Integrated management of pests infesting tomato
(Lycopersicon esculentum Mill.)

Alka and Dr. SK Singh

DOI: https://doi.org/10.22271/tpi.2022.v11.i10Sc.16051

Abstract
Investigations were carried out to study the effect of different modules (IPM, Insecticidal and organic) to control the infestation of whitefly and thrips on tomato, crop and their effect on natural enemies, at Agricultural Research Farm of Raja Balwant Singh College, Bichpuri, Agra, Uttar Pradesh, India during Rabi season of 2019-2020. The IPM module was found to be more effective for the control of whitefly and thrips. Significantly higher marketable yield (502.15 qha⁻¹) and the highest B:C ratio (3.24) was obtained with the adoption of IPM module. This module is eco-friendly and does not contain synthetic insecticides and hence less harmful to natural enemies (lady bird beetles and Crossopalpus sp.).

Keywords: Tomato crop, whitefly, thrips, IPM

Introduction
Tomato (Lycopersicon esculentum Mill.) is one of the most popular solanaceous vegetable crops grown all over the world and ranks second in importance after potato. In India, tomato is cultivated in almost all parts of the country and occupy an area of 786 thousand hectare with production of 19377 metric tons during 2017-18. In Uttar Pradesh, average area under tomato for last 5 years is 10.6 thousand hectares with average annual production of 540.67 thousand metric tonnes (NHB, 2019) [5].

Tomato is a good source of vitamin ‘A, B’ and excellent source of vitamin ‘C’. It can be eaten as a fresh fruit and as a salad vegetable. It is used for culinary purpose and also used in preparation of pickles, ketchup, sauces and many products. In India, productivity of tomato is very low as compared to its production potential of the developed countries. There are many factors for low production potential, these include abiotic factors like weather parameters such as temperature, humidity, nutrient deficiency, water deficiency etc. Biotic factors include insect pests, pathogens and weed which limit the productivity of tomato crop. Among them insect-pests infestation is one of the major factors that is responsible for reduction in productivity. The production and quality of tomato fruits are considerably affected by many pests infesting at different stages of crop growth. Amongst various pests reported in India, as many as sixteen of different groups have been observed feeding from germination to the harvesting stage which not only reduce yield but also deteriorate the quality (Butani, 1977) [3]. Among the various insect pest, whitefly (Bemisia tabaci) and leaf miner (Liriomyza trifolii) are major insect pest causing considerable damage to the crop by attacking the different plant parts of tomato (Brust, 2008; Sharma et al., 2013) [2, 10, 11]. So, it is prime need to find out such insecticides which was effective against leaf miner and whitefly on tomato under field condition for management.

Today great number of chemical control are often used on large scale regardless of their side effects. Indiscriminate use of synthetic pesticides has resulted in development of several problems like environmental pollution, insecticide resistance, pest resurgence, residual toxicity, health hazards and destruction of natural enemy, flora and fauna. It has therefore become necessary to review the chemical use and evaluate the other ecofriendly and bio intensive methods with minimum environmental damage to manage the pest population. Chemical insecticides are very costly, their use in field can laps the economy of the production of any crop. This mainly increases the cost of production. The integrated approach of the pest management can save the problem of losses from pest attack and the problem created from indiscriminate use of the insecticide also the reduction of the cost of production. In IPM, various pest control tactics i.e., physical, cultural, mechanical, biological and the ecofriendly insecticides are used in different combinations.
Results and Discussion
Effect of different modules on whitefly and thrip population
The data on number of survival population of whitefly adult are presented Table-1 indicate the significant difference among the modules tested with respect to population of whitefly. The whitefly population was the lowest (3.93 adults/leaf) in module M1 and it was significantly superior over rest of the modules. The thrip population was the lowest (3.34 adults/leaf) in module M1 and it was significantly superior over rest of the modules. In module M1 i.e., integrated pest management for the management of thrips nursery management, border crop maize, seedling root dip in imidacloprid and spray of NSKE were incorporated.

