CHAPTER VI
SUMMARY AND CONCLUSION

The research findings of the present investigation on “Pest complex of french bean and management of major pests through development and validation of certain IPM modules are summarized in this chapter.

1. All together eight insect pests viz. cutworm, pod borer, white fly, flea beetle, aphid, thrips, leaf miner, red ant and a mite pest i.e. two spotted spider mite were recorded infesting french bean crop in the field. Out of which cutworm, aphid, thrips, whitefly, pod borer and two spotted spider mite were recorded as major pest.

2. The incidence of cutworm, thrips, pod borer, whitefly and two spotted spider mite were found 1.33/plant, 0.97/leaf, 1.13/plant and 1.23/leaf, respectively at their peak period of incidence in the month of December. Thereafter, activity of the pests was observed to fluctuate at different times and was minimum during the rainy days. On the other hand Highest population of aphid was observed during 3rd week of November i.e. 1.43/plant in 2013-14 and 2014-15.

3. Correlation studies between weather parameters and incidence of cutworm in french bean showed negative and non significant correlation with rainfall, maximum temperature and evening relative humidity. On the other hand morning relative humidity and bright sunshine hour had a positive but non-significant correlation with the pest population. But cutworm population was positively significant with morning relative humidity during 2014-15 which was not significant during 2013-14.

4. During 2013-14, aphid showed a significant negative correlation with morning relative humidity during. Whereas maximum temperature and bright sunshine hours had positively significant correlation with aphid population. Further minimum temperature had a positive non significant correlation. Whereas
evening relative humidity and rain fall showed a negative correlation with aphid population. But during 2014-15 none of correlation between aphid and weather parameters were significant.

5. Two spotted spider mite population had a significantly negative correlation with maximum temperature and significant positive correlation with morning relative humidity in both the season. Minimum temperature, rainfall and bright sunshine hours showed a non significant but negative correlation. On the other hand evening relative humidity had a positive correlation with TSSM population.

6. The correlation studies between incidence of thrips and meteorological parameters showed a significant negative correlation with rainfall in 2013-14. However, maximum temperature and bright sunshine hours had a positive but non-significant correlation. On the other hand minimum temperature, morning relative humidity and evening relative humidity had negative non significant correlation during 2013-14 and 2014-15.

7. Pod borer had a significantly negative correlation with maximum temperature and positive significant correlation with morning relative humidity. On the other hand minimum temperature, rainfall and bright sunshine hour was negatively correlated with the pod borer population. The population had a negative correlation with evening relative humidity that was non-significant.

8. Whitefly had a significantly negative correlation with maximum temperature and positively significant correlation with morning relative humidity. On the other hand minimum temperature, rainfall and bright sunshine hour were negatively correlated with the pod borer population. The population had a negative correlation with evening relative humidity that was non-significant.

9. A total of four IPM modules including the control treatment were tested against major insect and mite pests of french bean and out of which IPM module -I with seed treatment by Captan @ 3gm/kg seed, weeding frequency (3 times at 15 days interval), yellow sticky trap @ 20nos./ha, mechanical
destruction (removing by hand picking and destroying them), inter crop with coriander (2:1 ratio), release of \textit{C. transversalis} of aphid and TSSM was found to be most effective as compared to the other IPM modules tested.

10. The effectiveness of IPM modules in respect to B:C ratio were obtained to be 2.06, 1.95 and 1.97 from Module-I, II and III, respectively as compared to control.

11. Bioassay test of seven plant extracts \textit{viz., Polygonum hydropiper, Murraya koenigii, Jatropha curcas, Piper longum, Phlogacanthus thyrsiflorus, Ocimum sanctum} and \textit{Pongamia pinnata} were conducted against aphid and TSSM of french bean crop. The observed LC\textsubscript{50} for the different plant extracts were found in \textit{P. longum} (3.39\% & 3.41\%), \textit{J. curcas} (4.17\% & 4.37\%), \textit{P. hydropiper} (4.37\% & 4.57 \%), \textit{P. thyrsiflorus} (5.13\% & 5.23\%), \textit{M. koenigii} (5.25\% & 5.35\%), \textit{P. pinnata} (5.25\% & 5.37\%) and \textit{O. sanctum} (5.62\% & 5.66\%) against the aphid and TSSM, respectively after 48 hrs. of exposure period.

