

Pre and Post Harvest IPM for the Mango Fruit Fly, *Bactrocera dorsalis* (Hendel)

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ABSTRACT: The fruit fly, *Bactrocera dorsalis* (Hendel) is a major pest of mango in India. So, investigations were carried out to standardize an Integrated Pest Management (IPM) for fruit fly-free and residue-free mango fruits. The study required orchard and laboratory studies, which were conducted on the commercial variety *Banganapalli*, at the Indian Institute of Horticultural Research, Hessaraghatta Lake PO., Bangalore, India, during 2004 and 2005. Results showed that a pre harvest IPM combination of male annihilation technique (MAT) (using methyl eugenol as a lure) + sanitation brought down *B. dorsalis* infestation to 5.00% from an infestation ranging from 17 – 66% in control in both years. An additional cover spray of Decamethrin 2.8EC 0.5ml/l (which is half the recommended dose) + Azadirachtin (0.03 %) 2ml/l (neem based botanical) gave 100% control in both the years. Post harvest treatments with hot water at 48°C for 60 and 75 min resulted in 100% control at both the time regimes in 2004 and 2005. The untreated fruits, which were also exposed to gravid females (but not treated in hot water) showed 30% and 5.5% infestations, respectively, in 2004 and 2005.

Key Words: Oriental fruit fly, Male annihilation technique, Chemical Control, Hydrothermic treatment, *Mangifera indica*

INTRODUCTION

In India, mango, *Mangifera indica*, is a major fruit crop with high potential for exports. The Oriental fruit fly (OFF), *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) is a direct pest on mango. In India, the loss in fruit yield ranges from 1 to 31% with a mean of 16% (Verghese *et al.*, 2002). The OFF not only causes economic loss but is also of quarantine importance. The fly is distributed in the Oriental regions of Bhutan, China, Myanmar, Thailand and India. Adults of the OFF are attracted to the para-pheromone, methyl eugenol, and several studies have shown the efficacy of methyl eugenol in monitoring and management (Verghese *et al.*, 2006).

As fresh mango fruits are of value both to domestic and international markets, it is important to avoid insecticidal sprays close to harvest so as to obtain residue-free fruits. Verghese *et al.* (2004) found that cultural methods like orchard sanitation (collection and destruction of all fallen fruits), inter tree ploughing combined with a cover spray of deltamethrin 2.8EC @ 1ml/l gave excellent

control of fruit flies. However, it was found in subsequent investigations that male annihilation technique (MAT) using methyl eugenol as lure is a potent tool in obtaining good control levels. It was also felt that insecticidal dose level should be reduced with exploration of safer and environment friendly insecticides like plant-based compounds with insecticidal action. In India, neem based component *viz.*, azadirachtin is commercially available. So, a preharvest IPM consisting of MAT + cultural methods + half the dose of recommended insecticide in combination with botanicals was investigated. A need was also felt for a cheap and viable post harvest treatment. So, research was carried out to standardize a Pre and Post Harvest Integrated Management (IPM) for *B. dorsalis* to obtain fruit fly-free and residue-free mango fruits for internal and export markets.

METHODOLOGY

The study was taken up at the Indian Institute of Horticultural Research, Bangalore (12°58'N; 77°35'E), S. India during 2004 and 2005 in a mango orchard of *cv. Banganapalli*. The orchard consisted of compact block of

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24 trees. Here the pre harvest IPM treatments were incorporated. An orchard of the same variety consisting of 20 trees about one km away from this IPM orchard served as control where no treatments were imposed.

Pre harvest IPM components consisted of MAT with methyl eugenol traps (4 traps/ acre) (30 days prior to harvest; common to all trees). The trap was a low-cost bottle trap (used mineral water bottle with four windows of 1.5cm diameter). Plywood (3 x 3 x 1 cm) soaked in methyl eugenol for 48 h in a solution of 6:4:1 ethanol: methyl eugenol: malathion was dangled using a twine in the bottle. The wooden blocks were almost at the same level of the windows. The trap is hung on the tree or staked under the tree, 2m above ground (Stonehouse *et al.*, 2005). Sanitation involved the destruction of all fallen fruits at weekly intervals starting 30 days prior to harvest; common to all trees. Cover sprays of botanicals/ insecticides 21 days prior to harvest (as detailed in Table 1) were investigated. Six trees were selected at random for each cover spray. Another six trees were not sprayed but received the above MAT + sanitation treatments.

