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Management of Bihar hairy caterpillar [*Spilarctia* (*Spilosoma*) *obliqua* Walker] in Mungbean [*Vigna radiata* (L.)

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ABSTRACT

The experiments were carried out at Students' Instructional Farm of AcharyaNarendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya during *Kharif* 2018. Among the various treatments evaluated for management of Bihar hairy caterpillar (*S. obliqua*), $\mathbf{T}_5$ (Triazophos 40 EC @ 250g a.i./ha) treated plots showed highest reduction in Bihar hairy caterpillar population of 75.85% and gave highest crop yield of 11.50q/ha followed by $\mathbf{T}_4$ (Lambda cyahlothrin 5 EC @ 40g a.i./ha) treated plots with 65.46% reduction and 10.90 q/ha yield. The highest income and cost-benefit ratio of Rs. 21,183/ha and 1:28.93 was obtained from $\mathbf{T}_5$ (Triazophos 40 EC @ 250g a.i./ha) followed by $\mathbf{T}_4$ (Lambda cyahlothrin 5 EC @ 40g a.i./ha) i.e., Rs. 17,043/ha and 1:23.93. Efficacy of the remaining treatments in order to their superiority were $\mathbf{T}_1$ (Indoxacarb 14.5 EC @ 75g a.i./ha)>$\mathbf{T}_2$ (Imidacloprid 17.8 SL @ 30g a.i./ha)>$\mathbf{T}_3$ (Thiamethoxam 25 WG @ 40g a.i./ha)>$\mathbf{T}_6$ (Azadirachtin 1500 ppm @ 3ml/L) respectively.

Key words: *Management, Bihar hairy caterpillar, [Spilarctia (Spilosoma) obliqua Walker] in Mungbean [Vigna radiata (L.).*

Introduction

Pulses are the cheap and best source of protein constituting about 27 percent of total dietary protein in our country. Pulses are an ideal component of human diet as they are rich source of proteins. The use of pulses as food is concentrated in developing countries which account for about 90 percent of global pulse consumption.

Mungbean is the third most important pulse crop of India after chickpea and pigeonpea (Singh and Singh, 2014). Mungbean (*Vigna radiata* (L.) Wilczek) commonly known as greengram, is native to India and Central Asia especially in tropical and subtropical Asia and belong to family Fabaceae and subfamily Papilionaceae (Singh and Singh, 2014). A low input, short duration, high value crop, mungbean fits very well into rice-wheat cropping systems and other crop rotations. Green gram in the cereal cropping system has the potential to increase farm income, improve human health and soil fertility as well as to promote long term sustainability of agriculture (Swaminathan *et al.,* 2012). The nutritive value of mungbean is high and easily digestible protein with approximately protein 25-28%, oil 1.0-1.5%, fibre 3.5-4.5%, ash 4.5-5.5%, carbohydrate 62-65%, water 9.1%, and vitamins on dry weight basis (Singh *et al.,* 2014). Being an important short-duration Kharif grain legume, mungbean is grown extensively in major tropical and sub-tropical countries of

the world (Kabir *et al.*, 2014).

In India, pulses are grown over an area of 29.28 m ha with a production and productivity of about 22.40 m tonnes and 765 kg/ ha, respectively (Anonymous, 2017). This covers about 20 % of total area and 8 % of total grain production in India.

About a dozen pulse crops are grown on 22-24 m ha area contributing 13-15 m tonnes of grain to the national food basket. These legumes grain contain about 25 per cent protein and richest in phosphoric acid among pulses and established itself as a highly valuable with ability to improve the soil by fixing atmospheric nitrogen. The area under mungbean cultivation in India is about 3.83 m ha with production of 1.60 m tonnes, and productivity 418 kg per ha. In Uttar Pradesh, green gram is being cultivated on 97000 hectares that produce 44000 tonnes with an average productivity of 454 kg/hectare (Anonymous, 2016-17). However, these crops remained neglected even in the era of 'Green revolution' that laid emphasis only on cereals to cope with the fast-multiplying population.

Among the major problems known to limit the yield of these pulses, incidence of insect-pests is main constrains. Pest play major role in low production in green gram in India.

In India, quantitative avoidable losses (7-35%) caused by insect pest complex, both in mungbean and urdbean vary with different agro-climatic conditions (Hamad and Dubey, 1983). The annual yield loss due to the insect pests has been estimated at about 30 per cent in mungbean and urd bean. (Duraimurugan and Tyagi, 2014) reported that the avoidable losses due to pest complex on mungbean ranged from 27.03 to 38.06% with an average of 32.97%.

