5. Pesticide Resistance

EVALUATION OF CODLING MOTH RESISTANCE TO AZINPHOS-METHYL AND CHLORPYRIFOS IN WALNUTS

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Abstract - Codling moth (CM) resistance for azinphos-methyl was screened in 15 orchards and for chlorpyrifos in 7 orchards. It appears that CM has developed a low level of azinphos-methyl resistance throughout the state with a moderate to high level of resistance in the southern San Joaquin region (Kings and Tulare counties). However, no resistance to chlorpyrifos was observed in any of the locations except possibly in an isolated untreated orchard near Hollister (San Benito county).

Methods and Materials - Adult CM were captured from 15 orchards in Kings, Tulare, San Joaquin, Yuba and San Benito counties. The orchards had a history of heavy insecticide use over the past few years except for those untreated orchards in San Benito and Tulare counties. One hundred pheromone traps were placed high in the tree canopy at about 6:00 p.m. and removed at about 5:00 a.m. the next morning. The trap bottoms with moths imbedded in the stickem were returned to Berkeley.

The CM were divided into two or three equal sets depending on the number of moths captured. If three sets were created, one set of CM was dosed with a discriminating dosage of 0.1 μg/μl of azinphos-methyl, the second set of CM was dosed with a discriminating dosage of 0.3 μg/μl of chlorpyrifos and the third set served as an untreated control. If only two sets were created, one set of CM was dosed with a discriminating dosage of azinphos-methyl and the second set served as an untreated control. The moths were scored for mortality 48 hours after treatment.

Dose mortality lines were generated for azinphos-methyl from two orchards. One orchard was susceptible to azinphos-methyl while the other orchard was resistant to azinphos-methyl based on the initial resistance screens. Dose mortality lines were generated by treating 20 to 30 moths with 6 to 7 concentrations ranging from 0.0 to 1.0 μg/μl of azinphos-methyl for both populations.

Results and Discussion - Resistance to azinphos-methyl was screened in 15 orchards throughout the state while only 7 orchards were screened for chlorpyrifos resistance. The percent corrected mortality for the discriminating dosage of azinphos-methyl ranged from 0 to 54% while the percent corrected mortality for the discriminating dosage of chlorpyrifos ranged from 68 to 86% in orchards which had a history of heavy insecticide use over the past few years. Thus, it appears that CM in most walnut orchards throughout the state have some degree of resistance to azinphos-methyl with a moderate to high level of

resistance in the Kings/Tulare county region. In addition, the azinphos-methyl resistance appears to be stable between the first and second generation. In an orchard in San Joaquin county the percent corrected mortality for the first generation was 42.3% while it was 45.2% for the second generation.

Four orchards had never been treated with insecticides and served as untreated control orchards. However, only two of the four orchards have azinphos-methyl susceptible populations. The low to moderate resistance in two of the orchards which were adjacent to treated orchards may indicate that there is mixing of the CM populations between orchards and possibly within a geographical region. This mixing of the populations may explain the wide spread moderate level of resistance. The two susceptible orchards were very isolated from any source of treated CM.

Probit analysis of the dose mortality data from the susceptible and resistant populations show a significant shift in the LC_{50} and CL 95% values. The LC_{50} and CL 95% for the susceptible population from the untreated orchard was 0.082 and 0.062 to 0.105 µg/µl, respectively and for the resistant population from a heavily treated orchard was 0.331 and 0.224 to 0.455 µg/µl, respectively. A completely susceptible CM population would be expected to have a LC_{50} of about 0.06 µg/µl. There appears to be about a 5 fold increase in the azinphos-methyl tolerance in the southern San Joaquin region (Kings and Tulare counties) compared to a susceptible population.

There was no resistance found to chlorpyrifos. It is interesting to note that a 46.5 % mortality to chlorpyrifos was found in the azinphos-methyl susceptible population which had never been treated with insecticides. This decreased mortality to chlorpyrifos in the untreated orchard which was susceptible to azinphos-methyl is very encouraging since it may mean that azinphos-methyl resistant CM may exhibit negatively correlated cross-resistance with chlorpyrifos. Nevertheless more orchards need to be evaluated for chlorpyrifos resistance before we can determine the extent of negatively correlated cross-resistance. But if there is negatively correlated cross-resistance to chlorpyrifos and possibly to microencapsultated parathion (Penncap-M), then it may be possible to break the resistance and revert the CM population to an azinphos-methyl susceptible population.