2. Spray application dates and corresponding degree-days.

Compound	Date Sprayed	Degree-Day	Designation
Dimethoate	9 Aug. 1984	411	before
"	12 Aug. 1984	489	optimum
"	15 Aug. 1984	552	after
"	21 Aug. 1984	750	before
"	24 Aug. 1984	831	optimum
"	27 Aug. 1984	902	after
Fenvalerate	14 Aug. 1984	550	2 days after
"	7 Aug. 1984	346	5 days before
"	20 Aug. 1984	724	4 days before

These data show that applications of either chemical can provide good tip moth control if applied on or near optimum spray dates predicted by the spray timing model. However, applications made after the predicted best time are more likely to provide better control than early applications.

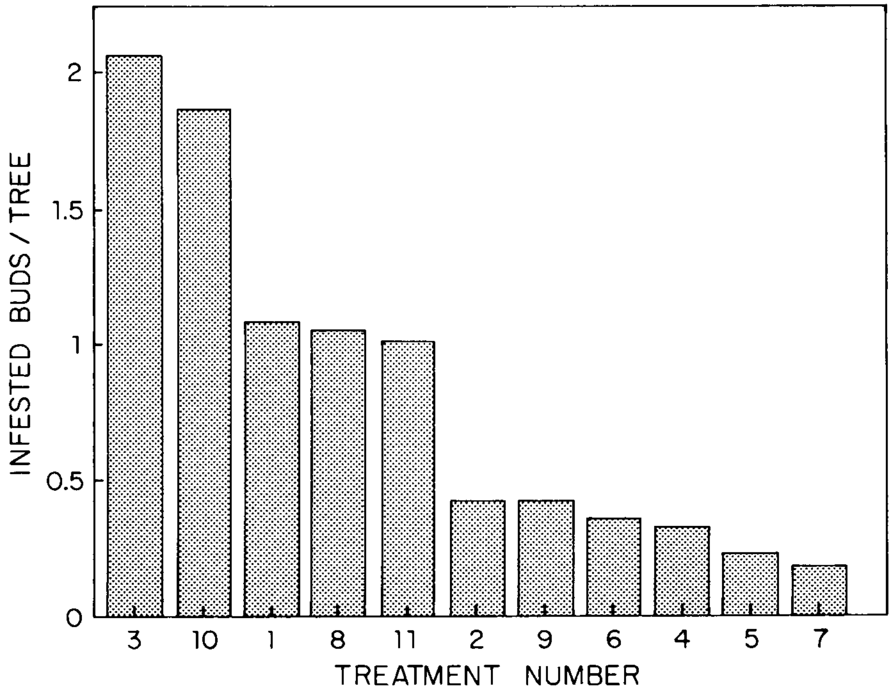

Fig. 1. Mean numbers of infested buds per tree for each of 12 insecticide treatments (Table 1).

Figure 3 shows numbers of adult moths trapped relative to degree-day accumulations. There were two periods of adult emergence; the first from 57 to 600 degree-days and the second between 1035 and 1615 degree-days. The second period of emergence suggests a possible fourth generation. However, there was a very small number of eggs collected at 1433 degree-days (Fig. 2) which resulted in no significant larval survival [only one second instar larva was collected (Fig. 4)] and no damage. Collections through October 31 revealed no other larvae, shoot damage, eggs or other indications of a partial or complete fourth generation. Following 1880 degree-days (October 11) only pupae (overwintering stage) were collected (Fig. 5). These data show that although some adult emergence may occur, no partial or complete fourth generation of Nantucket pine tip moth occurs in the piedmont region of Georgia.

