Impact of integrated fruit fly management module on the mango yield: An analysis through front line demonstrations

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ABSTRACT: The Oriental fruit fly, Bactrocera dorsalis Hendel, is a major pest of mango in India, which causes significant loss of marketable yield. A study was conducted to assess the impact of the integrated pest management (IPM) module involving crop sanitation, bait sprays and male annihilation technique (MAT) using methyl eugenol as lure developed by ICAR-Indian Institute of Horticultural Research, Bengaluru for control of mango fruit fly through field demonstrations during 2012-13, 2013-14 and 2014-15. It was evident that demo orchards recorded lower fruit fly infestation (8.66%) as against 38.13 per cent in non-adapted orchards. An advantage average yield increase of 51.51 per cent was recorded under demonstration orchards, as compared to farmers’ traditional way. Wide yield gaps were observed during all the years, ranging from 2.14 ton/ha to 3.06 ton/ha. On three years average basis, technology gap of total 30 demonstrations was observed as 2.58 ton per hectare. The benefit-cost ratio was 4.71 and 4.09 in 2014-15 and 2012-13, respectively.

Keywords: Bactrocera dorsalis, front line demonstration, mango fruit fly

INTRODUCTION

Mango (Mangifera indica) is a major fruit crop of India and is considered to be the king of fruits. Besides delicious taste, excellent flavour and attractive fragrance, it is rich in vitamin A&C. The tree is hardy in nature, can be grown in a variety of soil and requires comparatively low maintenance costs. The Oriental fruit fly (OFF), Bactrocera dorsalis (Hendel) is a major pest on mango. In India, the loss in fruit yield ranges from 1 to 31% with a mean of 16% (Varghese et al., 2002). The fruit fly not only causes economic loss but is also of quarantine importance. Adults of the fruit flies are attracted to the para-pheromone, methyl eugenol, and several studies have shown the efficacy of methyl eugenol in monitoring and management (Verghease 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. 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. Indian Institute of Horticultural Research (IIHR), Bengaluru has developed a module for effective management of fruit fly involving the following components:

- Collection and destruction all fallen fruits at weekly intervals
- Installing six methyl eugenol fruit fly traps per acre (Stonehouse et al., 2005).
- Ploughing the soil around the tree basin at frequent intervals.
- Three weeks before the harvest, spraying deltamethrin 2.8 EC @ 0.5 ml/l + Azadirachtin (0.3%) 2 ml/l and take up timely harvest.

Front Line Demonstrations (FLD) on farmers field may be helpful in establishing the technology at farming community. The basic objective of this programme is to demonstrate improved proven technology through Krishi Vigyan Kendras (KVK) to bringing enhanced application of modern technologies to generate yield data with farmers feedback. Hence, the present study was conducted with the objective of comparing the yield levels of local check (unprotected fields) and FLD plots and recorded feedback information for further improvement in research and extension programme.

MATERIALS AND METHODS

Front line demonstrations on fruit fly management were conducted in 30 selected private fields in Tumkur district, Karnataka during 2012-13, 2013-14 and 2014-15 (10 demos per year). The villages for FLDs were selected on the basis of extensive surveys made by KVK on incidence of fruit fly. After selection of the village, most responsive key farmers were selected,
so that the performance of the demonstrated technology can be seen by other farmers. All the demonstrations were of 0.4 ha area each and were conducted using recommended package of practices. An orchard of the same one acre area about one km away from this demonstrated orchard served as control where no treatments were imposed. Farmers were provided with six fruit fly traps along with three lures each during three years of the study. The method of installation of trap was shown through method demonstration and regularly monitored by the scientists of KVK, Tumkur.

The observations on number of flies trapped, fruit infestation, yield of demonstration crop were recorded and analysed.

**Calculation of fruit infestation:** Five trees per demonstration were selected randomly. From each tree, 20 fruits were selected and kept in cages for ripening. After ripening, they were cut and percentage infestation was calculated based on the number of infested fruits. Different parameters as suggested by Yadav et al. (2004) were used for calculating gap analysis, costs and returns.

The detail of different parameters areas follows:

- **Extension gap** = Demonstration yield (D1) – Farmers practice yield (F1)
- **Technology gap** = Potential yield (P1) - Demonstration yield (D1)
- **Technology index** = Potential yield (P1) - Demonstration yield (D1) x 100/ Potential yield (P1)
- **Additional returns** = Demonstration return (Dr) - Farmers practice return (Fr)

**Effective gain** = Additional return (Ar) – Additional cost (Ac)

**Incremental B:C ratio** = Additional return(Ar) / Additional cost (Ac)

**RESULTS AND DISCUSSION**

**a. Fruit fly incidence:** It was evident that, the incidence of Fruit fly was on par in all three years as shown in the Table 1. The maximum number (33.00) of Male Fruit fly Trapped/ trap was recorded during year 2014-15 compared to 24.70 per cent in the year 2013-14 due to comparatively low fruit fly incidence (24.70 flies/trap). The demo orchard recorded the decreased fruit fly infestation of 8.66 per cent as against 38.13 per cent in control orchard due to cent percent adaptation of management practices as taught by KVK scientists and also efficiency of fruit flies in attracting the male flies. The mean decreased fruit infestation of 76.50 per cent was recorded over the control.

**b. Marketable Fruit yield:** The increase in fruit yield under demonstration was 50.92 to 52.26 per cent over control orchard. On an average 51.51 per cent yield advantage was recorded under demonstrations carried out with IIHR technology as compared to farmers traditional way of Mango cultivation.

