



Weevil damage first appears at borders of plantings, then spreads into the field. Inset shows weevils on strawberry roots.

Furadan controls root weevil on strawberries

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When applied as a bed spray to weevil-infested strawberry plants after fall and winter picking, Furadan greatly reduced populations of woods and cribrate weevils.

Strawberries, a major crop in the Salinas-Watsonville area, today are being subjected to serious and increasing attacks by root weevils.

The woods weevil, *Nemocestes incomptus*, is the major pest; the cribrate weevil, *Otiorhynchus cribricollis*, is causing crop damage to a lesser extent.

Results from field tests conducted in the Salinas-Watsonville area during the past two years show that the insecticide carbofuran (Furadan), when applied as a bed spray to weevil-infested strawberry plantings after fall and winter picking, can control the woods weevil and the cribrate weevil. Registration for use on strawberries is expected following completion of residue studies that are now under way.

The pests

The small, brown-headed, whitish larvae of the two weevils feed on the roots of strawberries, causing their collapse and death. First signs of weevil attack usually are detected along the borders of strawberry plantings, with the damaged area gradually spreading into the fields. When first-year berry plantings are next to older, weevil-infested plantings, damage caused by weevil movement into the new field can be substantial.

The weevils have a single generation yearly. However, some adult weevils can be found most of the year. Adults are most numerous in summer and fall. The 1976 to 1977 studies of distribution

of life stages for the woods weevil in Watsonville strawberry fields show that 83 to 94 percent of the weevils were in the larval stage in late January. However, by late April, larvae represented about 37 percent, pupae 45 percent, and adults 18 percent of the weevil populations sampled. The cribrate weevil tends to emerge in June, according to the literature.

The adult weevils of both species enter strawberry fields by crawling, not flying. Cultivation and flood irrigation also spread weevils.

Both the woods weevil and the cribrate weevil are general feeders. They live on blackberries and other wild shrubs in uncultivated areas and on shrubs and trees such as Monterey pine and cypress. The cribrate weevil also is a pest of artichokes in the Castroville area.

Available insecticides

Chlordane formerly was recommended as a preplant soil treatment for control of cribrate and closely related weevil species, but its use is being restricted and its future is uncertain. Weevil-infested areas of strawberry fields can be treated by injecting ethylene dibromide into the soil; however, this material will kill strawberry plants. Although sprays of malathion, Guthion, diazinon, and Phosdrin can be applied for adult weevil control during the picking season, they generally have been ineffective in limiting weevil damage and spread.

Furadan experiments

Registration of Furadan in Washington and Oregon in 1976 for postharvest control of root weevils on strawberries gave rise to the hope for control of weevils in California. The tests reported upon here were begun in February 1976 to evaluate Furadan under California strawberry growing conditions. The later experiments included evaluations of the insecticides Dyfonate and Mesurol.

The first two experiments conducted in the Salinas-Watsonville area compared applications of Furadan 4F at 2 pounds active ingredient per acre as a spray over strawberry beds and as an injection into the soil adjacent to plants. These experiments were started in February 1976 on heavily damaged, second-year Tioga variety plantings. Plots were evaluated during the first week of April by digging plants and soil to a depth of approximately 1 foot and sifting the soil through a screen to re-

cover weevils. The counts obtained indicated that Furadan was more effective sprayed than injected (table 1).

In October 1976, the third and fourth experiments were begun to test Furadan 4F at rates of 2 and 4 pounds active ingredient per acre as a spray application. (Dyfonate 4F, registered for garden centipede control as a preplant soil treatment, was included in the third experiment as a spray application at the same rates as Furadan.) Results are summarized in table 2. Furadan gave good control of the woods weevil at the lower application rate and even better control at the higher rate. Dyfonate resulted in poor control.

The fifth experiment, beginning in November 1976, was aimed at evaluating drip irrigation as a method of applying Furadan for woods weevil control. The insecticide was introduced into a drip system shortly after the beginning of an irrigation cycle. Subsequent weevil counts from soil screening were high (table 2). Examination of the drip line at the time that counts were made revealed deposits of the insecticide along the bottom of the line, indicating that it had settled out and that not enough Furadan reached strawberry roots to provide effective weevil control.

In the final experiment, Mesurol

75WP at 4 pounds active ingredient per acre and Furadan at 2 and 4 pounds active ingredient per acre were sprayed over strawberry beds in January 1977. (Mesurol is being developed as a molluscicide for slug and snail control.) At the end of March, the treatments were evaluated. Mesurol failed to reduce the weevil population, but the Furadan treatments provided excellent control (table 2).

In addition to showing that Furadan, applied as a bed spray to weevil-infested strawberry plants after fall and winter picking, greatly reduced populations of woods and cribrate weevils, data from the experiments also suggest that overhead sprinkler irrigation following spray application of Furadan to strawberry beds enhances root weevil control, possibly because it aids movement of the insecticide into the soil. Because the experiments were conducted during severe drought conditions, the effect of rainfall on leaching insecticide into the soil could not be assessed adequately.

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TABLE 1. Control of the Cribrate Weevil with Furadan Sprays on Strawberries

Material	Lb AI/A	Application method	% control over number of weevils indicated in check of 346
Furadan	2	spray	81
Furadan	2	injection	43

TABLE 2. Control of the Woods Weevil with Various Sprays on Strawberries

Material	Lb AI/A	Application method	% control over number of weevils indicated in check
Test 1 applied Feb. 4; sampled April 2, 1976; 230 weevils in check			
Furadan	2	spray	92
Furadan	2	injection	82
Test 2 applied Oct. 26; sampled Jan 19, 1977; 576 weevils in check			
Furadan	2	spray	81
Furadan	4	spray	89
Dyfonate	2	spray	46
Dyfonate	4	spray	31
Test 3 applied Oct. 26; sampled Jan. 21, 1977; 1158 weevils in check			
Furadan	2	spray	85
Furadan	4	spray	98
Test 4 applied Nov. 19; sampled Jan. 20, 1977; 476 weevils in check			
Furadan	2	drip	54
Furadan	4	drip	49
Test 5 applied Jan. 5; sampled March 29, 1977; 170 weevils in check			
Furadan	2	spray	96
Furadan	4	spray	99
Mesurol	4	spray	0