
Max Badgley

Resin midges in Monterey pine Christmas trees

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Pine resin midges feed on fresh resin in wounds on Christmas trees. Though some growers perceive this as a problem, insecticide treatments are unwarranted — partly because they do not provide effective control, but mostly because consumers do not consider resin midge damage when they choose Christmas trees.


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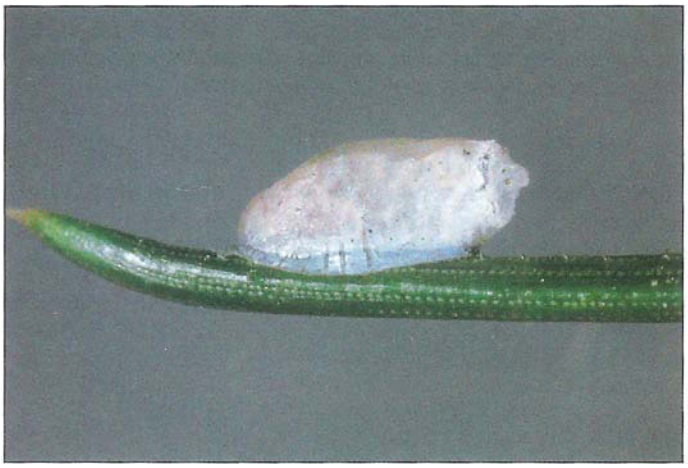
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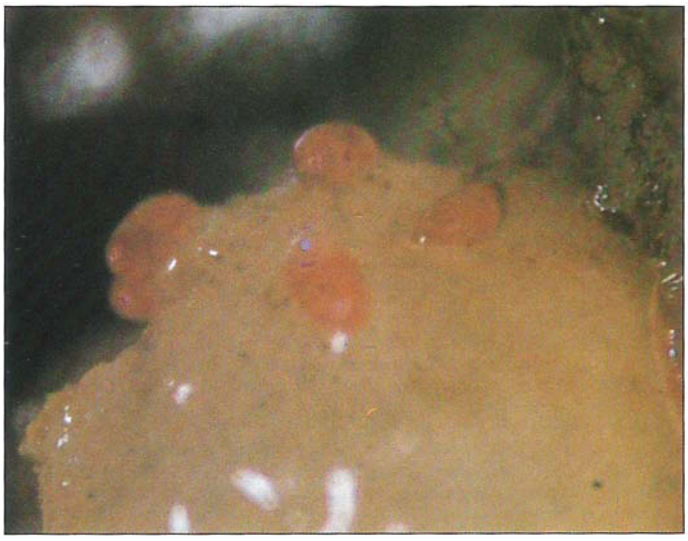
Clockwise from top: Adult resin midges, unable to penetrate Monterey pine bark on their own, lay their eggs in tree wounds or cracks. Depending on species, the midges pupate either in resinous cavities or on pine needles, as above. The resinous exudation in which the eggs below have been laid will also serve as home for the developing resin midge larvae. Even though noticeable on close inspection (left), resin midge damage has no apparent influence on the choices of Christmas tree purchasers.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The larvae of several species of small flies inhabit resin-filled cavities in the woody parts of Monterey pine trees (*Pinus radiata*). Thus far we have identified *Cecidomyia brevispatula*, *C. resinicola*, and *C. resinicoloides* in Monterey pines grown for Christmas tree markets in northern and southern California. All three species have similar habits, except for their place of pupation.

The adult flies are unable to penetrate tree bark, so they must depend on tree wounds or natural, resin-exuding cracks for egg-laying sites. The larva keeps the wound open and enlarges it, although there is no evidence the larvae feed on woody tissue. Larvae spend their entire period of development within the resinous cavity, and then pupate either within the cavity or on pine needles, depending on the midge species. Resin midges go through several generations each year, and succeeding generations may use a single feeding site over the growing season. New generations will exploit new cracks or wounds, however, as they become available.

Resin midges have had an uncertain status as pests of Christmas trees. Heavy infestations of some species reportedly retard tree growth, distort tree form, or cause foliage to die. The points of infestation, mostly on the main stem of a young tree, are structurally weaker than uncolonized parts, so infested trees are more subject to breakage during handling or shearing. Finally, the resinous cavities may constitute an aesthetic problem when infested trees are offered for sale.

