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Arun Kumar
Department of Entomology, Sardar Vallabhbhai Patel University of Agricultural and Technology, Meerut Uttar Pradesh, India

Rajendra Singh
Department of Entomology, Sardar Vallabhbhai Patel University of Agricultural and Technology, Meerut Uttar Pradesh, India

Shalendra Pratap Singh
Department of Entomology, Chandra Shekhar Azad University of Agricultural and Technology, Kanpur, Uttar Pradesh, India

Deepak Singh Pal
Department of Entomology, Chandra Shekhar Azad University of Agricultural and Technology, Kanpur, Uttar Pradesh, India

Sushant Kumar
Department of Entomology, Sardar Vallabhbhai Patel University of Agricultural and Technology, Meerut Uttar Pradesh, India

Corresponding Author:
Arun Kumar
Department of Entomology, Sardar Vallabhbhai Patel University of Agricultural and Technology, Meerut Uttar Pradesh, India

Economics of different treatments for the manage ment of mango hopper (*Amritotus atkinsoni*)

Arun Kumar, Rajendra Singh, Shalendra Pratap Singh, Deepak Singh Pal and Sushant Kumar

Abstract
The present investigation was carried out on the economics of different treatments for the management of mango hoppers (*Amritotus atkinsoni*) in western zone of U.P in randomized block design with three replication and nine treatments at the HRC, Siwaya farm of Sardar Vallabhbhai Patel University of Agricultural and Technology, Meerut U.P., India during 2018-19. Economic evaluation of the treatments was made on the basis of average healthy fruit yield obtained during year 2018-19. Treatment cost and marketable value of the produce. It can be seen from the data pertaining to net income (Rs./ha) in different treatments. The profit in different treatments are in increasing order of Dinutefuran 50% WP@ 0.005 > imidacloprid 17.8 SL @ 0.005% > dimethoate 30 EC @ 0.005% > thiamethoxam 50 WG @ 0.01% > neemal oil @ 1500 PPM > NSKE @ 5% > *Metarhizium anisopliae* 1x10^8 cfu/ml > *B. bassiana* 1.0X10^8 cfu/ml , However, Dinutefuran 50% WP@ 0.005 and imidacloprid 17.8 SL @ 0.005% were found very effective in controlling the Mango leaf hopper (*Amritodus atkinsoni*).

Keywords: Mango, treatments, population, observations, effective, population

Introduction
Mango described as the "king of fruits", known for its strong aroma, delicious taste, and high nutritive value is a prominent horticultural crop of India. Mango is a tropical and subtropical fruit crop grown in India. The major mango producing countries in the world are India, China, Pakistan, Mexico, Thailand, Indonesia, Brazil, Philippines, Nigeria and Viet Nam. India ranks first in production of mango in the world. The States of Andhra Pradesh, Uttar Pradesh, Karnataka, Bihar, Gujarat and Maharashtra are major mango production of the country. Uttar Pradesh is one of an important mango growing state of India and occupies 64350 hectares area with production of 327914 metric tons (Anon, 2015) [1]. The cultivation of mango is 2.5 mha with a annual production of fresh mango 49671.31 million tonnes. (DGCI&S, 2018) [3]. The perennial crop grown in diverse agro-climatic conditions face differential biotic and abiotic stress limiting the production and productivity of mango. Climate change is expected to trigger the changes in diversity and abundance of arthropods, geographical and temporal distribution of insect pests, insect biotypes, herbivore plant interactions, activity and abundance of natural enemies, species extinction, and efficacy of crop protection technologies which in turn will have a major bearing on food and nutritional security. (Anon, 2012) [2]. There was wide variations in hopper infestation level during three consecutive seasons. The relationship between the GDD and hopper population was established by linear regression analysis and it was inferred that the GDD had explained variation in hopper population upto 66 per cent across the three seasons. Thus, growing degree days served as a basis for predicting hopper population at different phenological stages of mango. (Gundappa *et al.*, 2018) [4]. Among the mango pests, mango hoppers are most serious and widespread pests throughout the country (Verghese, 2000) [7]. Damage is caused by the nymphs and adults by sucking sap from tender leaves, inflorescence as a consequence of which inflorescence and fruit if any set, fall prematurely. Mango hoppers secrete honey dew which facilitates the development of sooty mold on the leaves, twigs and inflorescence. (Raut *et. al.*, 2018) [5]. Mango hopper would provide significant information to protect the mango flower and leaves from the attack of the pest and thereby will increase the yields which ultimately increase the farmer's economy as well as the economy of the country. (Shawan *et al.*, 2018) [6]. They remain confined to the under surface of leaves, situated in dark and moist areas of the tree. Though several natural enemies have been reported on mango hoppers, chemical control remains the widely followed means of hopper management. The extensive and indiscriminate use of pesticides for hoppers in mango has led to several problems like resurgence of secondary pests, health hazards and pesticide residues on fruit. Hence there is a need to evaluate newer molecules.

