Integrated management of thrips-mite and borer complex attacking chilli

MH Rashid, NK Dutta, MA Sarkar, MA Zahid, AK Saha and MME Rahman

DOI: https://doi.org/10.22271/j.ento.2022.v10.i5c.9064

Abstract
Thrips, mite and borer complex are the most serious insect pests which reduce chilli yield remarkably in many chilli growing areas. This study exposed that sustainable bio-rational based management packages including different mechanical approaches and bio-pesticides were effective against Thrips, mite and borer pests in chilli. The results indicated that, spraying of Sodium lauryl ether sulphate (Fizimite) and Matrine (Biotrin) along with blue sticky trap and pheromone mass trapping of Helicoverpa armigera and Spodoptera litura was most effective against Thrips, mites and borer pests. The lowest number of Thrips and fruit borer infestation was observed from spraying of Sodium lauryl ether sulphate (Fizimite) and Matrine (Biotrin) along with blue sticky trap and pheromone mass trapping of Helicoverpa armigera and Spodoptera litura treated plots. Only application of chemical insecticides is not effective against the insect pest’s population in a long-term. In contrast, mechanical approaches such as sticky trap, pheromone trap as well as different bio-pesticides are environmental, economical, dependable and that facilitate the Integrated Pest Management (IPM) concept.

Keywords: Chilli, thrips, mite, borer complex, management

Introduction
Chilli is a well-known versatile crops. It is used as vegetable, spice, condiment, sauce, pickles and medicine. Chilli is widely cultivated in all parts of Bangladesh. Area under both summer and winter chilli is about 96900 hectares with an annual production of dry chilli 157607 tons during 2019-20 in Bangladesh [1]. Among the numerous causes liable for low production of chilli, the insect pests are of major threat, which largely affect the yield. Chilli crop is infested with Thrips and mite starting from seedling stage in nursery to harvesting of crop in field. In addition to these, pod borers including Helicoverpa armigera and Spodoptera litura also cause serious destruction to the crop during different cropping stages. Thrips, mite and borer complex cause severe damage in chilli crop and reduce its yield. Thrips, mite and borer complex are responsible to crop loss about 30-50%, 30-70% and 30-40% respectively [2]. For controlling insect pests, farmers frequently apply large quantities of toxic chemical insecticides which cause health hazard to non-target animals, resurgence and pest resistance [3]. Chilli growers used to spray more than six times of toxic chemical pesticide apply for controlling insect pests, the frequency of sprays have been increased day by day and because of that, production cost has also been increased massively creating the production of chilli extremely hazardous and non-profitable. The residual effect of chemical pesticide in chilli is also a great concern from the point of exports and domestic consumption as well. The extensive and indiscriminate use of toxic chemical pesticide is a continuous risk to the human health and environment [4]. The non-judicial application of chemical pesticides leads to increase the residues in the soil. It also serves as a powerful selection pressure for altering the genetic makeup of a pest population, leading to the development of resistance [4]. Resistance to different specific insecticides including pyrethroids, organophosphorus and carbamate groups in common cutworm created sporadic out breaks and significantly catastrophe of the crop [5]. It is also creating a great risk to cultivate the tomato, cabbage, aroids, cauliflower, jute, chilli,
Materials and Methods
The experiment was conducted at Regional Agricultural Research Station, Burirhat, Rangpur during the rabi season of 2020-21 for determining suitable management approach for controlling the Thrips, mite and borer complex in chilli. There were five treatments viz., T1 = Blue sticky trap @ 40 Nos./ha + Spraying of Sodium lauryl ether sulphate (Fizimite) @ 1 ml/L of water thrice starting from the first appearance of Thrips or mite infestation at 10 days interval + Pheromone mass trapping of Helicoverpa armigera and Spodoptera litura @ 40 Nos./ha + Matrine (Biotrin) @ 1.5 ml/L of water thrice during visible borer infestation at 10 days interval, T2 = Spraying of Matrine and plant oil (K-mite) @ 1 ml/L of water and application of soil recharge @ 5 gm/L of water thrice starting from the first appearance of Thrips or mite infestation at 10 days interval + Pheromone mass trapping of Helicoverpa armigera and Spodoptera litura @ 40 Nos./ha + Application of HNPV @ 0.1 g/L of water and SNPV @ 0.2 g/L of water thrice during visible borer infestation at 10 days interval, T3 = Spraying of Abamectin (Ecomec 1.8 EC) @ 1 ml/L of water thrice starting from the first appearance of Thrips or mite infestation at 10 days interval + Pheromone mass trapping of Helicoverpa armigera and Spodoptera litura @ 40 Nos./ha + Application of HNPV @ 0.1 g/L of water and SNPV @ 0.2 g/L of water thrice during visible borer infestation at 10 days interval, T4 = Alternative spraying of Chlorfenapyr (Intrepid 10 SC) @ 1.2 ml/L of water and Abamectin (Ecomec 1.8 EC) @ 1 ml/L of water thrice starting from the first appearance of Thrips or mite infestation at 10 days interval and T5 = Untreated control. The experiment was laid out in a randomized complete block (RCB) design with 3 replications. The chilli variety was BARI Morich-3. The seeds were sown in the seed bed and they were transplanted in the experiment field after 40 days. The unit plot size was 3m x 3m with a plant to plant spacing of 50cm apart maintaining a row to row distance of 50cm. Sticky and pheromone traps were placed starting from two weeks after transplanting. At least 500m distance were maintained between without sex pheromone and sex pheromone plots.