Recognizing that Christmas tree growers apply insecticides for midge control almost continuously in some areas, our goals in this study were to test whether a minimum number of insecticide applications, properly timed, could reduce resin midge damage during the growing season, and to evaluate consumer response to midge damage as an aesthetic injury at the time of sale.

Stanislaus County trials

Sixty-six 3- to 4-year-old Monterey pine Christmas trees were assigned to an insecticide trial in Stanislaus County. Because neither sticky traps nor the periodic measurement of larvae indicated whether or when peak emergences of adults occurred, we applied various calendar spray schedules in an attempt to empirically determine whether chemical control was possible with the minimum number of applications.

The treatments to single-tree plots, beginning in March, included applications made every month through August, every two months, every three months, and every four months, along with an untreated control. We tested two insecticides, dimethoate (Cygon) and fenpropathrin (Danitol). A completely randomized design was used, with six replications of all treatments; applications were made to runoff on tree trunks with a hand-compression sprayer. On September 17, we examined all trees and counted the number of active resin midge feeding sites.

San Diego County trials

Three blocks of 3-year-old Monterey pine Christmas trees, each comprising nine rows of eight trees, were assigned to a parallel chemical trial to the one described for Stanislaus County. A randomized complete block design was used, with three replications of the eight spray treatments and an untreated control. Each plot was a row of eight trees. Treatments, beginning in April, were applied every month, every two months, or every three months. On October 2, we examined the trees and counted the active midge feeding sites on each.

Christmas trees are unlike many agricultural crops in a number of ways. Not only do they take many years to reach a marketable size and shape, they are only offered for sale at one time of year. The sale period lasts about four weeks, and we could only conduct our consumer acceptance study after the rest of the project was completed.

Because it was not clear whether customers at choose-and-cut Christmas tree plantations noticed resin midge injury, or whether they considered it when they either rejected trees or delayed acceptance of trees, we evaluated 336 Monterey pines in another portion of this commercial operation on November 17, after each tree had been tagged with its selling price. The persons pricing the trees were unaware of our objectives.

For each tree, we recorded the number of midge feeding sites, the tree's height, and its price. We visited the plantation again once a week for the next 5 weeks to determine the selling date for each tree. We hoped to discover whether there was a shifting threshold of consumer response to midge-caused injury. That is, were the least-damaged trees sold during the first week, the next least-damaged trees during the following week, and so forth until only the most heavily damaged trees remained on the final week?

Results and discussion

In neither the Stanislaus County nor the San Diego County trial did we find significant differences in the numbers of active midge feeding sites for any treatment (table 1). Apparently, the insecticides had no effect on adult midges, and they were either ineffective against the larvae within the resin or unable to contact them in that medium. Knife wounds made to the trunks invariably contained eggs or larvae when observed 1 month later. Such observations indicate that adult midges are active over a prolonged period, and quickly lay their eggs in newly exposed pitch.

Our results led us to conclude that chemical control of resin midge is impractical. Although we evaluated only two insecticides, one of them a systemic organophosphate material (dimethoate) and the other a contact pyrethroid (fenpropathrin), we believe that other candidate materials would be unlikely to perform much differently, at least at the application frequencies used in these trials.

We analyzed the consumer acceptance study after all seasonal sales had ended. The trees that sold had significantly more midge damage sites ($\bar{X} = 4.28$, $P < 0.05$) than did

Table 1. Effect of various schedules of insecticide applications in preventing pine resin midge damage to Monterey pine Christmas trees, 1987

Insecticide & trial site	Date of application	Mean* active feeding sites per tree (Sept. to Oct.)
Stanislaus County Trial		
Dimethoate†	Monthly, Mar. to Aug.	0.67a
	Mar., May, July	0.50a
	Apr., June, Aug.	0.50a
	Mar., June	0.67a
	Mar., July	1.17a
Fenpropathrin‡	Monthly, Mar. to Aug.	0.83a
	Mar., May, July	0.67a
	Apr., June, Aug.	0.17a
	Mar., June	1.00a
	Mar., July	1.00a
None (control)	—	1.33a
San Diego County Trial		
Dimethoate†	Monthly, Apr. to Sept.	0.88a
	Apr., June, Aug.	1.67a
	May, July, Sept.	1.83a
	Apr., July	1.88a
Fenpropathrin‡	Monthly, Apr. to Sept.	1.54a
	April, June, Aug.	2.04a
	May, July, Sept.	2.39a
	Apr., July	2.09a
None (control)	—	2.04a