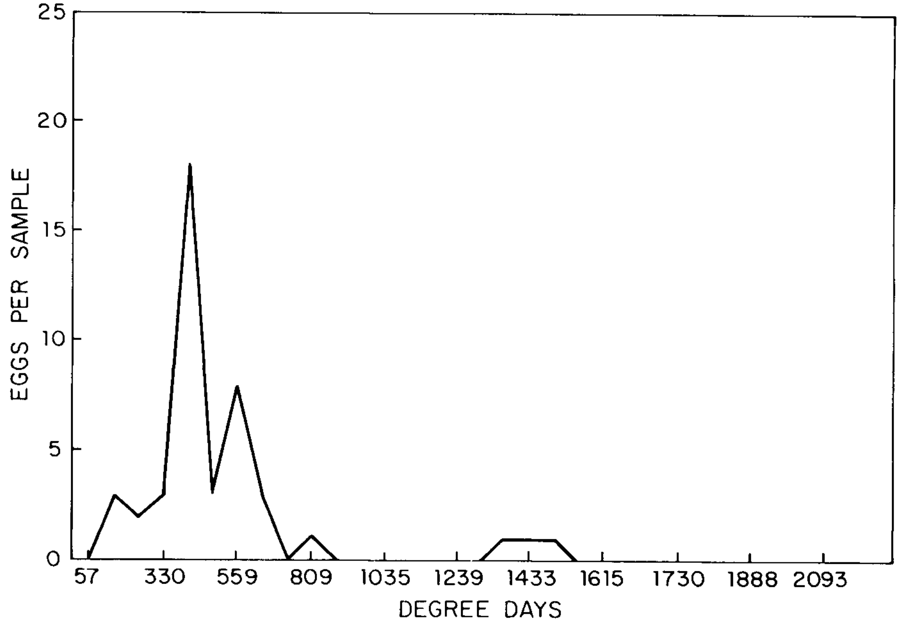

Fig. 2. Numbers of tip moth eggs collected from 10 randomly selected pine shoots at cumulative degree days.

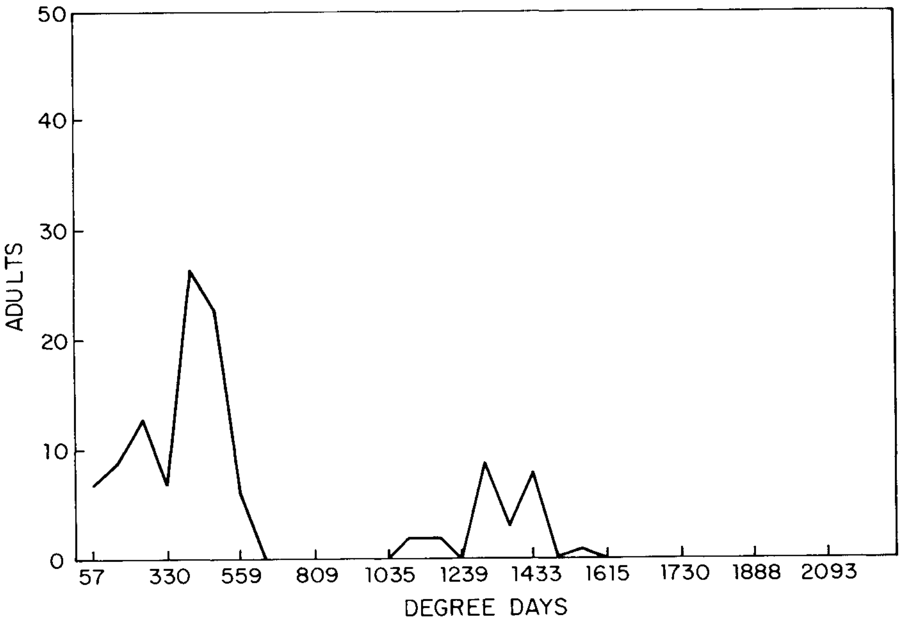

Fig. 3. Numbers of adult tip moths trapped in sticky traps at cumulative degree days.