Results
In many cases the increasing and indiscriminate use of synthetic insecticides have totally failed to control the pests as the pest populations are growing resistant to the used pesticides and causing non-profitable crop production system. In this perspective, the effectiveness of different treatments including sustainable management options with bio-rational management were carefully considered and confirmed in contrast with untreated control are given here.

Effectiveness of various management options against chilli Thrips
Effectiveness of various management options against chilli Thrips is demonstrated in Table 1. The average Thrips population per 15 cm twig before treatment application ranged between 2. 93-4. 45. From the results it was shown that mean number of Thrips was the lowest (1.02 Thrips/15 cm twig) in T1 (Blue sticky trap + Fizimite + Pheromone mass trapping + Biotrin) treated plots with population reduction of 69.26% on the third day after treatment application (DATA) and it was followed by T3 (Abamectin + Pheromone mass trapping + HNPV+ SNPV) treated plots with population reduction of 57.97% and T4 (Chlorfenapyr + Abamectin) treated plots with population reduction of 57.82%. The untreated control exhibited significantly highest Thrips per 15 cm twig (5.04 Thrips/15 cm twig). After 7th days of treatment application, mean number of Thrips was the lowest (1.25 Thrips/15 cm twig) in T1 (Blue sticky trap + Fizimite + Pheromone trapping + Biotrin) treated plots with population reduction of 67.67% and it was followed by T4 (Chlorfenapyr + Abamectin) treated plots with population reduction of 59.95% and T3 (Abamectin + Pheromone trapping + HNPV+ SNPV) treated plots with population reduction of 57.60%. The untreated control treatment showed significantly highest Thrips per 15 cm twig 5.04 and 5.87 at third and seventh day after treatment respectively.
| Treatments | Pretreatment count (mite/leaf) | Mean no. of mite population/leaf | Overall mean no. of mite/leaf | Reduction of mite population over control (%) | Overall reduction of mite (%) |
|------------|-----------------------------|---------------------------------|-------------------------------|---------------------------------------------|----------------------------|
|            | 3 Data                      | 7 Data                          | 3 Data                        | 7 Data                                      | 3 Data                      | 7 Data                      |
| Blue sticky trap + Fizimite + Pheromone trapping + Biotrin | 0.39±0.02b                     | 0.13±0.01bc                     | 0.21±0.02b                    | 0.17                                        | 73.33                       | 68.42                       | 70.88                       |
| K-mite + Soil recharge + Pheromone mass trapping + HNPV+ SNPV | 0.34±0.04b                     | 0.09±0.01c                      | 0.14±0.02b                    | 0.12                                        | 80.77                       | 75.76                       | 78.27                       |
| Abamectin + Pheromone mass trapping + HNPV+ SNPV | 0.45±0.02ab                     | 0.22±0.01bc                     | 0.28±0.02b                    | 0.25                                        | 62.86                       | 61.36                       | 62.11                       |
| Chlorfenapyr + Abamectin | 0.47±0.04ab                     | 0.24±0.03b                      | 0.32±0.02b                    | 0.28                                        | 61.11                       | 58.70                       | 59.91                       |
| Untreated Control | 0.59±0.06a                     | 0.77±0.05a                      | 0.97±0.08a                    | -                                           | -                           | -                           | -                           |