Effect of different modules on natural enemies
It is seen from table-2 that the survival of Coccinellid beetles was maximum in IPM Module M1 (3.91) followed by Insecticidal module M2 (3.79) and organic module M3 (3.76). While minimum number of Coccinellid beetles per leaf was noted with untreated control. During the present investigations, the IPM module M1 consisted of no harmful chemical sprays. Hence the lady bird beetle survival population with IPM module was at par with untreated control. The data on number of lady bird beetles (C. septempunctata) after 15 days of the treatments indicate that the survival of lady bird beetles was maximum in untreated control (4.04). However, it was at par with organic module and IPM module having survival number of lady bird beetles 3.84 and 3.83, respectively.

The data on number of survival Crossopalpus flies per plant before and 15 days after the treatments are also presented in Table-2 indicate that the survival of Crossopalpus flies were maximum in untreated control (4.72). However, it was at par with organic module (4.42). In the IPM module survival number of Crossopalpus was (3.42). During the present study no harmful chemicals were used in module M1 i.e., integrated pest management. Hence the survival no. of Crossopalpus was at par with untreated control. Hence it is clear that module M1 is eco-friendly and could be used for the management of tomato pest.

Yield of tomato fruit
The data on yield of tomato fruits obtained in various insecticidal treatments are summarized in Table 3. It is clear from the table-2 that the different modules exert significant influence on marketable yield of tomato. The yield of marketable fruits was highest (502.15 q ha⁻¹) in IPM module M1 and it was significantly higher than all other modules and untreated control tested in this experiment. The Insecticidal module M2 also produced significantly higher yield of marketable fruits than organic module M3 and untreated control.

Economics of different modules
The data enumerated in Table-4 reveal that the highest net profit of Rs. 383633 ha⁻¹ was recorded with Integrated Pest Management Module (M1) followed by Insecticidal module (M2) gave net return Rs. 93500. The highest additional net profit over control (Rs. 111433) was also obtained IPM module. As the return over one rupee invested is concerned the highest B:C ratio (3.24) was obtained in Integrated Pest Management Module (M1) followed by organic module.
The integration of pest management tactics was cheaper than synthetic insecticides even though the chemical module gave good control of pests. Therefore, Integrated Pest Management of tomato pests could be adopted successfully as alternative to chemical insecticides.

Table 1: Effect of different modules on whiteflies (B. tabaci) and thrips (F. schultzei) population

| Module               | No. of whiteflies/leaf | No. of thrips/leaf |
|----------------------|------------------------|--------------------|
| IPM Module- (M1)     | 3.93 (2.10)            | 3.34 (1.96)        |
| Insecticidal Module- (M2) | 5.00 (2.55)        | 4.06 (2.14)        |
| Organic Module- (M3) | 5.89 (2.53)            | 5.41 (2.43)        |
| Untreated control    | 12.09 (3.55)           | 9.20 (3.12)        |
| SEm±                 | 0.026                  | 0.276              |
| CD at 5%             | 0.073                  | 0.76               |

*Average of ten observations
Figures in parentheses indicate √n + 0.5 transform values

Table 2: Effect of different modules on natural enemies

| Module               | No. of adult C. septempunctata/plant | No. of adult Crossopolpus/leaf |
|----------------------|-------------------------------------|-------------------------------|
|                      | Before spray | After spray | Before spray | After spray |
| IPM Module- (M1)     | 3.91(2.10)   | 3.83(2.08)  | 5.07(2.36)   | 3.42(1.98)  |
| Insecticidal Module- (M2) | 3.79(2.07)   | 1.22(1.31)  | 4.80(2.30)   | 1.77(1.51)  |
| Organic Module- (M3) | 3.76(2.06)   | 3.84(2.08)  | 4.74(2.29)   | 4.72(2.29)  |
| Untreated control    | 3.88(2.09)   | 4.04(2.13)  | 5.11(2.37)   | 4.72(2.28)  |
| SEm±                 | 0.03         | 0.171       | 0.087        | 0.052       |
| CD at 5%             | 0.084        | 0.48        | NS           | 0.142       |

