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Dissipation of Dislodgeable Propargite Residues on Nectarine Foliage

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Exposure to propargite residue has been associated with numerous cases of dermatitis in farmworkers. In 1987, 32 cases of fieldworker dermatitis associated with exposure to propargite, both alone and in combination with other pesticides, were reported by physicians (Maddy 1990). In 1986, 114 orange pickers developed symptoms of contact dermatitis, including itching, burns, erythema, blistering and weeping, as a result of exposure to propargite-treated foliage (Saunders 1987, Maddy 1988).

In June, 1988 the Worker Health and Safety Branch investigated an incident of reported dermatitis among nectarine harvest workers that was associated with propargite residues (O'Malley 1990). Forty-six of 57 workers in three crews presented visible contact dermatitis on medical examination. A No Observed Effect Level (NOEL) of 0.2 ug/cm^2 was estimated.

Since reentry prohibitions have traditionally been used to protect workers from unhealthful residue exposure, characterization of propargite residue dissipation and degradation under various conditions is critical to ensuring a safe agricultural work environment. The objective of this study was to determine the rate of propargite dissipation on nectarine foliage under conditions similar to those present in the orchards associated with the investigated dermatitis incident. In addition, the data would be used to enable estimation of residue levels present in orchards suspected of causing the dermatitis from samples that were taken several days after exposure in suspect orchards.

Propargite, 2-[4-(1,1-dimethylethyl)phenoxy]cyclohexyl-2-propynyl sulfite, is formulated as a wettable powder and emulsifiable liquid for use as an agricultural miticide. Over 2.6 million pounds were sold for use in California in 1989 (CDFA 1990), with heaviest use on cotton, corn, almonds, grapes, citrus, strawberries, walnuts and stone fruit, including peaches, nectarines, apricots and cherries (CDFA 1990a). Of these, only citrus, strawberries, grapes and stone fruit generally require substantial worker contact with foliage during harvest.

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Degradation of propargite residue has previously been characterized on grape vines (Maddy 1986 and O'Connell 1987) and orange trees (Saiz 1986). The half-life reported for oranges was seven to 14 days. The reported data on grapes did not display a first-order decay behavior. No previous studies of dislodgeable propargite residues on peaches or nectarines were identified.

MATERIALS AND METHODS

Four fields were selected to conduct a dislodgeable residue degradation study on nectarine foliage. Dislodgeable foliar residue was chosen because it is a frequently used index of pesticide residue exposure to workers contacting treated foliage (Gunther 1973).

Study plots were identified from treatment records of a grower not involved in the illness episode. Nectarine orchards were chosen on the basis of: (1) geographical proximity to the orchards suspected of involvement in the dermatitis incident; (2) applications of propargite made during the time period of interest, late May to mid-June, 1988; and (3) similarity of application rate and method to the orchards involved in worker injuries. All orchards were treated with 7.5 pounds Omite 30W[R] (2.25 pounds propargite) with Britz Buffer[R] in 70 gallons of water per acre using an orchard-type (air blast) sprayer.

Two blocks of trees, ten rows wide by ten trees long, were selected randomly and marked in each orchard. Within each block, two samples were collected by sampling each of the ten trees on both corner-to-corner diagonals. Each sample consisted of 40 five square centimeter leaf discs, collected using a Birkestrand leaf punch with a four-ounce glass jar attached. Four discs were collected from each tree, one from each of four sides, at a height of approximately four to six feet. After collection each sample was sealed with aluminum foil and a screw cap and placed on ice for shipment to the analytical laboratory for next day extraction and analysis.

Sampling was initiated 13 to 35 days after application and continued at seven- to ten-day intervals for approximately five weeks, or until residues became non-detectable. Field 1 was harvested 12 days after application, and before sampling began. Harvest had been completed in Fields 2, 3 and 4 before application.

Analysis for dislodgeable residue was conducted using the method of Iwata (1977). Residues were washed from leaf discs by immersion and agitation three times, for 20 minutes each, in 50 ml water with a few drops of a 2 percent aqueous solution of dioctyl sodium sulfosuccinate (Sur-Ten[R]), a surfactant. The solution was then decanted and extracted with ethyl acetate. Analysis was by gas chromatograph with a 10 m x 0.54 mm megabore column with 5 percent phenyl methyl silicone and electron capture detector. Injector, oven and detector temperatures were 300^{o}C, 230°C and 275°C, respectively. Helium gas flow was 40 ml/min. The minimum level detectable was 30 micrograms per sample. Sample results reported as "none detected" were treated as having residues of 0.07 ug/cm^2, equivalent to the limit of detection.