Data = Days after treatment application± Corresponds to standard error

Effectiveness of various management options against mite on chilli mite is demonstrated in Table 2. The average mite population per leaf before treatment application ranged between 0.34-0.59. It was shown that on the third day after treatment application, mean mite population was the lowest (0.09 mite/leaf) in T2 (K-mite + Soil recharge + Pheromone mass trapping + HNPV+ SNPV) treated plots with population reduction of 73.33% and T3 (Abamectin + Pheromone mass trapping + HNPV+ SNPV) treated plots with population reduction of 62.86%. The untreated control demonstrated significantly highest mite per leaf (0.77 mite/leaf). After 7th days of treatment application almost similar trend of results were also observed.

Table 3: Effectiveness of different management options against borer pests on chilli at RARS, Burirhat, Rangpur during 2020-21 cropping season

| Treatments | % Fruit infestation (By no.) | % Fruit infestation (By wt.) | Yield (t/ha) |
|------------|-----------------------------|-----------------------------|--------------|
| Blue sticky trap + Fizimite + Pheromone trapping + Biotrin | 1.82 ± 0.24d               | 1.66 ± 0.14d               | 20.93 ± 0.81a|
| K-mite + Soil recharge + Pheromone mass trapping + HNPV+ SNPV | 2.46 ± 0.31cd             | 2.37 ± 0.16d               | 19.33 ± 0.67ab|
| Abamectin + Pheromone mass trapping + HNPV+ SNPV | 4.21 ± 0.01c               | 3.95 ± 0.07c               | 16.53 ± 0.58bc|
| Chlorfenapyr + Abamectin | 6.81 ± 0.67b              | 6.36 ± 0.60b               | 15.73 ± 0.71bc|
| Untreated Control | 9.43 ± 0.35a             | 8.65 ± 0.40a               | 12.08 ± 1.09bc|

± Corresponds to standard error
**Table 4:** Cost and return analysis of different treatments assigned for the management of different insect pests of chilli at RARS, Burirhat, Rangpur during 2020-21 cropping season

| Treatments | Yield (t/ha) | Addl. yield over control (t/ha) | Addl. income over control (Tk/ha) | Cost of insecticide appl.(Tk/ha) | Net income (Tk/ha) | Mbcr |
|------------|--------------|-------------------------------|----------------------------------|-------------------------------|-------------------|------|
| Blue sticky trap + Fizimite + Pheromone trapping + Biotrin | 20.93 | 8.85 | 177000 | 31475 | 145525 | 4.62 |
| K-mite + Soil recharge + Pheromone trapping + HNPV+SNPV | 19.33 | 7.25 | 145000 | 50650 | 94350 | 1.86 |
| Abamectin + Pheromone trapping + HNPV+SNPV | 16.53 | 4.45 | 89000 | 34900 | 54100 | 1.55 |
| Chlorfenapyr + Abamectin | 15.73 | 3.65 | 73000 | 13080 | 59920 | 4.58 |
| Untreated Control | 12.08 | - | - | - | - | - |

MBCR = Marginal benefit cost ratio

Cost relevant materials or activities:

Farm gate price of chilli = Tk. 20/Kg. Sex pheromone = Tk. 30/lure, Cost of trap and soap water = Tk. 100/trap, Blue sticky trap= Tk. 40/trap, Trap management = 12 labour/ha, Fizimite = Tk. 400/100ml, K-mite = Tk. 4500/L, Ecomec = Tk. 200/100ml, Soil recharge = Tk. 1600/kg, SNPV = Tk. 34000/Kg, HNPV = Tk. 38000/Kg, Biotrin = Tk. 3500/L, Intrepid 10 SC = Tk. 130/50ml, 2 Labour required for per ha spray, Labour wage = Tk. 450/day/laborer (8 hours day), Spray volume required = 500L/ha.