**c. Gap analysis:** An extension gap of 6.08 to 6.72 ton per hectare in yield was found between demonstrated technology and farmers practices during three years. Average extension gap was 6.40 ton per hectare (Table 2). Such gap might be attributed to adoption of improved technology in demonstrations which resulted in higher fruit yield than the traditional farmers’ practices. Wide technology gaps were observed during all the years, the lowest (2.14 ton/ ha) and the highest (3.06 ton/ha) were recorded under demonstrations carried out with IIHR technology as compared to farmers traditional way of Mango cultivation.

<table>
<thead>
<tr>
<th>Table 1. Mango fruit fly incidence in demo and control orchards</th>
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<tbody>
<tr>
<td><strong>Parameter</strong></td>
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<tr>
<td>----------------</td>
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<tr>
<td></td>
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<tr>
<td>Avg. No. of male flies caught/ trap</td>
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<tr>
<td>Per cent fruit infestation</td>
</tr>
<tr>
<td>Per cent decrease in fruit infestation</td>
</tr>
</tbody>
</table>

reported in 2014-15 and 2012-13 respectively. On three years average basis, technology gap of total 30 demonstrations was observed as 2.58 ton per hectare. This technology gap during different years could be due to more feasibility of recommended technologies during study period. Similarly, the technology index for all the demonstrations during study period were in accordance with technology gap. Higher technology index (20.40%) reflected the inadequate proven technology for transferring to farmers and insufficient extension services for transfer of technology.

d. Economic analysis: Different variables like fertilizers, bio fertilizers, herbicides and pesticides were considered as cash inputs for the demonstrations as well as farmers practice and on an average an additional investment of Rs.767 per ha was made under demonstrations. Economic returns as a function of fruit yield and minimum support price (MSP) sale price varied during all the years. Maximum return was obtained during 2014-15 due to higher fruit yield and higher MSP sale price. The higher additional returns and effective gain obtained under demonstrations could be due to potentiality of the technology in controlling the fruit flies. The benefit: cost ratio (BCR) was 4.71 and 4.09 in 2014-15 and 2012-13, respectively (Table 3). Overall BCR was found as 4.38. The results confirmed the findings of studies conducted by Verghese et al., (2006).

Table 2. Fruit yield and gap analysis of front line demonstrations on management of fruit fly in mango (n = 10)

<table>
<thead>
<tr>
<th>Year</th>
<th>Potential yield (ton/ha)</th>
<th>Demo orchard yield (ton/ha)</th>
<th>Control orchard yield (ton/ha)</th>
<th>Per cent Increase over control orchard</th>
<th>Extension gap (ton/ha)</th>
<th>Technology gap (ton/ha)</th>
<th>Technology index %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-13</td>
<td>15.00</td>
<td>11.94</td>
<td>5.86</td>
<td>50.92</td>
<td>6.08</td>
<td>3.06</td>
<td>20.40</td>
</tr>
<tr>
<td>2013-14</td>
<td>15.00</td>
<td>12.46</td>
<td>6.06</td>
<td>51.36</td>
<td>6.40</td>
<td>2.54</td>
<td>16.93</td>
</tr>
<tr>
<td>2014-15</td>
<td>15.00</td>
<td>12.86</td>
<td>6.14</td>
<td>52.26</td>
<td>6.72</td>
<td>2.14</td>
<td>14.27</td>
</tr>
<tr>
<td>Mean</td>
<td>15.00</td>
<td>12.42</td>
<td>6.02</td>
<td>51.51</td>
<td>6.40</td>
<td>2.58</td>
<td>17.20</td>
</tr>
</tbody>
</table>

e. Farmers feedback: Farmers opinion that, they are very much confident and convincing with the technology in effective control of fruit fly at an average pest load. They also feel that spraying of one additional neem based insecticide is very laborious, when the severe outbreak of fruit fly. Non availably of trap at local pesticide shop is main inconvenience for timely adaption of the technology. Low life span of the lure is also another limitation.

The findings of the demonstrations indicate that adoption of IIHR technology for management of fruit fly,

Table 3. Economic analysis of front line demonstrations on management of fruit fly in mango

<table>
<thead>
<tr>
<th>Year</th>
<th>Demo orchard</th>
<th>Control orchard</th>
<th>Additional cost in demo orchard (Rs./ha)</th>
<th>Total returns (Rs./ha)</th>
<th>Additional return in demo orchard Rs/ha</th>
<th>Effective gain/h</th>
<th>B:C Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-13</td>
<td>24800</td>
<td>24000</td>
<td>800</td>
<td>101490</td>
<td>51680</td>
<td>50880</td>
<td>4.09</td>
</tr>
<tr>
<td>2013-14</td>
<td>26500</td>
<td>25800</td>
<td>700</td>
<td>115255</td>
<td>59200</td>
<td>58500</td>
<td>4.35</td>
</tr>
<tr>
<td>2014-15</td>
<td>27300</td>
<td>26500</td>
<td>800</td>
<td>128600</td>
<td>67200</td>
<td>66400</td>
<td>4.71</td>
</tr>
<tr>
<td>Mean</td>
<td>26200</td>
<td>25433</td>
<td>767</td>
<td>115115</td>
<td>59360</td>
<td>58593</td>
<td>4.38</td>
</tr>
</tbody>
</table>
on an average gave 51.51 per cent more marketable yield over the control orchards resulting in a benefit cost ratio of 4.38 which was sufficient enough to motivate the farmers for adoption of technology. The additional expenditure required to adopt technology was very nominal (Rs. 767/ha). The front line demonstrations were effective in spreading the awareness about fruit fly management among farmers by convincingly showing the additional yield benefits accrued by implementing the simple and cost effective IPM technology.

ACKNOWLEDGEMENTS

Authors are grateful to Director, ICAR-IIHR, Bengaluru for providing the facilities for conducting the study and participating farmers for their cooperation in implementing the technology and their valuable feedback.

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*MS Received : 19 July 2016*

*MS Accepted : 23 August 2016*