The Bihar hairy caterpillar, (*Spilosoma obliqua* Walker) is considered as a dominant polyphagous pest of various crops including soybean, pulses, oilseeds, legumes etc. (Bhattacharya and Rathore, 1977). This pest has been recorded in India, Pakistan, Sri Lanka, eastern Asia, Borneo, China and Japan (Biswas, 2006).

Materials and Methods

An Experiment on the field evaluation of novel insecticides and botanicals against pod borer in mungbean was carriedout with following layout at Students'Instructional Farm of Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya during *Kharif*, 2018. The mungbean variety NDM-1was sown on 21 July, 2018. All the recommended agronomical practices were used to grow a good crop. The experiment was laid out in Randomized Block Design with seven treatment and three replications. The seed were sown at spacing of 30×10 cm^2.

Bihar hairy caterpillar population was recorded on five randomly selected plants at each location at weekly interval starting with 20 "Days after Showing" (DAS) on 3 farmers' fields in terms of (egg mass/ plant or no. of larvae/plant).

$$\text{Reduction percent} = \frac{\text{Initial population} - \text{Reduced population}}{\text{Initial population}} \times 100$$

Results and Discussion

The data on the effect of various treatments on Bihar hairy caterpillar population has been presented in (Table 1). The application of treatments (insecticides) was executed at ETL (5 caterpillars / plant) on mungbean crop.

All the treatments were significantly superior over control when observations were made on 3th days after spray. The treatment of $\mathbf{T_5}$ (Triazophos 40 EC @ 250g a.i./ha) showed maximum 68.36% reduction in population of Bihar hairy caterpillar after 3th days of spray were mean population of 9.07 and gave more protection to green gram leaves. The next treatments in order of superiority were $\mathbf{T_4}$ (Lambda cyahlothrin 5 EC @ 40g a.i./ha), $\mathbf{T_2}$ (Imidacloprid 17.8 SL @ 30g a.i./ha), $\mathbf{T_1}$ (Indoxacarb 14.5 EC @ 57g a.i./ha), $\mathbf{T_3}$ (Thiamethoxam 25 WG @ 40g a.i./ha) and $\mathbf{T_6}$ (Azadirachtin 1500 ppm @ 3ml/l) with respective mean population i.e., 8.53, 8.37, 7.93, 8.20 and 9.63 in which respective mean reduction per cent of Bihar hairy caterpillar population were 57.80, 56.15, 50.82, 49.63 and 32.50. The next treatment was $\mathbf{T_7}$ i.e., control (Water spray) with mean population 9.33 which exceptionally showed 85.74% increase in Bihar hairy caterpillar population.

Treatment $\mathbf{T_5}$ (Trizophos 14.5 EC @ 75g a.i./ha) was significantly superior over all the treatments $\mathbf{T_4}$ (Lambda cyahlothrin 5 EC @ 40g a.i./ha), $\mathbf{T_1}$ (Indoxacarb 14.5 EC @ 57g a.i./ha), $\mathbf{T_2}$ (Imidacloprid 17.8 SL @ 30g a.i./ha), $\mathbf{T_3}$ (Thiamethoxam 25 WG @ 40g a.i./ha) and $\mathbf{T_6}$ (Azadirachtin 1500 ppm @ 3ml/l). However, the treatments $\mathbf{T_4}$ (Lambda cyahlothrin 5 EC @ 40g a.i./ha), $\mathbf{T_2}$ (Imidacloprid 17.8 SL @ 30g a.i./ha) and $\mathbf{T_1}$ (Indoxacarb 14.5 EC @ 57g a.i./ha)

Table 1. Effect of insecticidal treatments on Bihar hairy caterpillar, *Spilosoma obliqua* (Walk.) population:

S. No.	Treatments	Dose	Pretreatment count/plants (Mean)	Mean population% After the spray			reduction and increase (+) of Bihar hairy caterpillar After the spray			Mean reduction (%)
				3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS	
1	Indoxacarb 14.5 EC	75g a.i./ha	7.93 (2.86)	3.90 (2.07)	2.00 (1.55)	3.57 (1.99)	50.82	74.78	54.98	60.19
2	Imidacloprid 17.8 SL	30g a.i./ha	8.37 (2.97)	3.67 (2.02)	2.10 (1.61)	5.33 (2.41)	56.15	74.91	36.32	55.79
3	Thiamethoxam 25 WG	40g a.i./ha	8.20 (2.94)	4.13 (2.14)	2.33 (1.65)	5.03 (2.34)	49.63	71.59	38.66	53.29
4	Lambda cyahlothrin 5 EC	40g a.i./ha	8.53 (3.00)	3.60 (2.02)	1.87 (1.48)	3.37 (1.97)	57.80	78.08	60.49	65.46
5	Triazophos 40 EC	250g a.i./ha	9.07 (3.07)	2.87 (1.83)	0.97 (1.21)	2.73 (1.79)	68.36	89.31	69.90	75.85
6	Azadirachtin 1500 ppm	3ml/L	9.63 (3.16)	6.50 (2.62)	4.97 (2.30)	7.53 (2.80)	32.50	48.39	21.81	34.23
7	Control (Water spray)	-	9.33 (3.12)	17.33 (4.20)	17.13 (4.18)	10.57 (3.32)	+85.74	+83.60	+13.29	+60.88
	SE m±		0.21	0.19	0.18	0.17				
	C. D. at 5%		NS	0.59	0.56	0.53				
	CV%		11.8	13.7	15.8	12.5				

DAS = Days after Spray
() = Figures in parentheses indicates transformed value √ (x+0.5)

were at par with each other but significantly superior to $\mathbf{T_3}$ (Thiamethoxam 25 WG @ 40g a.i./ha) and $\mathbf{T_6}$ (Azadirachtin 1500 ppm @ 3ml/l).

When observations were made on 7th days after spray all the treatments were found significantly superior over control. The treatment of $\mathbf{T_5}$(Triazophos 40 EC @ 250g a.i./ha) showed maximum reduction of 89.31% in population of Bihar hairy caterpillar. The next treatments in order of superiority were $\mathbf{T_4}$ (Lambda cyahlothrin 5 EC @ 40g a.i./ha), $\mathbf{T_2}$ (Imidacloprid 17.8 SL @ 30g a.i./ha), $\mathbf{T_1}$ (Indoxacarb 14.5 EC @ 57g a.i./ha), $\mathbf{T_3}$ (Thiamethoxam 25 WG @ 40g a.i./ha) and $\mathbf{T_6}$ (Azadirachtin 1500 ppm @ 3ml/L) with respective mean reduction per cent of Bihar hairy caterpillar population of 78.08, 74.91, 74.78, 71.59 and 48.39. The treatment $\mathbf{T_7}$ i.e., control (Water spray) exceptionally showed 83.60% increase in the population of Bihar hairy caterpillar.

Treatment $\mathbf{T_5}$ (Triazophos 40 EC @ 250g a.i./ha) was significantly superior over all the treatments $\mathbf{T_4}$ (Lambda cyahlothrin 5 EC @ 40g a.i./ha), $\mathbf{T_1}$ (Indoxacarb 14.5 EC @ 57g a.i./ha), $\mathbf{T_2}$ (Imidacloprid 17.8 SL @ 30g a.i./ha) and $\mathbf{T_3}$ (Thiamethoxam 25 WG @ 40g a.i./ha). The treatments $\mathbf{T_4}$ (Lambda cyahlothrin 5 EC @ 40g a.i./ha), $\mathbf{T_1}$ (Indoxacarb 14.5 EC @ 57g a.i./ha), $\mathbf{T_2}$ (Imidacloprid 17.8 SL @ 30g a.i./ha) and $\mathbf{T_3}$ (Thiamethoxam 25 WG @ 40g a.i./ha) were at par with each other but significantly superior to $\mathbf{T_6}$ (Azadirachtin 1500 ppm @ 3ml/l).

When observations were made on 14th days after spray all the treatments were found significant superior over control. The treatment of $\mathbf{T_5}$(Triazophos 40 EC @ 250g a.i./ha) again showed maximum reduction of 69.90% in population of Bihar hairy caterpillar. $\mathbf{T_4}$ (Lambda cyahlothrin 5 EC @ 40g a.i./ha), $\mathbf{T_1}$ (Indoxacarb 14.5 EC @ 57g a.i./ha), $\mathbf{T_3}$ (Thiamethoxam 25 WG @ 40g a.i./ha) and $\mathbf{T_2}$ (Imidacloprid 17.8 SL @ 30g a.i./ha) showed with mean reduction per cent of population of Bihar hairy caterpillar i.e. 60.49, 54.89, 38.66 and 36.32 respectively. However, $\mathbf{T_6}$ (Azadirachtin 1500 ppm @ 3ml/L) showed the least mean reduction per cent of 21.81 and treatment T_7 i.e., control (Water spray) exceptionally showed 13.29% increasing the population of Bihar hairy caterpillar which was minimum in comparison to 3 & 7 days after sprays.