4. Discussion

Thrips, mite and borer pests in chilli were effectively controlled through integrated pest management approaches including bio-pesticides and other mechanical practices such as sticky trap. In this study, our results demonstrated that the lowermost Thrips population was documented from the blue sticky trap and pheromone mass trapping along with spraying of Fizimite and Biotrin treated plots (Table 1). Up to date, a small number of reports have been available on bio-rational based management of chilli Thrips. Hossain et al. have reported that alternate application of Antio and Fizimite were found effective against betel leaf sucking insect pest. Celiz et al. have stated that Thrips were successfully controlled by bio-pesticide called Matrine. Mannan, et al. showed that spraying of bio-pesticides along with the sticky traps were effectively controlled Thrips in chilli, in agreement with our results. Our results showed that the lowest mite population was recorded from the treatment spraying of K-mite, Soil recharge, HNPV and SNPV along with pheromone mass trapping which was statistically similar with the spraying of Fizimite and Biotrin along with the blue sticky trap and pheromone mass trapping (Table 2). Biopesticide such as Fizimite was found effective for managing sucking pest like red mite.

After fruit setting, borer insect pests such as *Helicoverpa armigera* and *Spodoptera litura* infest chilli fruits. It was found that the lowest percentage of infested fruits by number and weight as well as highest yield were found from the blue sticky trap and pheromone mass trapping of *Helicoverpa armigera* and *Spodoptera litura* along with application of Fizimite and Biotrin treated plots which was statistically similar with the treatment spraying of K-mite, Soil recharge, HNPV and SNPV along with pheromone mass trapping of *Helicoverpa armigera* and *Spodoptera litura*. The highest net income and marginal benefit cost ratio were obtained from the treatment spraying of Fizimite and Biotrin along with the blue sticky trap and pheromone mass trapping of *Helicoverpa armigera* and *Spodoptera litura*. Matrine is an effective biological insecticide which can effectively control different Lepidopteran borer insect pests. Borer insect pests of chilli are successfully managed through spraying of HNPV and SNPV along with pheromone trapping of *Spodoptera litura* and weekly release of a larval parasitoid, *Bracon hebetor*. Phenome mass trapping was reported to control a wide range of insect pest such as Dipteran, Lepidopteran, Homopteran and Coleopteran. In the same way, target insect pests population was declined by long-term use of pheromone based management option. In our study, it has been revealed that application of different bio-pesticides along with mass trapping of insect pests was found an effective sustainable management package against chilli insect pests which was supported by the above authors.

Conclusion

Our results showed that spraying of Sodium lauryl ether sulphate (Fizimite) and Matrine (Biotrin) along with blue sticky trap and pheromone mass trapping of *Helicoverpa armigera* and *Spodoptera litura* was most effective against Thrips and borer complex of chilli. Whereas, spraying of Matrine and plant oil (K-mite), soil recharge, HNPV and SNPV along with pheromone mass trapping of *Helicoverpa armigera* and *Spodoptera litura* was more effective against mite but statistically similar with spraying of Sodium lauryl ether sulphate (Fizimite) and Matrine (Biotrin) along with blue sticky trap and pheromone mass trapping *Helicoverpa armigera* and *Spodoptera litura* treated plots. From the above results it may be concluded that thrice spraying of Sodium lauryl ether sulphate (Fizimite) @ 1 ml/L of water starting from the first appearance of Thrips or mite infestation at 10 days interval and thrice sprayed of Matrine (Biotrin 0.5%) @ 1.5 ml/L of water during visible borer infestation at 10 days interval along with blue sticky trap and pheromone mass trapping of *Helicoverpa armigera* and *Spodoptera litura* were most effective against Thrips, mite and borer complex of chilli in respect of reducing major insect pests infestation with higher yield and economic returns. From the above viewpoint, we hope this study will be very useful for developing sustainable management tactics for different insect pests of chilli using different bio-pesticides, pheromone trap and sticky trap.

Acknowledgements

The authors would like to acknowledge their great thanks to the technical staffs and other co-workers for their hard work and sincere devotion for completing this article successfully. The manuscript has been accepted by authors without conflict.
of interests.