* Means for each trial followed by the same letter are not significantly different, according to Duncan's Multiple Range Test ($P < 0.05$).
† Cygon 4E, 1.0 lb AI/100 gal water.
‡ Danitol 2.4E, 0.2 lb AI/100 gal water.

TABLE 2. Mean heights, prices, and degrees of resin midge damage on Monterey pine Christmas trees at Escondido, 1987

Weeks before Christmas*	No. sold	Per-tree means† Damage sites‡	Price	Height
			$	feet
5	97	4.16a	32.64a	8.46a
4	31	3.64a	30.04a	7.87b
3	12	7.17b	26.21b	7.89b
2	25	4.32a	26.88b	7.78b
1	14	4.00a	25.81b	7.05c
(Unsold)	(157)	3.48a	21.24c	6.93c

* Week "5" was 22–28 November, 1987.
† Means in each column followed by the same letter are not significantly different, according to Duncan's Multiple Range Test ($P < 0.05$).
‡ Active and abandoned feeding sites.

trees that remained unsold (157, $\bar{X} = 3.48$). Trees that sold had been priced higher ($\bar{X} =$ $30.42) than trees that did not sell ($21.24), and were significantly taller ($\bar{X} = 8.10$ feet) than the trees that remained unsold ($\bar{X} = 6.39$ feet).

We also analyzed these data by date of sale to determine any consumer preference patterns. Trees sold during the third week had significantly more damage than those sold during any other week or those remaining unsold (table 2). During the first two sales weeks, the most expensive trees sold and the least expensive trees remained unsold. Further, the tallest trees sold during the first week; all but those sold in the final week were significantly taller than the trees that remained unsold. A stepwise regression, using price as the dependent variable and height and damage as independent variables showed, not surprisingly, that price was significantly correlated with height ($r^2 = 0.6829$).

Based on consumer preference, chemical control of pine resin midges is both unnecessary and impractical. Either customers did not notice midge damage or they were not influenced by it in their purchasing decisions. Instead, the taller and more expensive trees, damaged or not, sold first, leaving the shorter and less expensive trees for later sales. The pricing structure in that plantation did not reflect midge damage, suggesting that even those professionals responsible for assigning prices to individual trees did not recognize any aesthetic injury caused by these insects.

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By pruning all branches 18 inches from the orchard floor, citrus growers can prevent damage from snails and some insects. New research shows this practice also helps reduce Phytophthora brown rot on lemon fruit without reducing overall fruit yields. Phytophthora-infected lemon fruit (facing page) is discolored, rotten, and unmarketable.

Citrus skirt pruning — a management technique for Phytophthora brown rot

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Trials in Ventura and Tulare counties now establish that skirt-pruning can significantly reduce Phytophthora brown rot damage to lemon fruit without harming fruit yields.

For management of snails, honeydew-seeking ants, the Fuller rose beetle, and several other citrus pests, pruning the canopy skirts of citrus trees has become an accepted tactic in southern California citrus growing areas. Until now, no information has been available on the possibility this tactic might harm fruit yields or the possibility it might help manage Phytophthora brown rot on lemon fruit. Other researchers have determined that skirt pruning has no significant impact on yields of Valencia or navel oranges. We conducted two studies: one to determine the impact of skirt pruning on lemon yields, and another to test the hypothesis that skirt pruning could reduce the incidence of fruit infection with *Phytophthora citrophthora* (brown rot) on tree skirts.

Methods

The yield study took place in Ventura County on the Limoneira Ranch between February 1986 and March 1988. The site was an 18-acre lemon orchard (Limoneira 8A on Macrophylla rootstock) with eight plots; four replicates of skirted and unskirted trees alternated across the orchard. Each replicate