Sampling for pre harvest: At harvest 15 fruits at random were selected from each tree and grouped, thus each treatment had 90 fruits. These fruits were brought to the laboratory held in cages for ripening after which they were cut and percentage infestation was calculated based on the number of infested fruits.

Sampling and treatments for post harvest:

Fruits at 80% maturity along with the stalk (1 cm length) were harvested from the trees, which received pre harvest IPM, brought to the laboratory and de-sapped. Only healthy firm fruits were selected. Fruits, which showed partial yellowing, and softness (suspected of fruit fly infestation) were discarded. 360 fruits were selected and 270 fruits were exposed to sexually mature female fruit flies for oviposition in cages for 24 hrs and 90 fruits were kept unexposed. After oviposition, 180 fruits were subjected to hot water treatment at 48°C for 60 and 75 min separately (90 fruits for each time regime) and 90 fruits were kept as control A. Another 90 fruits that were not exposed to oviposition were also kept as control B. All fruits were cut and examined for percent fruit fly infestation after ripening. Fruits were treated in a double walled steel tank of 1000 l capacity, with thermostat.

Results and Discussion

In 2004 and 2005, MAT + sanitation appreciably brought down *B. dorsalis* infestation (Table 1). An additional cover spray of Deltamethrin 2.8EC 0.5ml/l + Azadirachtin (0.03) 2ml/l gave 100% control. As the cover spray was only half the recommended dose, residues are not expected because at 1 ml of deltamethrin (the earlier recommended dose) the waiting period was only one day (Awasthi, 2001). Use of botanical was synergistic with 1/2 the dose of deltamethrin.

Table 1: Pre harvest IPM of fruit fly

MAT + Sanitation + Cover spray	% infested fruits n = 90 fruits	
	2004	2005
MAT + Sanitation + Deltamethrin 0.5 ml/l + Azadirachtin 2 ml/l	0.00	0.00
MAT + Sanitation + Azadirachtin 3 ml/l	3.33	0.00
MAT + Sanitation + Neem oil 10 ml/l	10.00	1.11
MAT + Sanitation without cover spray	5.55	5.55
Control	17.78	66.67

Treatments with hot water at 48°C for 60 and 75 minutes resulted in 100% control at both the time regimes in 2004 and 2005. The untreated fruits, which were also exposed to gravid females (Control A) showed 30% and 5.55% infestations, respectively, in 2004 and 2005. Natural infestation did occur as evident in Table 2 (Control B). This however, seems to have been controlled in the hot water treatment.

The above results would mainly pertain to mortality of eggs as oviposition period would be around 3 days, within which the treatments were administered. Fruits, which have larval feeding, tend to yellow early and become softer and therefore gets culled out. Subsequent studies by the authors have shown that eggs and three instars of larval stages are heat susceptible at 48°C for 60 minutes. So, hot water treatment is ideal for pre export fruit fly disinfestations.

CONCLUSIONS

The mango fruit fly is a major pest of mango but can be well managed by a combination of pre harvest and post harvest treatments. Pre harvest treatments alone ensures 100% control and it can be further subjected to post harvest treatments to satisfy international disinfestation requirement. These strategies are environment friendly and residue-free. Efforts are being made to study the impact of area wide (community level) IPM application as opposed to individual orchard approach, for greater adoption of IPM.

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Table 2. Percentage fruit fly (*B. dorsalis*) infestation at different temperature-time regimes

Temperature (°C)	Time (minutes)	Infestation (%) n = 90 fruits	
		2004	2005
48	60	0.00	0.00
48	75	0.00	0.00
Control A (exposed to fruit fly oviposition)		30.00	5.55
Control B (not exposed to fruit fly oviposition)		5.55	1.11

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