Reference
1. BBS, Yearbook of Agricultural Statistics-2020. 32nd Series. Bangladesh Bureau of Statistics, Statistics and Informatics Division, Ministry of Planning, Government of the People’s Republic of Bangladesh. 2021, p. 134.
2. Mallapur CP, Kusbas VS, Raju SG. Influence of nutrient management in chilli pests. Proceedings of National Symposium on Frontier Areas of Entomological Research; c2003. p. 5-7.
3. Gill HK, Garg H. Pesticide: environmental impacts and management strategies. Pesticides-toxic aspects. 2014 Feb 20;8:187.
4. Akhtar W, Sengupta D, Chowdhury A. Impact of pesticides use in agriculture: their benefits and hazards. Interdiscip Toxicol. 2009;2(1):1-2.
5. Ahmed M. Improve cultivation practices for field crops. Univ Agric Sci., Dharwad; c2004. p. 227-234.
6. Saleem MA, Ahmad M, Aslam M, Sayyed AH. Resistance to selected organochlorin, organophosphate, carbamate and pyrethroid, in Spodoptera litura (Lepidoptera: Noctuidae) from Pakistan. J Econ Entomol. 2008;101:1667-1675.
7. Ahmad M, Sayyed AH, Saleem MA, Ahmad M. Evidence for field evolved resistance to newer insecticides in Spodoptera litura (Lepidoptera: Noctuidae) from Pakistan. Crop Prot. 2008;27(10):1367-1372.
8. Hong T, Qi S, Xiaomao Z, Lianyang B. Field resistance of Spodoptera litura (Lepidoptera: Noctuidae) to organophosphates, pyrethroids, carbamates and four newer chemistry insecticides in Hunan, China. J Pest Sci. 2013;86(3):599-609.
9. Shad SA, Sayyed AH, Fazal S, Saleem MA, Zaka SM, Ali M. Field evolved resistance to carbamates, organophosphates, pyrethroids, and new chemistry insecticides in Spodoptera litura Fab. (Lepidoptera: Noctuidae). J Pest Sci. 2012;85:153-162.
10. Hossain M, Singha A, Jiku M, Sayem A, Sarker D, Sarkar A, et al. Sustainable management approach for sucking pests control in betel leaf of Bangladesh. Bull Natl Res Cent. 2020;44(1):1-7.
11. Celiz RJR, Ubaub LT. Insecticidal effects of Matrine against flower Thrips, Thrips hawaiiensis Morgan on ‘Cavendish’banana. JOSPA. c2018, p. 21.
12. Karimzadeh J. The efficacy of a new insecticide, Rui Agro® (Matrine), against the diamondback moth. agris fao org; c2014.
13. Wu J, Yu X, Wang X, Tang L, Ali S. Matrine enhances the pathogenicity of Beauveria bronzi against Spodoptera litura (Lepidoptera: Noctuidae). Front Microbiol. 2019;10:1812.
14. Henderson CF, Tilton EW. Tests with acaricides against the brown wheat mite. J Econ Entomol. 1955;48(2):157-161.
15. Aristizábal LF, Chen Y, Cherry RH, Cave RD, Arthurs SP. Efficacy of biorational insecticides against chilli Thrips, Scirto Thrips dorsalis (Thysanoptera: Thripidae), infesting roses under nursery conditions. J Appl Entomol. 2017;141(4):274-284.
16. Hossain MM, Khalequzzaman KM, Mondal MTR, Alam J, Islam MS. Development of Management Approach against Thrips-Mite Complex of Chilli. IJSR, 2016;3(1):18-24.
17. Mannan MA, Hossain MM, Hossain MM, Alam MK, Singha A. Development of eco-friendly management approach against sucking and borer insect pest complex in chilli. Int J Biosci. 2020;17(5):202-208.
18. Annonymous. Annual Research Report. 2012-2013. Entomology Division, BARI, Joydebpur, Gazipur; c2012. p. 142.
19. El-Sayed AM, Suckling DM, Wearing CH, Byers JA. Potential of mass trapping for long-term pest management and eradication of invasive species. J. Econ. Entomol. 2009;99:1550-1564.
20. Witzgall P, Kirsch P, Cork A. Sex pheromones and their impact on pest management. J Chem. Ecol. 2010;36:80-100.
21. Varner M, Lucin R, Matted IL, Forno F. Experience with mating disruption technique to control grape berry moth, Lobesia botrana, in Trentino. IOBC WPRS Bulletin. 2001; 24(2):81-88.
22. Ioriatti C, Lucchi A, Bagnoli B. Grape areawide pest management in Italy. O. Koul, G. Cuperus, and N. Elliott; 2008. p. 208-225.