IPM Techniques for Management of Major Pests of Mango

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Mango (*Mangifera indica* L.) is very important commercial fruit crop in the world and choicest fruit of sub-continent and considered as king of all fruits. India contributes major share with 50% of worlds mango production (22 MT) with covering an area of 2.5M ha (NHB, 2023-24). The major mango growing states in India are Andhra Pradesh, West Bengal, Karnataka, Kerala, Bihar, Uttar Pradesh, UttarakhandUttarkhand, Maharashtra, Punjab and Haryana. Production of mango is enormously handicapped by various insect pests and diseases from seedling to maturity stage. The mango crop is attacked by about 492 species of insect pests and 285 pathogens, 17 species of mites and 26 species of nematodes in the world level. Of these, 188 species have been reported from India. Important and most destructive pests include, mango hopper, fruitfly, stone weevil, stem borer, thrips, leaf webber etc and among diseases powdery mildew, anthracnose, dieback, sooty mould etc. are of great economic importance and cause huge loss in mango production.

A survey was conducted before initiating the project at two different geographical regions of the country (Chikkaballapura, Karnataka and Meerut, Uttar Pradesh) in collaboration with KVK & College of Sericulture UAS, Bengaluru and SVPUAT, Meerut during October, 2020. The baseline information consists of name of village, area of mango cultivation, variety grown, total population and major constraints in mango crop etc. Mango hopper, fruitfly, leaf webber, stone weevil, stem borer, thrips, powdery mildew, anthracnose, dieback, sooty mould were important pests observed. Apart from insect pests and diseases, we also come across natural enemies *viz*., coccinellids, chyrsoperla, spiders and reduvid bug which play major role in checking the pest population. Also baseline information on varieties cultivated (Mallika, Totapuri-Chintamani, Dasheri, Gulab jamun, Chausa-Meerut), type of pesticides applied for management of major pests of mango, rate of application, cocktail pesticides if any, economics involved in the management of pests of mango was collected.

IPM module

An IPM module was synthesized for validation and further disseminated in wide area as per below details:

S. No.	Interventions	Against pests
1	Pruning of overcrowded branches, pruning of malformed flowers & paste with Bordeaux mixture, mechanical removal of leaf webber nests and burning, raking soil around tree trunk & ploughing operations, flooding orchard & alkathene stem banding	Leaf hoppers, Anthracnose, Leaf webbers, Fruit fly & Mealy bug
2	Installation of yellow sticky traps (5/acre)	Leaf hoppers
3	Use of Arka borer control & Installation of Light traps (Black bulb) or 250 wt bulb)	Stem borer
4	Installation of fruit fly traps (methyl eugenol) @ 20 traps/ha & bait splash on tree trunk	Fruit fly
5	Neem oil (5ml/lit) & azadirachtin 1% (3 ml/lit)	Thrips and leaf hoppers
6	Need based spray with sulphur 80% WP (2g/lit) or hexaconazole 5% EC (1 ml/lit) or azoxystrobin 23 % SC (1ml/lit) and	Powdery mildew, anthracnose
7	Need based Spray with lambda cyhalothrin 05% EC (0.5-1 ml/lit) or buprofezin 25% SC(1-2 ml/lit) and tolfenpyrad 15% EC (0.5 ml/lit)	leaf hoppers and Thrips

IPM module for major pests of mango at Chintamani, Karnataka

The experiment was implemented and validated in farmers participatory mode in 5 villages at Chintamani, Karnataka covering 16 ha. Different Integrated Pest Management (IPM) strategies were validated against important pests of mango *viz*; leaf hopper, thrips, leaf webber, stem borer, powdery mildew, anthracnose and sooty mould. Two orchards of IPM and two farmer practice from every village were selected for recording weekly pests' observations. Besides, control plants were also maintained in orchard for comparison with IPM and farmer practice at each location.

The population dynamics of leaf hopper was recorded for three consecutive years. The pooled mean of three years data revealed that, mean population of hoppers was lowest in IPM (2.99/ panicle) followed by farmers' practice (FP) (6.69/panicle) and highest in untreated control (10.57/ panicle). Reduction of hopper population in IPM over untreated control and FP was 71.71% & 55.3%, respectively. According to meteorological data, hoppers appeared throughout the year but peak population of hoppers was observed during 44-52th SMW. The population of hopper was below the economic threshold level in IPM whereas it crossed ETL in both untreated control and FP. Similarly, thrips also appeared from 40-52 &1-18 SMW of three consecutive years (2021-2023).

Highest population of thrips was observed in untreated control (3.54/tap) followed by FP (2.14/tap) whereas, IPM plot recorded lowest population (1.02) which is below ETL. There was 71.18 & 52.33% reduction was observed in IPM against untreated control and FP, respectively. Peak population of thrips was observed during 1-12 SMW. Leaf webber population started appearing during April and symptoms of web started appearing during July-August. IPM recorded lowest no. of webs per direction (2.27 webs/direction) followed by FP (5.21 webs/direction) and highest in untreated control (8.70 webs/direction). Reduction of 73.90 & 56.42 % was noticed in IPM compared to untreated control and FP respectively. Fruit fly population was also recorded using methyl eugenol traps from 1-22 SMW i.e., from beginning of flower to till harvest of the crop. An average of 40.12/flies/trap/week was observed from 2021 to 2023.

