Chapter - 5

Summary
Use of biological control including bio-pesticides, pheromones and bio-intensive IPM (BIPM) strategies is gradually emerging as a major alternative to chemical control of insect pests. Therefore, the present investigation emphasises the utilisation of biopesticides and pheromones for developing and validating IPM module for three major vegetable crops viz., Brinjal, Cabbage and Tomato. Farmers participatory approach is inculcated in this study, besides pre-evaluation survey and impact assessment surveys have been conducted before and after validation of the BIPM modules.

Preliminary survey for the pest management practices adopted by Brinjal, Cabbage and Tomato growers in selected villages of the 3 agro-climatic zones of Karnataka

Three agro-climatic regions of Karnataka were selected for study are Bangalore and Kolar (Eastern Dry zone), Hubli-Dharwad (Northern Transition Zone) and Belgaum (Northern Dry zone). The study was conducted in the years 2008 to 2011. Preliminary survey conducted in 2008 in all three zones by random selection of 50 farmers of each vegetables viz., Brinjal, Cabbage and Tomato by using suitable questionnaire. Total farmers interviewed in three zones were 450 covering more than 200 villages. The survey result indicated that 80 per cent of them were small farmers having less than one acre and had poor knowledge of pests and diseases. Again 80 per cent of farmers used chemical pesticides and largely depended on nearby chemical dealers as source of information. Survey also indicated that farmers were taking 4 to 12 sprays of chemical pesticides depending on the crop and pest infestation by spending ₹ 2000 to ₹15000 per acre. Though more than 90 per cent of the farmers were aware of harmful affects of chemical pesticides and ready to try any new environmental friendly products or methods to manage their crop pests and diseases. But their major concerns were improper information on pest and disease management and non- availability of alternative methods.
or products in their respective places. Thus the survey clearly indicated the need of alternative method to manage the pest and diseases and also to reduce the dependency on chemical pesticides. Over all it was found that farmers were mainly depending on chemical pesticides though few were practicing alternate methods or not used anything. This survey helped to know the need of alternative to chemical pesticides and education to the farmers on bad effects of chemical pesticides and importance of IPM.

Validations of bio-intensive integrated pest management (BIPM) module through farmer's participatory approach on selected vegetable crops

Bio-intensive IPM modules were validated in three agro-climatic zones on Brinjal, Cabbage and Tomato by using suitable trial protocol in two seasons of 2008-10. The new Bio-intensive IPM module was compared with existing traditional farmers practice.

Six BIPM validational trials were conducted on Brinjal crop wherein the BIPM module was compared with farmer's practices. More number of healthy plants were observed (both in nursery and main field) in Bio-Pesticides (T. viride, and P. flurosence) treated plot as compared to the Non-IPM plot.

Higher mean infestation of brinjal shoot and fruit borer- BSFB (L. orbonalis) was found in non-IPM plot (1.57 per plant) as compared to BIPM plot (0.99 per plant) and so also the damage to the shoots and fruits. Even the infestation of minor pests viz., mites, weevils and white flies were observed to be lower in BIPM treated plots. Similarly, the incidence of diseases like leaf blight and fruit rots were also found to be lesser in BIPM fields as compared to non-IPM plots. Pheromone trap catches of 1.27 moths/ day/ trap along with fruit and shoots clipping treatment was able to bring down the BSFB population substantially.

Cost of BIPM inputs viz., was 25 per cent lesser, as compared to that of chemical pesticides cost besides 10 per cent higher yields were obtained in case of BIPM treated plots (1.5 ton more yield per acre in BIPM plot). Average return was also 10 per cent
higher in BIPM treatment as compared to that in the chemical insecticide treated plots.

As far as the cost: benefit analysis was concerned, for every rupee invested to manage pest and diseases in brinjal crop, the farmer who adopted BIPM recovered ₹18.65, whereas, the farmers who did not adopt BIPM was able to obtain a benefit of only ₹13.29. The farmers who adopted BIPM were able to understand other additional benefits due to use of bio-pesticides and pheromones viz., conserving of natural enemies, reduced environmental pollution and virtually no health hazards to the farmer/ farm labour.

Trials for the validation of BIPM modules on cabbage were conducted in three different plots coming under each of the three agro-climatic zones. Totally nine trials were conducted in different seasons of the years 2009-10. Around two per cent more seedlings death was observed in chemical treated fields compared to Bio-Pesticides treated IPM fields. The benefits realized by the farmer due to adoption of BIPM modules were reduced cost, preservation of beneficial non-target organisms and decrease of pesticide residues in soil.

Diamond Back Moth (DBM) was the major pest on cabbage observed in all 9 validation trials. Minor incidence of defoliator, *Spodoptera litura* and aphids especially during vegetative stage of the crop were also observed. Though, diseases like blight and leaf spot were also observed, they were not of much economic significance. On an average, the use of 3-4 sprays of *Beauveria bassiana* formulation and 8 Pheromone traps per acre was able to bring down the pest population to 0.65 per plant. In the chemical insecticidal treated plots (non-IPM) though the farmer took up on an average 5-6 sprays, he was able to bring down the mean pest population to only 1.1 larvae per plant. With the 9 validation trials, it was proved that use of IPM measures like bio-pesticides (*B.bassiana*) and pheromone traps was a better method as compared to the traditional chemical based pest control practices. It is possible to manage *S. litura* by using *Spodoptera* NPV and pheromone traps and aphids by using organic salt.

