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## Article Information

Journal Title	Journal of economic entomology.
Volume	37
Issue	
Month/Year	1944
Pages	764-766
Article Author	
Article Title	Control of filbertworm and filbert weevil by orchard sanitation
Imprint	[Lanham, Md., etc.] Entomological Societ

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# Control of the Filbert Worm and Filbert Weevil by Orchard Sanitation<sup>1</sup>

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In the course of studies of the filbert worm, *Melissopus latiferreanus* (Wlsm.), and certain weevils, chiefly *Curculio uniformis* (Lec.), in the Pacific Northwest, investigations have been made of their possible control by picking up the nuts that dropped prematurely, before the worms in them could complete their development. During the preharvest season, when summer temperatures prevail, the *Melissopus* worms feed voraciously, complete their larval development in about 20 days, then bore their way out of the nuts to seek places for hibernation. They usually hibernate in tough, impervious cocoons within the first 2 or 3 inches of soil, but occasionally in rolled leaves or other suitable trash on the ground. The larva of the filbert weevil requires only a few more days for maturing than does the filbert worm. Some weevil larvae complete their development before harvest time, issue from the nuts, form their cells some 10 inches or deeper in the soil, and hibernate there for 2 or 3 years.

The filbert grower need have no serious concern regarding the disposal of the worms in the mature crop, because as soon as these nuts are harvested they are transported to the processing plant, where the wormy nuts are sorted out and destroyed, worms and all. That source of the potential reinfestation of his orchard is thereby eliminated, unless the mature nuts are allowed to remain on the ground an undue length of time. The other and more dangerous source is the infestation in the nuts that drop prematurely.

At the outset of the work on the filbert worm in 1937 it seemed desirable to include in the program a study to determine the ratio of infestation in the nuts that drop prematurely to those in the final crop together with the number infested in each group. Beginning in 1938, therefore, an accurate record was kept of the total yield of certain designated trees in different localities in the principal filbert-growing areas of the Pacific Northwest, only 16 of the more important of the numerous

varieties of filbert being included in the study. The results of these studies are presented in table 1. It will be noted that 606 filbert trees produced a total of 896,195 nuts in 6 years, of which only 15.3 per cent dropped from the trees during the pre-harvest season. It is a significant fact that this small proportion of the total yield included a few more wormy nuts than those gathered in the harvest. In the above total of 896,195 nuts are included, by actual count, 35,890 infested ones, of which 18,198, or slightly more than half of the wormy nuts found during the 6-year period, were among those that dropped from the trees prematurely.

Table 1.—Comparison of the infestation by the filbert worm in the pre-harvest drops and the harvested nuts for the years 1938, 39, 40, 41, 42 and 43.

TREES	PREHARVEST DROPS		HARVESTED NUTS	
	Total	In-fested	Total	In-fested
<i>Number</i>	<i>Number</i>	<i>Per Cent</i>	<i>Number</i>	<i>Per Cent</i>
229	35,928	14.3	176,675	3.0
127	35,807	6.2	180,284	.7
72	16,352	9.5	61,233	2.0
65	14,720	14.8	132,106	2.3
67	22,444	22.7	108,710	4.1
46	12,166	16.4	99,770	2.4
Total	Total	Average	Total	Average
606	137,417	—	758,778	—
—	—	15.3	—	2.3

The results shown in table 1 are in substantial agreement with preliminary results reported earlier (Dohanian 1940). Although these experiments were intended primarily to yield information on the filbert worm, work in subsequent years indicates that much the same situation exists with reference to the filbert weevil.

From the beginning of the study it became apparent that the periodic gathering and the immediate destruction of the pre-harvest drops would considerably reduce the worm hazard. In 1942 an experiment was therefore started in a filbert orchard covering 5.75 acres near Eugene, Oregon. The owner of the orchard had his regular

<sup>1</sup> From the Program of the Pacific Slope Branch, June 1944.

farm hands gather the dropped nuts on August 3, and at 10-day intervals thereafter, keeping the different varieties in separate gunny sacks. The gathered drops were brought to the laboratory at Eugene, where each sackful was weighed, then the nuts were emptied into large, shallow, rectangular boxes, and 15 or 20 per cent of them were removed for examination. These sample lots were taken, a handful

Taking the 2 years together, only 5 to 7 per cent of the larvae present in the premature drops were able to escape, therefore the population that would otherwise have remained in the orchard was reduced about 94 per cent. In the case of the filbert worm, there was an improvement in the results the second year by reason of the shorter intervals between successive pick-ups.

Table 2.—Computed number of *Melissopus latiferreanus* and *Curculio uniformis* larvae in the preharvest drops in 1942 and 1943, and the percentage of worms destroyed in the orchard-sanitation experiment.

