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HOST SELECTION BY THE PINE PROCESSIONARY CATERPILLAR *THAUMETOPOEA WILKINSONI*

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The occurrence of nests of the pine processionary caterpillar (PPC), *Thaumetopoea wilkinsoni* Tams (Lepidoptera: Thaumetopoeidae), was recorded in two 9-year-old plots planted with *Pinus halepensis, P. brutia* and *P. eldarica* in a randomized block design. Nest density was highest in *P. eldarica* and lowest in *P. halepensis*. The mean number of nests per tree and their frequency distribution indicate that the preference of the PPC is in the order *P. eldarica* > *P brutia* > *P. halepensis*; it is believed to be related to shape of the tree. Planting of *P. eldarica* in camping sites is not recommended, due to its high susceptibility to colonization by the PPC.
KEY WORDS: Thaumetopoea wilkinsoni; Pinus halepensis; Pinus brutia; Pinus eldarica; host selection.

INTRODUCTION

The pine processionary caterpillar (PPC), *Thaumetopoea pityocampa* Schiff., and its eastern vicariant *T. wilkinsoni* Tams (Lepidoptera: Thaumetopoeidae), are important defoliators of natural and artificially established pine stands in many Mediterranean countries (1,5,7,8,11,12,15). They feed on the needles of various pines. Both species have a univoltine life cycle, oviposition is restricted to the autumn and the offspring of a single female are easily detected due to the habit of the larvae to aggregate in conspicuous nests. The caterpillars build a succession of temporary frail nests, with the final, firm one (Fig. 1) being constructed when they reach the third instar. Egg mass deposition is not related to the location on the tree where the caterpillars construct their last nest (3,7).

Throughout their range both *Thaumetopoea* spp. show affinity for certain hosts. In the eastern Mediterranean mainly *Pinus halepensis* and *P. brutia* are injured

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Fig. 1. A final nest of *Thaumetopoea wilkinsoni.*

(11,15,16), whereas in southern Europe *P. nigra* seems to be the main host (2-5,14). Tiberi (17) found that among the dominant trees in mixed plantations, *P. radiata* was three times more susceptible to attack than *P. maritima*. Preference of the female for oviposition on trees growing at the edge of the forest or on the tallest trees in the stand is well known (7,17). So far little is known concerning the host selection behavior of the females.

Israeli foresters are concerned with *T. wilkinsoni* (PPC) injury to mainly *P. halepensis, P. brutia* and *P. eldarica* occurring in young plantations and open stands. The population (number of nests per unit area) is negligible in plantations of more than 25 years of age with a closed canopy (10). In the present study the host selection of the above mentioned three pine species was examined at the stage when the stand is most prone to injury. Special emphasis was given to the study of *P. eldarica*, a newly introduced close relative of *P. brutia*, the natural range of which does not overlap with that of the PPC. There are but slight differences in needle thickness and color among the species tested and it may be that different host preference is related to other factors, possibly crown shape (Fig. 2).

Fig. 2. Typical 10-year-old *Pinus halepensis* (left), *P. brutia* (center) and *P. eldarica* (right) trees, planted at Nahshon.

STUDY PROCEDURE

The study was carried out in 9-year-old provenance trial plots with a randomized block design of *P. halepensis*, *P. brutia* and *P. eldarica* at Ramat haNadiv (32°22'N, 34°56 E) and Nahshon (31°50'N, 34°38'E) (17). Mean tree heights in spring 1986 of *P. halepensis*, *P. brutia* and *P. eldarica* were, respectively, 3.49, 3.16 and 3.41 m at Nahshon and 6.09, 4.00 and 5.35 m at Ramat haNadiv (Weinstein, pers. commun.). High mortality in *P. brutia* occurred during the first 2 years after planting, apparently due to low drought tolerance, and between 3 and 6 years of age in *P. halepensis* due to infestation by the Israeli pine bast scale, *Matsucoccus josephi* Bodenh. et Harpaz (Homoptera: Margarodidae) (12). In both plots the number of final nests in normally developing trees of each of the pine species was counted in late January of the years 1985 and 1986.

The data were examined by analysis of variance and Duncan's Multiple Range Test (by SAS).

RESULTS

Mean number of nests was highest in *P. eldarica* and lowest in *P. halepensis* (Table 1); differences among the three tested species were significant except between *P. brutia* and *P. halepensis* at Nahshon in 1985. Analysis of variance of the results (Table 2) showed that numbers of nests were essentially the same in both years and plots, and that nest density among species was affected neither by site nor by year, but interactions between species, site and year were highly significant (P=0.01).

TABLE 1

AVERAGE NUMBER OF *THAUMETOPOEA WILKINSONI* NESTS PER TEN TREES OF *PINUS* SPECIES AT TWO SITES
(Total number of trees in parentheses)

Species	*Ramat haNadiv*		*Nahshon*	
	1985	1986	1985	1986
P. halepensis	2.56[a]* (238)	3.50[a] (228)	1.02[a] (326)	1.26[a] (323)
P. brutia	6.33[b] (270)	8.30[b] (268)	1.18[a] (169)	3.23[b] (164)
P. eldarica	9.52[c] (165)	12.10[c] (164)	3.23[b] (23)	11.50[c] (23)

*Within sites and years, means not sharing a common letter are significantly different at P = 0.05.