Around ₹2813 more cost incurred per acre by farmer for pesticides compared to the cost of bio-Pesticides and pheromones incurred on IPM fields. But IPM farmers were
able to harvest 3.85 tons more yield per acre as compared to the non-IPM farmers. Total return per acre due to adoption of BIPM module was ₹ 53225 whereas it was only ₹ 43656 due to farmers practice. Ultimately, cabbage farmer who adopted BIPM was able to realize ₹ 16.93 for every rupee invested by him as compared to ₹ 8.28 for every rupee invested on chemical pesticides.

Two BIPM module evaluation trials were conducted in tomato crop in each of three agro-climatic zones during 2009-11 in different seasons. Due to the timely application of Trichoderma and Pseudomonas to soil through enriched FYM, seedling death was reduced to just 5.92 per cent whereas farmers practice registered 10.16 per cent seedling death.

Application of 3-4 sprays of Helicoverpa armigera NPV was able to manage the average larval population of 0.82 larvae per plant whereas in Non IPM plot the larval population per plant was 1.13. With this it was concluded from the present study that by monitoring the pest population by using pheromones trap coupled with 3-4 sprays of NPV, farmers will be able to effectively manage fruit borer infestation on Tomato. Fruit damage in BIPM adopted plot was 6.63 per cent as compared to the plots sprayed with chemical insecticides (10.78%). Farmers were convinced on other advantages of using NPV with regard to absence of residual toxicity in fruits and plants which would also helps in conserving the natural enemy population in the tomato ecosystem, besides safety to the consumers. Farmer could also save substantially on the cost of chemical insecticides.

Application of organic salt was on par with chemical insecticides, though reduction in the mites and aphids population took more time as compared to chemical insecticides. Average population of aphids in BIPM treatment was 5.94 per leaf as compared to 7.26 per leaf in Non-IPM treatment. Similarly, disease intensity was also observed to be lesser in IPM plots (9.7%) as compared to that in Non IPM plots (16.68%).
Chapter 5

Summary

On an average, farmers incurred an additional expenditure of ₹ 2064.66 for application of chemical insecticides as compared to the investment on Bio-pesticides and Pheromones. But he obtained 2.89 tons more yield in BIPM plots as compared to chemical treatment. The farmer got on an average ₹ 12212 additional income per acre because of the implementation of new BIPM module in his field and an higher cost : benefit ratio of 1 : 16.26 as compared to 1 : 11.53 due to chemical insecticides.

Dissemination of validated BIPM module among vegetable growers

The evaluation of the BIPM module involving Bio-Pesticides and Pheromones on three vegetable crops in three agro-climatic zones in two to three seasons during 2008-11 proved that BIPM was a better alternative to traditional chemical practice adopted by farmers to manage pest and diseases. To promote the technology further, few dissemination techniques like farmer trainings, field days and distribution of pest and disease fact sheets were also taken up. Six training programmes and six field days were conducted during the study and over all 478 farmers took part in these two activities. Fact sheets were also distributed to more than 1000 vegetables farmers in three zones together. The help of governmental and non-governmental agencies (NGOs), agri-input suppliers of the locality was also sought for easy and fast dissemination of the proven BIPM technology among vegetable growers.

Impact assessment survey

As a final part of this investigation, in order to know the impact of the BIPM module among vegetable growers, surveys were undertaken by randomly selecting 100 farmers in each of three zones. Conclusions on the impact of the BIPM technology were drawn by comparing the response of farmers during preliminary surveys and post-validation and dissemination survey. The major findings of the impact survey are, farmers reduced the no. of chemical sprays to the crop and seemed to be more educated to look for alternatives to the chemical pesticides. Among the respondent farmers 80.67 per cent had completed high school and 74.43 per cent had developed good knowledge
about pests and diseases. There was a 52.33 per cent increase in farmers growing vegetables in more than two acres after the IPM validation studies started in those zones. Among the respondents 77.67 per cent of farmers were practicing IPM since 2-3 years, 67.67 per cent of the farmers preferred pheromone component of IPM, because of its user-friendly features and cost-effectiveness. About 39.67 per cent farmers were found applying bio-pesticides like *Trichoderma* and *Pseudomonas* and 24.33 per cent used NPV or organic salt. Seven per cent of the farmers had started practicing physical or mechanical collection of insect pests / infested parts and their destruction. Around 38 per cent of the farmers were completely satisfied and 31.33 per cent were partially satisfied w. r. t. the use and performance of bio-pesticides and pheromones of new BIPM module. Around 46.33 per cent farmers readily agreed to adopt BIPM in the future years, 24.33 per cent were not sure and felt IPM usage depends on many factors like availability of the products, pest infestation, etc.,. The major feedback given by farmers for better adoption of BIPM methods were to keep enough stock of bio-pesticides and pheromones in dealer shops (63.67%), more training programmes for creation of awareness about IPM (65.67%), reduction in price of bio-pesticides and pheromones (45%) and in making available of IPM components in time to farmers (22.67%), better market opportunity for organically grown produce (27%) more product related services (19.33%) and strict quality control on Bio-pesticides and Pheromones (19.67%).

To conclude, pest and diseases can be effectively managed in Brinjal, Cabbage and Tomato by adoption of IPM practices including bio-pesticides and pheromones. Emphasis needs to be given on creating awareness to the farmers about IPM through extension agencies of state agricultural universities, government departments and private firms. Ensuring the availability of quality IPM inputs to the farmers at appropriate time and place is the need of the day.