RESULTS AND DISCUSSION

Results were used to calculate rate constants for decay of propargite using a first order log-linear model of decay. Table 1 shows the calculated rate constant, the coefficient of determination (r^2-value), corresponding half-life, and estimated initial deposition for each field. Dislodgeable propargite on individual samples and results of least squares regression analysis are plotted in Figure 1 for the sampling period in each field.

Table 1. Half-life and deposition of propargite residue on nectarine foliage

Field	Rate Constant (ln[ug/cm^2]/d)	r^2-value	Half-life (days)	Estimated Deposition (ug/cm^2)
1	-0.044	-0.96	15	1.75
2	-0.055	-0.74	12	1.05
3	-0.062	-0.98	11	1.49
4	-0.014	-0.34	53	0.59
Median	-0.049		13	1.27

First-order rate constants (expressed in ln[ug/cm^2]/day) in the four fields studied ranged from -0.014 to -0.062, with associated half-lives of 11 to 53 days. Since these data include monitoring only during the period of two to nine weeks after application, half-lives derived can only be considered representative of the later stages of dissipation. For the same reason, estimates of deposition should be considered theoretical. The median half-life of dislodgeable propargite residues found during the period two to nine weeks after application was 13 days. The median first-order dissipation rate constant was -0.049.

The relatively high r^2-values in three out of four fields demonstrate the data fit reasonably well with the log-linear model of decay. The lower r^2-value in Field 4 is associated with a slower observed dissipation and a lower residue level at first sampling. The median half-life of 13 days is consistent with findings of others investigating propargite residues on other tree crops (Saiz 1987). Since the data here are based on a limited number of study fields, it is not practical to evaluate the significance of the much longer half-life observed in Field 4 versus that in other fields. There were no apparent differences in environmental conditions or agricultural practices to explain the anomally. It is important to explore the conditions necessary to cause markedly slower dissipation in certain fields as a possible insight to the infrequent and erratic incidence of illness episodes.

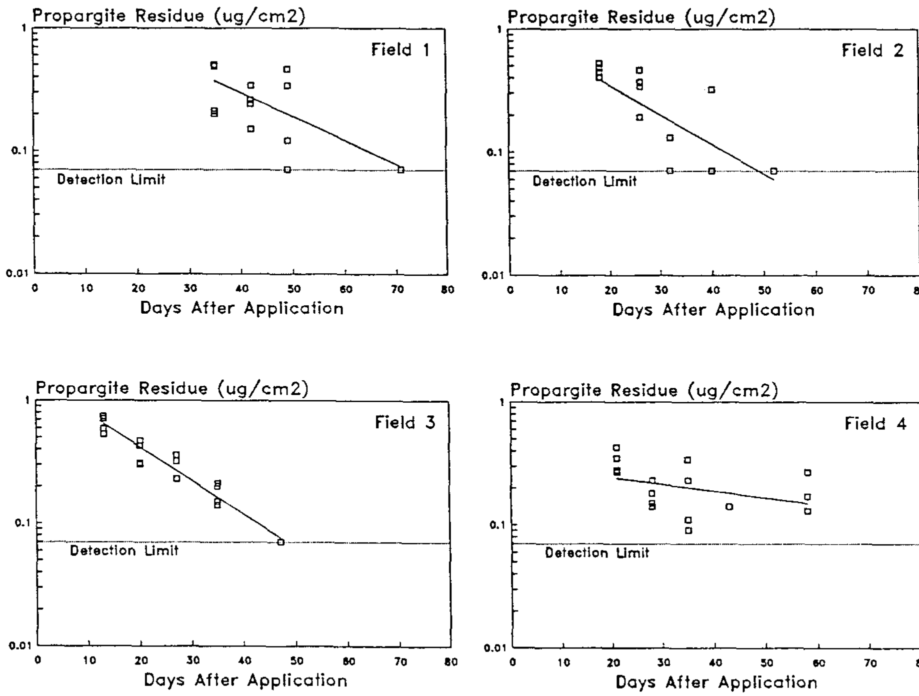

Figure 1. Dislodgeable propargite residue on nectarine leaf discs and least square regression indicating dissipation

The final recommendation of a reentry interval for nectarines treated with propargite will depend on determination of a safe exposure level. Based on this investigation, a reentry interval of 35-45 days would be necessary to achieve a proposed safe level of 0.2 ug/cm^2 in nectarines.

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