Methods and Materials

The experiment was conducted at the HRC, Siwaya farm of the Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, (Uttar Pradesh) India during May 2018 to April 2019. with Nine treatments, replicated thrice in Randomized Block Design. Nine tree of mango (Var. Dashehari) were be randomly selected and tagged, the insecticidal treatments would be applied with the help of rocker sprayer before bud burst stage on the these tree when the pest population reaches between 5-10 hoppers/twig/panicle. The pre and post treatment observations would be recorded before twenty four hour and after 1DBS, 7DAS, 14DAS and 21DAS days of insecticide spray, respectively. The hopper population was recorded on randomly selected and tagged twelve/panicle *i.e.* three panicle in each direction (North, South, East, and West) per branch in each tree. The sample size of each panicle/were of about ten to twelve cm. The pretreatment hopper counts along with the post treatment population reduction were transformed and subjected to statistical analysis for result interpretation. The fruit yield was also recorded from each treatment.

The cost benefit ratio would be worked out in order to find out the effective and economical treatment for the control of mango hopper *Amritodus Atkinsoni* by using formula.

$$\text{Cost : benefit ratio} = \frac{\text{Net return (Rs / ha)}}{\text{Cost of treatment (Rs./ha)}}$$

Preparation of spray solution

The final insecticidal spray solutions were prepared by the following formula:

$$Amount\ of\ insecticidal\ formulation = \frac{Concentration\ required\,(\%) \times Volume\ required\,(litre)}{Concentration\ of\ toxicant\ in\ insecticidal\ formulation} \times 100$$

Results and Discussion

The final yields of mango fruits as a result of application of different treatments are presented in. All the treatments resulted in higher fruit yield and were proved significantly superior over control during the 2018-19 years of application. The maximum fruit yield 144.42 q/ha was obtained during 2018-19 by the treatment with Dinutefuran 50% WP@ 0.005 and imidacloprid 17.8 SL @ 0.005%. was second most effective treatment with fruit yield of 240.17 q/ha during year 2019-19. It was followed by Dimethoate 30 EC @ 0.05% (110.52 q/ha), thiamethoxam 50 WG @ 0.01% (104.98 q/ha), neemal oil @ 1500 PPM (90.45 q/ha), NSKE @ 5% (86.84 q/ha), *Metarhizium anisopliae* $1x10^8$ cfu/ml (83.84) and *B. bassiana* $1.0X10^8$ cfu/ml (81.23 q/ha), during 2018-19. respectively. It was statistically superior over rest of the treatments, except Dinutefuran 50% WP@ 0.005% during the years 2018-19.

It is evident from the data that all the treatments were effective in controlling nymphs and adult infestation at all the time intervals after each spray in comparision to untreated control. The most effective treatment was dinotefuron 50% WP found to be best the treatment which recorded a significantly lowest number of nymphs and adults, followed by imidacloprid 17.8 SL and dimethoate 30 EC.

Economics of the application of different treatments

The net returned in all the treatments was higher in comparison to control. Economic evaluation of the treatments was made on the basis of average healthy fruit yield obtained during year 2018-19. Treatment cost and marketable value of the produce.

Table 1: Cost economics of insecticide molecules against Mango leaf hoppers during 2018 – 2019

S. No.	Treatment	Conc. %	Average yield (q/ha)	increase in yield over control (q/ha)	Addnl income (Rs.)	Cost of biopesticides / insecticide formulation	Labour charges/ equip. (Rs.)	Total (Rs) (b)	Net profit Rs.	C:B ratio
1	T_1 Imidacloprid	0.005	140.17	69.97	280340	9000	15200	24200	256140	1:10.58
2	T_2 Dinutefuran	0.005	144.42	74.22	294840	7600	15200	22800	272040	1:11.93
3	T_3 Thiamethoxam	0.01	104.98	34.78	209960	6000	15200	21200	188760	1:8.90
4	T_4 Dimethoate	0.005	110.52	40.32	221040	5200	15200	20400	200640	1:9.84
5	T_5 *Metarhizium anisopliae*	0.004	83.84	13.64	167680	4000	15200	19200	148480	1:7.73
6	T_6 *Baeuberia bassiana*	0.004	81.23	11.03	162460	4500	15200	19700	142760	1:7.25
7	T_7 Neemal	1500 ppm	90.45	20.25	180900	3500	15200	18700	162200	1:8.67
8	T_8 NSKE	5%	86.84	16.64	173680	4000	15200	19200	154480	1:8.05
9	T_9 Untreated		70.20	00.00	140400	00.00	00.00	00.00	00.00	00.00