Population dynamics of coccinellid population was highest in untreated control (2.51/ m^2) followed by IPM plots (1.75/ m^2) and lowest was in FP (1.17/ m^2). Other natural enemies like, chrysoperla and spider has highest population in untreated control followed by IPM and lowest in FP. Among the diseases, powdery mildew severity (%) was highest in untreated control (19.13%) followed by FP (14.41%) whereas, lowest severity was observed in IPM (3.44%) during 2021-23. There was a reduction of 82.01 & 76.12% observed in IPM against untreated control and FP, respectively. Similarly, for sooty mould disease, highest pooled mean severity was observed in untreated control (15.19%) followed by FP (5.59%) and lowest in IPM (1.77%).

Socio-economic impact of IPM strategies

Economics of mango (var. Totapuri) were calculated considering various yield and other parameters. The average number of chemical sprays was 4.23 in IPM compared to 8.60 in farmer practice while no chemical spray was taken up in untreated control. There was 50.81% chemical sprays were reduced in IPM over FP for control of various pests. There was reduction of 9.81% total cost of cultivation in IPM compared to farmer practice. Highest average yield was recorded in IPM plots with 24.58 tons/ha, followed by FP with 20.46 tons/ha and lowest yield was in untreated control 13.31 tons/ha. The elevated yield of 16.76% & 45.85% in IPM over FP and untreated control respectively. Highest benefit cost ratio was also highest in IPM (2.72) compared to farmer practice (1.61) and control (0.99) respectively. Highest yield and other economic parameters were highest in IPM due to effective IPM techniques intervention at right time against key pests of mango crop.

IPM module for major pests of mango at Meerut, Uttar Pradesh

The experiment was implemented and validated in farmers participatory mode in 5 villages at Meerut, Uttar Pradesh covering 16 ha. The mean of three years data revealed that, population of hoppers was lowest in IPM (5.14/panicle) followed by farmer practice (10.27/panicle) and highest was in untreated control (11.25/panicle). There was reduction of 54.31 & 49.95% in IPM against untreated control and FP, respectively. The population of hopper was below or near the economic threshold level in IPM whereas it crossed ETL in both untreated control and FP. the highest population of thrips was observed in untreated control (11.91/tap) followed by FP (7.27/tap) whereas, IPM plot recorded lowest population (1.12/tap) which is below ETL. Per cent reduction of 90.59 & 84.59% was observed in IPM plots over untreated control and FP, respectively. Peak population of thrips was observed during 1-12 SMW. Leaf webber population started appearing during April and symptoms of web started appearing during July-August. The pooled mean population was

also highest in untreated control>FP>IPM. Fruit fly population was also recorded using methyl eugenol traps from 1-22 SMW i.e., from beginning of flower to till harvest of the crop. An average of 194.44/flies/trap/week was observed from 2021 to 2023.

Among coccinellids, highest no. of population/ m^2 was recorded in untreated control (3.50/ m^2) followed by IPM plots (1.94/m^2). Lowest was in (1.47/ m^2). Other natural enemies like, chrysoperla and spider has highest population in untreated control followed by IPM and lowest in FP. Among the diseases, powdery mildew severity (%) was highest in untreated control (20.34%) followed by FP (16.11%) whereas lowest severity was observed in IPM (4.20%) during 2021-23. Reduction of powdery mildew disease 79.35 & 73.92% over untreated control and FP, respectively. Similarly, for sooty mould disease, highest pooled mean severity was observed in untreated control (16.78%) followed by FP (5.55%) and lowest in IPM (2.51%).

Socio-economic impact of IPM strategies

Yield parameters and economics of mango (var. Dasheri) showed that, the average number of chemical sprays were 4.26 in IPM compared to 9.43 in (FP) while no chemical spray was taken up in untreated control. Reduction of 54.82% chemical sprays was observed in IPM over FP. Reduced cost of 7.81% was observed in IPM compared to FP. Highest average yield was recorded in IPM plots (9.79 tons/ha), followed by FP with 8.03 tons/ha and lowest yield was in untreated control 6.18 tons/ha. An increased yield of 17.97 & 36.87% was noticed in IPM over FP and untreated control, respectively. Benefit cost ratio was also highest in IPM (2.93) compared to FP (1.66) and least in untreated control (1.78), respectively. Timely intervention of IPM strategies are responsible for highyield and other economic parameters in IPM against key pests of mango crop.

Socioeconomic studies of IPM technologies in mango crop was carried out in five selected villages covering 16 farmers each at two locations (Chintamani, Karnataka & Meerut, UP). Various parameters were used to know the IPM impact on mango farmers. It was found that cent percent farmers have knowledge on IPM, minimizing the numbers of sprays, all technical information related to IPM, usefulness and economics of IPM, different components of IPM like, use of pheromone traps, yellow, blue sticky traps, neem oil, *Trichoderma*, *Pseudomonas*, *Bacillus*, awareness on environmental pollution, contamination of air, water, soil by pesticides and their adverse effect on beneficial insects, pesticides spraying methods, safety issues and intercropping. Likewise, 80% farmer know about economic threshold limit of pests and 80.58% farmers have identification ability of natural enemies. However, 23.5% farmers still depend on local pesticide dealer advisories. The income of mango farmers increased by 10-20% after adoption of IPM technology.

Dissemination of IPM technology

The IPM module developed, refined and validated in farmers field were disseminated in large area covering around 65 ha in each location (Chintamani, Karnataka & Meerut UP area). Which includes various villages covering more than 100 mango growing farmers. The awareness on IPM was created among farmers, which includes use of cultural, mechanical

and biological control agents for sustainable pest management, conducting various trainings, FFS, field days and distribution of IPM related literature.