*Average of ten observations
Figures in parentheses indicate √n + 0.5 transform values

Table 3: Effect of different modules on yield of marketable fruits (q ha⁻¹)

| Module               | Marketable Yield (q ha⁻¹) |
|----------------------|---------------------------|
| IPM Module- (M1)     | 502.15                    |
| Insecticidal Module- (M2) | 490.22                   |
| Organic Module- (M3) | 440.79                    |
| Untreated control    | 377.22                    |
| SEm±                 | 19.82                     |
| CD at 5%             | 54.47                     |

Table 4: Economics of different modules

| Module               | Gross Income (Rs ha⁻¹) | Cost of cultivation (Rs ha⁻¹) | Net Profit (Rs ha⁻¹) | Additional income over control (Rs ha⁻¹) | B:C Ratio |
|----------------------|------------------------|------------------------------|----------------------|----------------------------------------|-----------|
| IPM Module- (M1)     | 502133                 | 118500                       | 383633               | 111433                                 | 3.24      |
| Insecticidal Module- (M2) | 490200                | 124500                       | 365700               | 93500                                  | 2.94      |
| Organic Module- (M3) | 440767                 | 108000                       | 332767               | 60567                                  | 3.08      |
| Untreated control    | 377200                 | 105000                       | 272200               |                                        | 2.59      |

References
1. Bharpoda TM, Patel NB, Thumar RK, Bhatt NA, Ghetiya LV, Patel HC, et al. Evaluation of insecticides against sucking insect pests infesting Bt cotton BG-II. The Bioscan- An International Quarterly Journal of Life Sciences. 2014;9(3):977-980.
2. Brust GE. Insect pests of tomato. Maryland cooperative extension, University of Maryland, USA; c2008.
3. Butani DK. Insect pest of vegetables-tomato. Pesticides. 1977;11(4):33-36.
4. Gupta PK, Ansari NA, Tewari HD, Tewari JP. Efficacy of different insecticides against whitefly (Bemisia tabaci Gen.) in tomato crop and control of Tomato Leaf Curl Virus (TLCV). Pesticide Research Journal. 2007;19(2):218-219.
5. National Horticulture Board, 2019. Area and Production of Vegetables for the year; c2017-2018.
6. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi; c1985. p. 378.
7. Rai D, Singh AK, Sushil SN, Rai MK, Gupta JP, Tyagi MP. Efficacy of insecticides against American serpentine leaf miner, Liriomyza trifoli (Burgess) on tomato crop in N-W region of Uttar Pradesh, India. International Journal of Horticulture. 2013;3(5):19-21.
8. Rai D, Singh V, Singh V, Kewal R. Evaluation of different insecticides against serpentine leaf miner, Liriomyza trifoli (Burgess) (Diptera: Agromyzidae) in tomato crop. Plant Archives. 2017;17(1):295-298.
9. Razaq M, Aslam M, Sharif K, Salman B, Aleem MF. Evaluation of insecticides against cotton whitefly, Bemisia tabaci (Genn.) (Homoptera: Aleyrodidae). Journal of Research (Science). 2003;14(2):199-202.
10. Sharma D, Asifa M, Hafeez A, Jamwal VVS. Meteorological factors influencing insect pests of tomato. Annals of Plant Protection Sciences. 2013;21(2):68-71.
11. Sharma VK, Arora RK, Singh K, Gupta A. Relative efficacy and economics of some insecticides against leaf miner, Phytomyza atricornis (Meigen) on pea. Annals of Biology. 2003;19(1):99-102.
12. Singh, Habbal, Jat BL, Bana JK, Ram N. Bio-efficacy and economics of some new insecticides and plant products against major insect pests of moth bean. Journal of Insect Science (Ludhiana). 2010;23(4):387-394.

13. Thompson HC, Kelly WC. Vegetable crops. McGraw Hill Book Company, New York. c1957. p. 476.