

Natural enemy promises control of Nantucket pine tip moth

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In July 1971, San Diego County agricultural inspectors collected larvae from tips of severely damaged Monterey pine trees at the Carlton Oaks Golf Course in Santee. The larvae were determined to be the Nantucket pine tip moth, *Rhyacionia frustranae*, a moth common in the southwestern United States but new to California. A major pest of young pines in forest plantations throughout the Southeast, it presents a serious threat to California's Christmas tree industry, nursery industry, and urban ornamental pines. The moth now infests a major portion of southwestern San Diego County.

In spring 1973, study sites were established at Santee, the apparent center of the infestation. Plot 1 consisted of five small (8 to 15 foot) and five large (20 to 30 foot) Monterey pine trees on the Carlton Oaks Golf Course. Monthly samples of five tips from the upper crown and five tips from the lower crown of each tree (100 tips altogether)

were removed and returned in sealed bags to the quarantine facility at the University of California, Riverside, for dissection.

Various mortality factors affecting the pine tip moths in the tips were assessed. Two species of native natural enemies, *Erynnia tortricis* and *Scambus applopappi*, were consistently found associated with the moth but did not account for more than 10 percent of mortality. The greatest mortality occurred in the moth's larval stages after most of the pine tips had been consumed by the earlier-maturing larvae. The new tips which sprouted from the base of the killed ones were quickly attacked and killed. Thus, the 1973-74 moth populations appeared to be limited by the availability of living Monterey pine tips.

Examination of other species of pines in the infested area revealed that only *P. radiata* was severely attacked. Other common ornamental pines—Alleppo, Japanese Black, Torrey, Canary Island, and

Italian Black—were either free from infestation or only slightly damaged.

The next phase in the program was to determine if promising natural enemies occurred in the pest's area of origin, the southeastern and eastern United States, and arrange for their introduction into the San Diego area. Literature indicated that an ichneumonid parasite, *Campoplex frustranae*, was successfully introduced from Virginia to young pine plantations in Nebraska. Another parasite, a tachnid, *Lixophaga mediocris*, also appeared promising.

Workers in the southeastern United States familiar with Nantucket pine tip moth shipped adult parasites in spring 1974. The parasites were carefully identified to ensure they were specific natural enemies of the moth and then released at Carlton Oaks Golf Course. Subsequent samples failed to reveal evidence of *L. mediocris*; however, a few *D. frustranae* were found in overwintering tip moth pupae. *C. frustranae* in-

Fig. 1A. Typical growth of Monterey pine in areas free of Nantucket pine tip moth.



Fig. 1B. Typical growth of Monterey pine in areas infested with Nantucket pine tip moth.





Fig. 2. *Rhyacionia frustrana*, the Nantucket pine tip moth.



Fig. 3A (above). *Erynnia tortricis*, a native tachinid parasite of pine tip moth. Fig. 3B (below). *Scambus applopappi*, a native ichneumonid parasite of pine tip moth.



creased rapidly throughout 1976 and 1977 with 50 percent parasitism in overwintering pupae at the end of the 1977 season.

An analysis of the monthly pine tip samples from plot 1 (1974, 1975, 1977) indicates that the number of uninfested tips increased each year while the number of dead tips decreased (fig. 5). The year 1976 was not included because some of the sample trees were inadvertently sprayed in the spring with an insecticide. Fig. 5 also indicates the

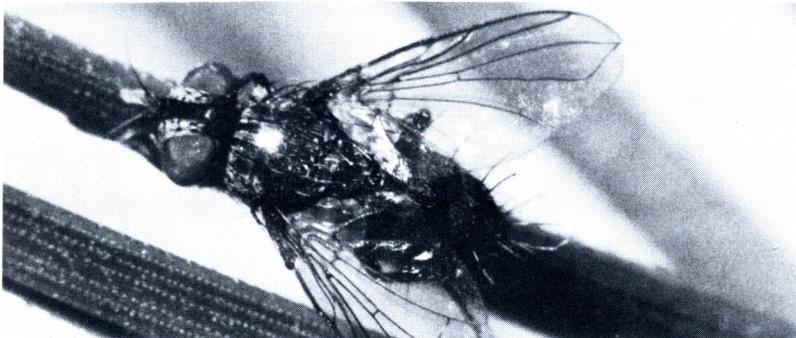
delayed onset of moth attacks and tip kill. The moth's spring generation is less dense than that of the previous year because of the parasite-caused mortality to the overwintering generation.

Preliminary observations and analysis of sample data indicate that the establishment of *C. frustrana* at Carlton Oaks Golf Course in Santee has materially improved the appearance and vigor of many Monterey pine trees in the area; the biological control

of the Nantucket pine tip moth at this golf course looks promising. Additional studies will be necessary to determine whether the parasite can successfully improve the condition of damaged pines in environments different from those of the golf course.

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Fig. 4A (above). *Lixophaga mediocris*, a tachinid parasite of Nantucket pine tip moth. Fig. 4B (below). *Campoplex frustranae*, a newly established parasite of the Nantucket pine tip moth in California.



Figs. 5A and B. Above, reduction in number of infested tips after introduction of ichneumonid parasite *Campoplex frustranae*. Below, reduction in dead tips and delay in their appearance after introduction of ichneumonid parasite *Campoplex frustranae*.

