Pesticide resistance

TOXICOLOGICAL RESPONSE OF MALE ORIENTAL FRUIT MOTH COLLECTED FROM EASTERN APPLE ORCHARDS TO AZINPHOSMETHYL

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The Oriental fruit moth, *Grapholita molesta* (Busck), is a serious pest of stone fruit worldwide. Some populations have developed resistance to azinphosmethyl in eastern Canada. While *G. molesta* is usually a pest of peach in eastern and Mid-Atlantic States, larvae have been found infesting apples during the past few years. From 1995 to present, reports of azinphosmethyl control failures have been reported in parts of NJ, PA, MI, WV, VA, and NY. In some locations, both azinphosmethyl rates and the number of applications per season have increased as a result of reduced product efficacy. In response to this particular situation, a project was initiated to determine if *G. molesta* populations have developed resistance to azinphosmethyl in eastern orchards.

In NJ, during 1998, toxicological responses to azinphosmethyl of male Oriental fruit moth from 5 commercial orchards in which control failures had occurred were examined for azinphosmethyl resistance and for potential resistance mechanisms using a topical pheromone trap bioassay first pioneered by Riedl. Results were compared with a reference population that had no history of control failure and received little selection pressure. 1998 field survey results indicated moderate level of resistance to azinphosmethyl (2.7 to 4.1 fold). LC_{50}s ranged from 90.6 – 220.7. The slopes of regressions lines (2.5 – 2.8) indicated genetically heterogeneous populations. A 2-fold decline was observed between fourth flight of 1998 and first flight of 1999, suggesting that resistance was unstable in moths collected from these study sites. 1999 field surveys indicated lower level of resistance to azinphosmethyl. The resistance ratios ranged from 1.2 to 1.9 during first flight of 1999 (LC_{50}s 63.2 – 100.8 ppm) and 1.2 to 2.6 during fourth flight of 1999 (LC_{50}s 54.1 – 148.0 ppm). Steep slopes of regression lines during 1999 season indicated the presence of genetically homogeneous populations with the exception of the reference population. A 1.5 to 2.0 fold increase in the LC_{50}s was observed between first and fourth flights of 1999, indicating that resistance can build up during the growing season. DEF, but not Piperonyl butoxide, significantly enhanced the toxicity of azinphosmethyl, suggesting that enhanced metabolism by esterases are involved in the tolerance of azinphosmethyl in moths collected form these study sties. Our data also provides a basis for suggestion that there may be nonmetabolic (target sites) mechanisms involved in the increased tolerance to azinphosmethyl.

In 1999, PA began assaying OFM using the above procedure. LC_{50}s from PA apple orchards ranged from 29.0 – 129.2 ppm and for peach, 18.6 – 150.7 ppm. Results from PA also showed that LC_{50} values increased between early and later season testing.

The resistance survey was expanded during CY2000 and the responses of OFM collected from MI, NJ, NY, and PA orchards were tested. Results are resented in Table 1. In NJ, while LC_{50}s were apparently lower in 2000 than in previous years, orchards that originally had high LC values were removed from production (with a bulldozer). LC_{50} values obtained in PA were also lower in 2000 compared with 1999 results.

The fact that LC values fluctuate during a growing season and between years suggests that OFM resistance to azinphosmethyl is not stable and can be managed. Resistance levels have declined following seasonal pyrethroid and carbamate use. However, this resulted in increased mite and wooly apple aphid problems. Softer management tools such as Intrepid (methozyfenozide) and OFM mating disruption are being implemented.

Table 1. LC50s of male OFM collected from orchards in different States and then topically treated with azinphosmethyl: CY2000

State	Site	LC_{50} (ppm)	RR[a]
MI	1	26.7	-
	2	59.4	2.2
	3	58.5	2.2
NJ	1	76.1	1.5
	2	70.2	1.3
	3	52.1	-
	4	74.5	1.4
	5	81.4	1.6
	6	66.7	1.3
NY	1	9.3	-
PA	1	19.7	-
	2	24.1	1.2
	3	36.5	1.9
	4	32.7	1.7

[a]Resistance ratios calculated by dividing LC_{50} by lowest LC_{50} observed within each state.

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