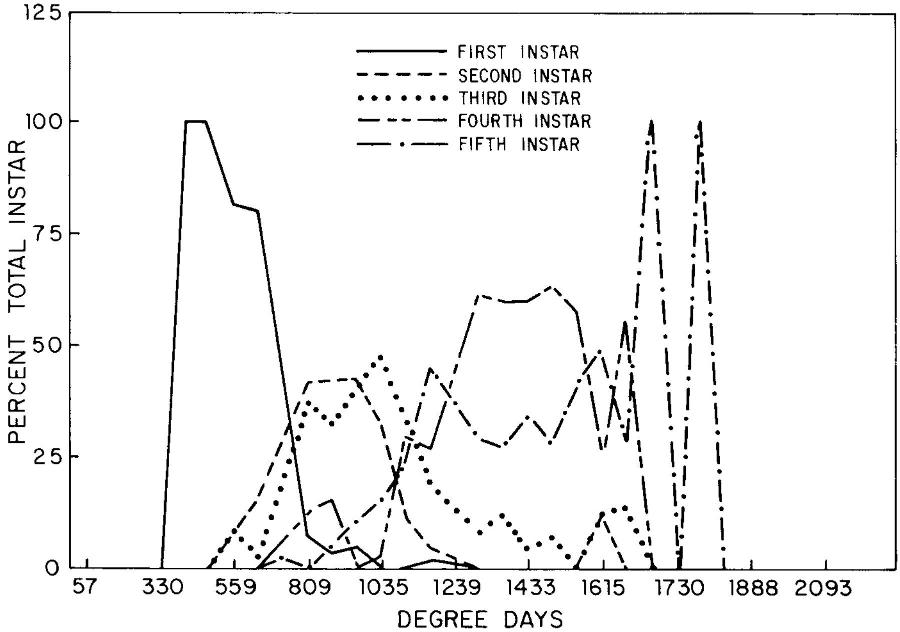

Fig. 4. Numbers of tip moth instars collected from 10 randomly selected pine shoots at cumulative degree-days.

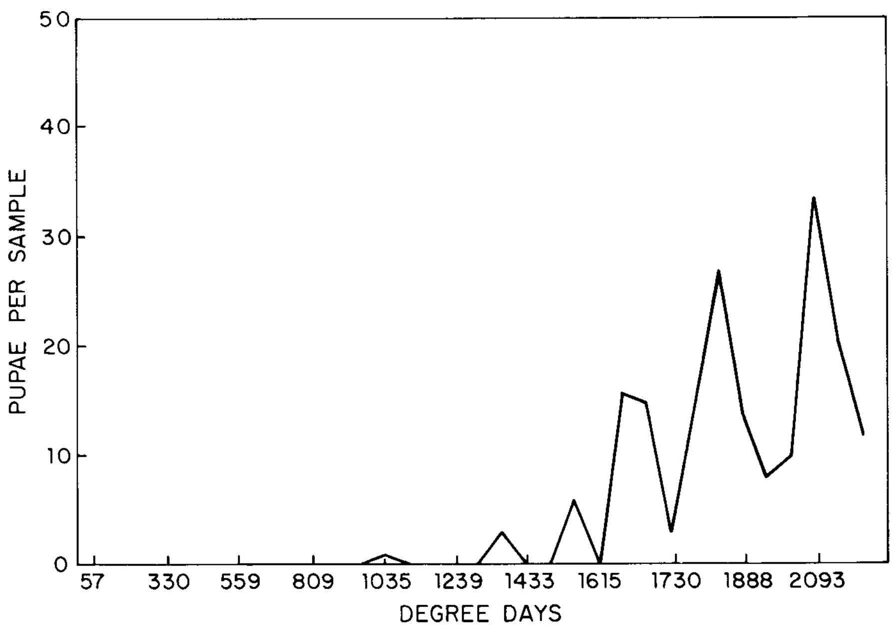

Fig. 5. Numbers of tip moth pupae per sample collected from 10 randomly selected pine shoots at cumulative degree-days.

LITERATURE CITED

Berisford, C. W., P. M. Gargiullo, and C. G. Canalos. 1984. Optimum timing for insecticidal control of the Nantucket pine tip moth (Lepidoptera: Tortricidae). J. Econ. Entomol. 77: 174-77.

Fox, R. C., N. H. Anderson, S. C. Garner, and A. I. Walker. 1953. Larval head capsules of the Nantucket pine tip moth. Ann. Entomol. Soc. Amer. 65: 513-14.

Gargiullo, P. M., C. W. Berisford, C. G. Canalos, and J. A. Richmond. 1983. How to time dimethoate sprays against the Nantucket pine tip moth. Georgia For. Res. Paper 44.

Gargiullo, P. M., C. W. Berisford, and J. F. Godbee, Jr. 1985. Prediction of optimal timing for chemical control of the Nantucket pine tip moth *Rhyacionia frustrana* (Comstock) (Lepidoptera: Tortricidae), in the southeastern coastal plain. J. Econ. Entomol. 78: 148-54.

Haugen, D. A., and F. M. Stephen. 1984. Development rates of Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock) (Lepidoptera: Tortricidae) life stages in relation to temperature. Environ. Entomol. 13: 56-60.

Hill, A. S., C. W. Berisford, U. E. Brady, and W. L. Roelofs. 1981. Nantucket pine tip moth, *Rhyacionia frustrana*: identification of two sex pheromone components. J. Chem. Ecol. 7: 517-28.

Webb, J. W., and C. W. Berisford. 1978. Temperature modification of flight and response to pheromones in *Rhyacionia frustrana*. Environ. Entomol. 7: 278-80.