Labour charge = 400/day

Rental value of sprayer = 100/day

Self price of product = 2000/quintal

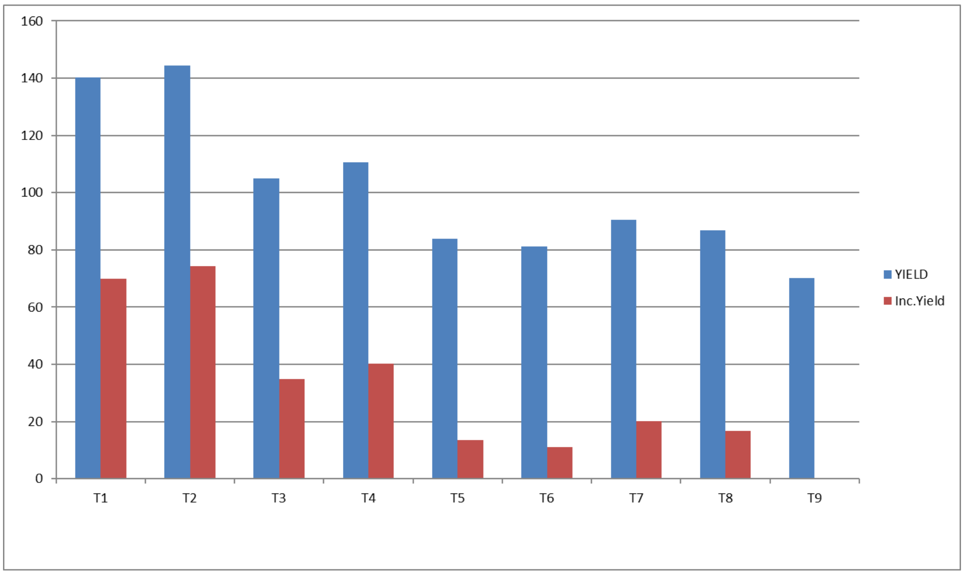

Fig 1: Cost economics of insecticide molecules against Mango leaf hoppers during 2018 – 2019

It can be seen from the data pertaining to net income (Rs./ha) in different treatments. The profit in different treatments are in increasing order of Dinutefuran 50% WP@ 0.005 > imidacloprid 17.8 SL @ 0.005% > dimethoate 30 EC @ 0.005% > thiamethoxam 50 WG @ 0.01% > neemal oil @ 1500 PPM > NSKE @ 5% > *Metarhizium anisopliae* $1x10^8$ cfu/ml > *B. bassiana* $1.0X10^8$ cfu/ml , However, Dinutefuran 50% WP@ 0.005 and imidacloprid 17.8 SL @ 0.005% were found very effective in controlling the Mango leaf hopper *Amritodua atkinsoni* . The maximum return of Rs. 294840/ha was achieved from dinutefuran 50% WP@ 0.005%, while lowest return of Rs 162460/ha was obtained in *Baevberia bassiana* @ 0.004% treatment.

The minimum avoidable loss was recorded in dinutefuran 50% WP@ 0.005%, leading to higher profit margin of Rs. 272040/ha. Thus, the cost benefit ratio (C: BR) was highest in dinutefuran 50% WP@ 0.005%, (1: 11.93). It was followed by > imidacloprid 17.8 SL @ 0.005% (1: 10.58), dimethoate 30 EC @ 0.005%@ (1: 9.84), thiamethoxam 50 WG @ 0.01%(1: 8.90), neemal oil @ 1500 PPM(1: 8.67) NSKE @ 5% (1: 8.05) *Metarhizium anisopliae* $1x10^8$ cfu/ml(1: 7.73) *B. bassiana* $1.0X10^8$ cfu/ml (1: 7.25) due to their high cost.

Conclusion

Finally the economics of each insecticide was studies to determine the best insecticide in controlling the mango hoper (*Amritodus atkinsoni*). The profit in different treatments are in increasing order of Dinutefuran 50% WP@ 0.005 > imidacloprid 17.8 SL @ 0.005% > dimethoate 30 EC @ 0.005% > thiamethoxam 50 WG @ 0.01% > neemal oil @ 1500 PPM > NSKE @ 5% > *Metarhizium anisopliae* $1x10^8$ cfu/ml > *B. bassiana* $1.0X10^8$ cfu/ml , However, Dinutefuran 50% WP@ 0.005 and imidacloprid 17.8 SL @ 0.005% were found very effective in controlling the Mango leaf hopper *Amritodua atkinsoni* . The maximum return of Rs. 294840/ha was achieved from dinutefuran 50% WP@ 0.005%, while lowest return of Rs 162460/ha was obtained in *Baevberia bassiana* @ 0.004% treatment.

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