TABLE 2

ANALYSIS OF VARIANCE FOR NUMBER OF NESTS IN THREE PINE SPECIES AT TWO SITES IN 1985 AND 1986

Source	*SS*	*D.F.*	*Prob >F*
Pine species	5957.35	2	0.05
Years	365.128	1	n.s.
Plots	2842.8	1	n.s.
Pine species x years	10715.0	2	0.01
Pine species x plots	26237.0	2	0.01
Years x plots	83070.95	1	0.01

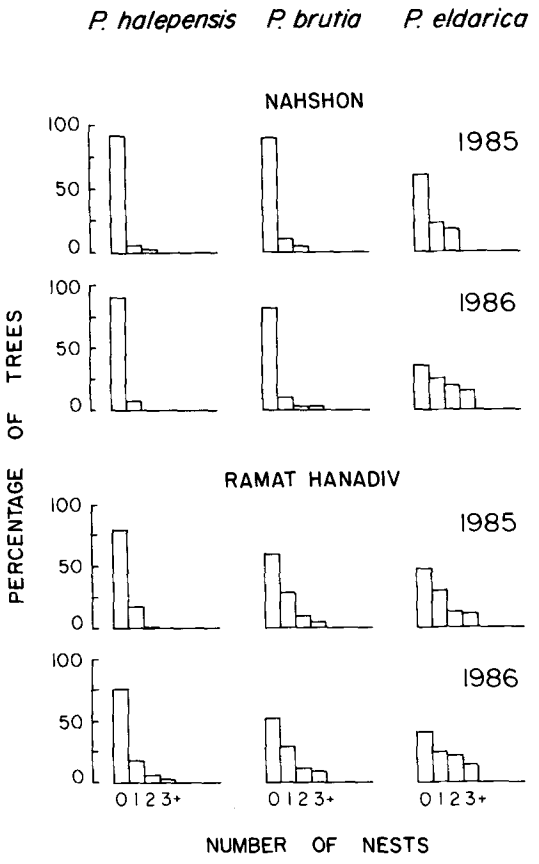

Fig. 3. Distribution frequency of *Thaumetopoea wilkinsoni* nests in three pine species at two sites (for total number of trees, see Table 1).

The frequency distribution of nests in the species examined shows that more than one nest per tree is relatively more frequent in *P. brutia* and *P. eldarica* than in *P. halepensis*. The proportion of trees with two nests and more is highest in *P. eldarica*, which also has the smallest number of unaffected trees (Fig. 3).

Many *P. eldarica* trees were heavily defoliated by the PPC in both plots; only a few *P. brutia* canopies were markedly affected, and only at Ramat haNadiv; no significant loss of needles was observed in infested *P. halepensis*.

DISCUSSION AND CONCLUSIONS

Nest counts showed significant differences in the behavior of the PPC with regard to the three pine species tested, the preference being in the order of *P. eldarica* > *P. brutia* > *P. halepensis*. This conclusion is valid only for the specific age at which the trees were examined. Our findings do not agree with those of Halperin (7), who suggested that *P. halepensis* is preferred over *P. brutia*.

At 5-15 years of age, when the plantation is most susceptible to PPC injury, the trees vary in crown shape. *P. halepensis* tends to display a somewhat spherical crown, *P. brutia* has a more or less conical shape, and *P. eldarica* a pyramidal form (Fig. 2). Halperin (9) suggested that the thickness of the needles and the density of the crown determine the host preference of the PPC. Our findings, however, suggest that the shape of the tree may be the dominant factor. Thus, shape could explain the affinity of the PPC for pine species with narrow crowns; *e.g. P. canariensis* is preferred to *P. brutia* or *P. halepensis* in Israel (7), and *P. nigra* is chosen over *P. pinea* in Lebanon (Mendel, unpublished data). Similarly, *T. pityocampa* prefers *P. nigra* to *P. pinea* or *P. halepensis* (4), and *P. radiata* to *P. maritima* or *P. halepensis* (5,17). Demolin (4) and Battisti (pers. commun.) noted that *T. pityocampa* oviposits mainly on protruding shoots, which are more frequent in the crown of *P. nigra* than in that of *P. maritima* and *P. pinea*. There is little doubt that protruding branches are a decisive factor in the host selection process by the female moth, due to the advantage of oviposition in situations exposed to direct radiation, which will keep the nests warm during the winter. Narrow crowns or the upper parts of conical crowns are probably most suited for the PPC, because there the nests can absorb solar radiation from almost any angle.

The possibility of chemical cues from the tree attracting the ovipositing female is not excluded. However, considering that in all reported cases both *T. wilkinsoni* and *T. pityocampa* prefer pine species with a narrow shape, it is probable that in our study host volatiles or contact chemicals were not the decisive factor in the host selection among the different pine species. On the other hand, volatiles are probably most important in the habitat selection, *viz.*, the pine stand.

Needle length and color do not differ greatly among the pine species examined. Although needles of *P. brutia* and *P. eldarica* are slightly thicker and darker than those

of *P. halepensis*, in our opinion needle morphology does not play an important role in host preference of the PPC among the pines tested in the present study.

The decline of large areas planted with *P. halepensis* due to the Israeli pine bast scale (6) and the relatively low drought tolerance of other locally planted conifer species, have led to increased use of *P. eldarica* in new afforestation projects. The present results suggest that this species is strongly preferred by PPC and is probably also most prone to injury. Thus, its planting should be reconsidered on sites susceptible to PPC attack and inaccessible to control operations. Use of *P. eldarica* should also be questioned in urban environments and it is suggested not to plant it in camping sites due to the urticarian hairs of the *T. wilkinsoni* caterpillars, which cause human dermatitis and conjuctivitis.

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