Treatment T_5 (Triazophos 40 EC @ 250g a.i./ha) was significantly superior over all the treatments. The treatments T_4 (Lambda cyahlothrin 5 EC @ 40g a.i./ha) and T_1 (Indoxacarb 14.5 EC @ 57g a.i./ha) were at par but significantly superior over the treatments T_3 (Thiamethoxam 25 WG @ 40g a.i./ha), T_2 (Imidacloprid 17.8 SL @ 30g a.i./ha) and T_6 (Azadirachtin 1500 ppm @ 3ml/L). However, the treatments T_3 (Thiamethoxam 25 WG @ 40g a.i./ha)

and T_2 (Imidacloprid 17.8 SL @ 30g a.i./ha) were at par to each other.

The overall mean reduction per cent was maximum in T_5(Triazophos 40 EC @ 250g a.i./ha) i.e., 75.85. The next treatments in order of superiority were T_4 (Lambda cyahlothrin 5 EC @ 40g a.i./ha), T_1(Indoxacarb 14.5 EC @ 75g a.i./ha), T_2 (Imidacloprid 17.8 SL @ 30g a.i./ha) &T_3 (Thiamethoxam 25 WG @ 40g a.i./ha) with overall mean reduction per cent of population of Bihar hairy caterpillar, i.e., 65.46, 60.19, 55.79 and 53.29 respectively. The least overall mean reduction per cent was observed in case of T_6 (Azadirachtin 1500 ppm @ 3ml/l), i.e., 34.23.

All the insecticides tested against Bihar hairy caterpillar (*S. obliqua*) were found significantly superior on a untreated control. Out of the six tested insecticides T_5 (Triazophos 40 EC @ 250g a.i./ha) proved the most effective and showing maximum overall mean reduction per cent of Bihar hairy caterpillar population, i.e., 74.14 and gave significantly more protection and produced highest yield, followed by T_4 (Lambda cyahlothrin 5 EC @ 40g a.i./ha), T_1 (Indoxacarb 14.5 EC @ 75g a.i./ha) & T_2 (Imidacloprid 17.8 SL @ 30g a.i./ha). The next insecticide in order of efficacy was T_3 (Thiamethoxam 25 WG @ 40g a.i./ha) & T_6 (Azadirachtin 1500 ppm @ 3ml/L).

The present findings are in conformity with the findings of Preeti *et al.* (2015) who found Lambda cyhalothrin effective against 7 days old larvae of Bihar hairy caterpillar.

The present findings are in accordance with the findings of Mandal *et al.* (2013) who found the highest per cent reduction of Bihar hairy caterpillar population in order of efficacy triazophos (90.64%) >ë-cyhalothrin (83.71%) >indoxacarb (78.76%) >endosulfan (69.53%) >imidacloprid (62.31%) > thiamethoxam (57.40%). Azadirachtin was found to be least effective in controlling of hairy caterpillar. Highest cost benefit ratio (1:21.69) was observed in triazophos 40 EC @ 250g a.i/ha.

The present findings are also in accordance with the findings of Mohapatra *et al.* (2018) who found Trizophos 40 EC most effective in reducing the Bihar hair caterpillar population (89.30%) followed by Lambda cyhalothrin 5 EC (75.16%), Indoxacarb 14.5 EC (73.66%), Imidacloprid 17.8 SL (63.26%), Thiamethoxam 25 WG (60.63%) and Azadirachtin 1500 ppm (48.37%). Highest cost-benefit ratio of 1:22.99 was recorded from Trizophos 40 EC @ 250 g a.i./ha.

Yield of green gram (*Vigna radiata*)

The data given in (Table 2) revealed that all the treatments produced higher and significantly more yield over untreated check, i.e., 6.43 q/ha. The treatment T_5 (Triazophos 40 EC @ 250g a.i./ha) produced maximum yield of 9.50 q/ha followed by T_4 (Lambda cyahlothrin 5 EC @ 40g a.i./ha), T_1 (Indoxacarb 14.5 EC @ 75g a.i./ha), T_2 (Imidacloprid 17.8 SL @ 30g a.i./ha), T_3 (Thiamethoxan 25 EC @ 40g a.i./ha) and T_6 (Azadirachtin 1500 ppm @ 3ml/ L) with respective yields 8.90 q/ha, 8.70 q/ha, 8.40 q/ha, 7.63 q/ha and 7.40 q/ha were recorded.