SPECIES	NUTS INFESTED		Dead Number	In Nuts Number	LARVAE—			
					That Left Nuts Number	Total Living Number	In Hiber- nation Per Cent	Destroyed Per Cent
	Number	Per Cent			Number	Number	Number	Per Cent
<i>M. latiferreanus</i> :								
1942	2,313	3.5	361	1,690	262	1,952	13.4	86.5
1943	1,574	1.3	396	1,097	81	1,178	6.9	93.1
<i>C. uniformis</i> :								
1942	3,277	5.0	755	2,472	50	2,522	2.0	98.0
1943	767	.6	44	711	12	723	1.7	98.3
Total:								
1942	5,590	—	1,116	4,162	312	4,474	7.0	93.0
1943	2,341	—	440	1,808	93	1,901	4.9	95.1

Total premature drops: 1942, 65,350; 1943, 110,383.

at a time, from different parts of the box in the attempt to make them typical and representative of the entire lot. The nuts were then cracked and a record made of the infestation, all larvae found, either living or dead, being recorded as to species. When nuts had holes in the shell and the kernels had been largely consumed it was assumed that the larvae, being full-fed and full-grown, had left the nuts for hibernation. In such cases the worms were classified as being "in hibernation," since under actual farm practice of orchard sanitation they would have escaped destruction before the nuts were picked up and burned.

The results of the experiment in 1942 warranted its continuance in 1943. Again the same procedure was followed, with one exception. In order to ascertain whether more frequent collection of the premature drops would result in the removal and consequent destruction of a larger number of worms, the interval between collections was reduced from 10 to 7 days. The results of the two seasons' work are presented in table 2.

The cost of picking up the drops was surprisingly low—only \$2.92 per acre for picking up the drops four times in 1942, and \$7.18 per acre for picking them up seven times in 1943. The nuts that drop prematurely are very easily gathered because they fall in clusters and are retained in the shucks. These clusters are readily seen on the ground, which is clean-cultivated at that time of the year. The cost of removing the premature drops compares very favorably with that of spraying.

Studies of the susceptibility of the different filbert varieties to attack by the several worms found infesting the nuts indicated decided preferences for certain of the varieties. The two insects discussed in this paper strongly favored some of the pollinizers, particularly the very common variety Daviana. The filbert worm has invariably shown preference for the Daviana in the ratio of 3:1, as compared with the important commercial variety Barcelona. The filbert weevil has manifested even a greater liking for the Daviana, four times as many nuts of this variety having been found infested by the weevil during

the years 1938-43 as the combined infested total of the remaining 15 varieties studied during those years. From the point of view of insect injury it is probably fortunate that, in general, the pollinizers bear much fewer nuts than the commercial varieties. Since the filbert crop is harvested by hand picking the individual nuts from the ground, practically all growers follow the practice of allowing the nuts under the pollinizing varieties to remain unpicked until the very last, or until the accumulation of a sufficient quantity to make it profitable for the pickers to work. (Pickers are usually paid at a given rate per pound of nuts picked.) This procedure has been one of the chief reasons for the gradual increase in infestation, once the insects have become established in an orchard. Although gathering and burning of the drops during the preharvest season only once a week seems adequate to keep the infestation at a minimum in normal seasons, growers are advised that more frequent picking of the drops under the pollinizers, specially the Daviana—the variety most favored by all of the kernel-infesting worms—is strongly urged. Even the daily picking of the crop of this variety and its prompt removal from the orchard is suggested as a further substantial aid in the reduction of potential future infestations.

It is also possible to use hogs for removing the premature drops, thus avoiding the trouble and expense of picking them up. That has been done by a filbert grower of Gervais, Ore. Among the filbert plantations operated by this farmer is a 6-acre plot which was 18 years old in 1943. (Infestations are rare or extremely light in plantations under 10 years of age, but tend to increase as the orchards grow older.) For several years some of the nuts produced here have been wormy. No deductions have been made, however, by the nut-processing plant for excessive percentages of wormy nuts during the last

5 years, apparently because each year this grower has allowed about 18 pigs to graze in this plot, which is fenced in, from the time the first premature nuts began to drop until the first fall of mature nuts. The pigs ate not only the kernels, if any, that may have been in the nuts but the worms as well. Since the pigs crack all nuts, they feed on, any worms escaping are doomed, for they are still immature and have practically no chance of completing their development once they have been removed from the kernels, which provide their nourishment.

Filbert growers considering the use of orchard sanitation for the control of insects feeding in the kernels of the nuts should bear in mind that the effects of the work will not be fully evident until the third or fourth year after it is started. Any reduction in the population of the filbert worm should be evident the year after the drops are first picked up, but in the case of the weevils, which have 2- or 3-year life cycles, at least 2 years must elapse before any benefit can be anticipated. From that time on an increasing cumulative benefit should be realized, unless there are present nearby abundant sources of reinfestation. In such circumstances it is indeed imperative that a grower continue to practice orchard sanitation with even greater persistence.

Another reason for considering orchard sanitation as a means of controlling these insects is the absence of an effective insecticidal treatment for the filbert weevil. Spraying with lead arsenate has been reported (Thompson 1942) as effective in the control of the filbert worm, but not all growers have yet adopted spraying as a standard practice. Under present war-time conditions, the adoption of available insect-control methods that will conserve insecticides for use against insects not otherwise controlled is especially desirable, particularly when such practice is less expensive than the application of insecticides.—7-3-44.

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