12. The highest per cent mortality of both aphid and TSSM were obtained in \textit{P. longum} (3\%) 75.46\% & 66.85\% after 96 hrs. of exposure period followed by \textit{J. curcas} (4\%) with 65.89\% & 58.89\%, \textit{P. hydropiper} (4\%) with 63.89\% & 57.31\%, \textit{P. thyrsiflorus} (5\%) with 60.19\% & 51.02\%, \textit{M. koenigii} (5\%) with 55.56\% & 48.61\%, \textit{P. pinnata} (5\%) with 52.31\% & 46.11\% and \textit{O. sanctum} (6\%) with 48.61\% & 36.57\%, respectively under laboratory condition.

13. Under field condition, highest per cent reduction of both aphid and TSSM were obtained in \textit{P. longum} (3\%) with 84.38\% & 63.41\% after 7 days of treatment followed by \textit{J. curcas} (4\%) with 73.53\% & 52.50\%, \textit{P. hydropiper} (4\%) with 72.73\% & 50\%, \textit{P. thyrsiflorus} (5\%) with 60.0\% & 44.74\%, \textit{M. koenigii} (5\%) with 56.25\% & 43.59\%, \textit{P. pinnata} (5\%) with 45.0\% & 40\% and \textit{O. sanctum} (6\%) resulted 39.39\% & 37.84\%, respectively.

14. The order of toxicity on \textit{Aphis craccivora} and \textit{Tetranychus urticae} with respect to LC\textsubscript{50} values was \textit{Piper longum} > \textit{Jatropha curcas} > \textit{Polygonum hydropiper}. 


CONCLUSION

1. Insect and two spotted spider mite pest complex play a significant role in reducing french bean crop production.

2. From the incidence pattern of different pests in french bean it can be concluded that mid of November to mid of December is the most favorable period for most of the pests. Maximum pest population and plant infestation were recorded during this period. Based on incidence and peak period of activity management strategies can be adopted including manipulation of sowing date of crop that may help to escape the maximum pest infestation period and economic damage.

3. Out of three IPM modules tested against insect and mite pests, IPM module-I with Seed treatment by Captan @ 3gm/kg seed, weeding frequency (3 times at 15 days interval), yellow sticky trap @ 20nos./ha, mechanical destruction (removing by hand picking and destroying them), inter crop with Coriander (2:1 ratio), release of potential predators of aphid and two spotted spider mite was found to be best against these pests, hence this IPM module may be recommended against insect and mite pests of french bean.

4. Bioassay test conducted on the percent mortality of both aphid and two spotted spider mite due to plant extracts indicated that all the plant extracts had their significant impact on the 50% mortality for different exposure periods.

5. Considering the effectiveness of plant extracts on per cent mortality of aphid and two spotted spider mite under both laboratory and field conditions, these plant extracts can be recommended as organic pesticides in french bean production in India as well as Assam that suffers most from the damage caused by these two pests.

FUTURE THRUST
1. The present study confirmed that incidence of the certain insects and TSSM, peak period of their activity and population build up in relation to the prevailing weather parameters in french bean crop. Hence plant protection scientist as well as agricultural extension workers need to emphasis on the pest forecasting system for the french bean growers to prepare well ahead before appearance of the pest in french bean crop field.

2. Among the tested IPM modules, Module-I could be best utilized as the substitute of chemical pesticides against insect and TSSM pests of this crop.

3. Further, plant extracts tested in the present investigation against *Aphis craccivora* and *Tetranychus urticae* can be recommended as organic pesticides and believed to be a promising strategy in controlling french bean pests in organic cultivation of this crop. Due to inadequate information on the importance of these practices to farmers, there is a need to disseminate this useful information to them in order to minimize the use of synthetic insecticide in controlling insects and TSSM of french bean crop.

4. Moreover, information on “mode of action” of the selected plant extracts are scanty, so this could also be a further line of research.