Costs-Benefit Ratio

Data given in (Table 3) revealed that highest cost benefit ratio 1:28.93 was obtain from the plots treated with the T_5 (Triazophos 40 EC @ 250g a.i./ ha) and was followed by T_4 (Lambda cyahlothrin 5 EC @ 40g a.i./ha), T_2 (Imidacloprid 17.8 SL @ 30g a.i./ha), T_3 (Thiamethoxam 25 WG @ 40g a.i./ha) and T_1 (Indoxacarb 14.5 EC 75g a.i./ha) with the re-

Table 2. Yield of green gram under different treatments during *Kharif* 2018

Treatments	Rate/Dose	Grain yield q/ha			
		R1	R2	R3	Mean
Indoxacarb 14.5 EC	75g a.i./ha	9.00	8.50	8.60	8.70
Imidacloprid 17.8 SL	30g a.i./ha	8.00	8.30	8.90	8.40
Thiamethoxam 25 WG	40g a.i./ha	7.00	8.00	7.89	7.63
Lambda cyahlothrin 5 EC	40g a.i./ha	8.00	9.80	9.10	8.90
Trizophos 40 EC	250g a.i./ha	9.20	9.50	9.80	9.50
Azadirachtin 1500 ppm	3ml/L	7.30	7.40	7.50	7.40
Control (Water spray)	-	6.89	6.00	6.40	6.43
SEm±					**0.28**
CD at 5%					**0.86**
CV%					**5.9**

Table 3. Economics and cost benefit ratio of treatments

Treatments	Dose	Cost of treatment (Rs/ha)	Yield (q/ha)	Saved yield due to treatment (q/ha)	Benefit due to treatment (Rs/ha)	Cost: benefit Ratio
Indoxacarb 14.5 EC	75g a.i./ha	1350	8.70	2.27	15,663	1:11.60
Imidacloprid 17.8 SL	30g a.i./ha	620	8.40	1.97	13,593	1:21.92
Thiamethoxam 25 WG	40g a.i./ha	562	7.63	1.20	8,280	1:14.73
Lambda cyahlothrin 5 EC	40g a.i./ha	722	8.90	2.47	17,043	1:23.60
Trizophos 40EC	250g a.i./ha	732	9.50	3.07	21,183	1:28.93
Azadirachtin 1500 ppm	3ml/L	1050	7.40	0.97	6,693	1:6.37
Control (Water spray)	-		6.43			

- ✓ Price of grain Rs. 6900.00/q
- ✓ Labour charges Rs. 175/day/man
- ✓ Sprayer charges Rs. 50/day/sprayer

spective cost-benefit ratio 1:23.60, 1:21.92, 1:14.73 and 1:11.60. The minimum cost benefit ratio of 1:6.37 was recorded in the plots treated with Azadirachtin 1500 ppm @ 3 ml/l.

Conclusion

These finding revealed that management of Bihar hairy caterpillar, *Spilosoma obliqua* (Walk.) in mungbean crop was found effective in reducing infestation by insect. T_5 (Triazophos 40 EC @ 250g a.i./ha) who found most effective in reducing the Bihar hairy caterpillar population followed by T_4 (Lambda cyahlothrin 5 EC @ 40g a.i./ha) which respectively yielded 9.50 q/ha and 8.90 q/ha healthy grain. The least effective treatment was T_6 (Azadirachtin 1500 ppm @ 3ml/L) and yielded only 7.40 q/ha healthy grain. The maximum cost-benefit ratio (1:28.93) was obtained by T_5 (Triazophos 40 EC @ 250g a.i./ha) treated plots.

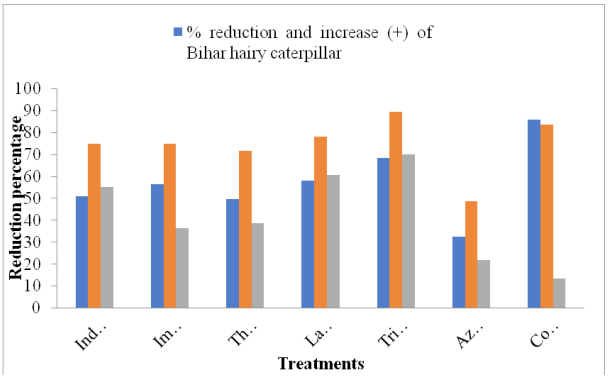

Fig. 1. Effect of various treatments on Bihar hairy caterpillar population in mungbean during *Kharif*, 2018

Conflict of Interest: None

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