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Incremental Cost: Benefit analysis of Botanicals and Insecticides against whitefly in mungbean (*Vigna radiata* L.)

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ABSTRACT

The current studies on incremental cost: benefit analysis of botanicals and insecticides were carried out at Students' Instructional Farm of Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (UP), India during *Kharif* 2022 and 2023 with nine treatments *viz*.,T_1: Kaner powder 5 percent, T_2: Garlic extract 5 percent, T_3: Azadirectin 1500 ppm 5 ml/l, T_4: Dasparni Ark 5 percent, T_5: Flonicamid 50 WG 75 g a.i./ha, T_6: Thiamethoxam 25 WG 50 g a.i./ha, T_7: Imidacloprid 70 WG 50 g a.i./ha, T_8: Dimethoate 30 EC 300 g a.i./ha and T_9: Control (water spray). The economics of some newer insecticide molecules and botanicals against the white fly in mungbean was investigated, and when the data from both years of experiment were combined, it was concluded that Thiamethoxam 25 WG (50 g a.i./ha) (1:16.73) was the most effective insecticide among all the treatments, with maximum population reduction over control. Imidacloprid 70 WG (50 g a.i./ha) (1:10.27) was the second best treatment against white fly. Among the botanicals, Azadirectin 1500 ppm (5 ml/l) (1:6.21) was the most efficient against whitefly infestation in mungbean and could be utilized as an eco-friendly alternative to conventional pesticides for white fly management in mungbean.

Keywords: Economics, *Kharif,* mungbean, white fly, botanicals and Insecticides

INTRODUCTION

Mungbean (*Vigna radiata* L. Wilczek) is a very important pulse crop in India after gram and pigeon pea (Ved *et al.,* 2008). Due to the presence of protein, minerals and vitamins in mungbean, it is used to make dry and green fresh legume vegetables (Das *et al.,* 2014). In India, the productivity of this legume mungbean is 629 kg per hectare and we consume it extensively for making papad, biscuits, bread, soup and consuming fresh sprouts by swelling them in water (Sehrawat *et al.,* 2013). Mungbean seeds are rich in (amounts in 100 g) minerals like calcium (132 mg), iron (6.74 mg), magnesium (189 mg), phosphorus (367 mg) and potassium (1246 mg) and vitamins like ascorbic acid (4.8 mg), thiamine (0.621 mg), riboflavin (0.233 mg), niacin (2.251 mg), pantothenic acid (1.910 mg) and vitamin A (114 IU) (Haytowitz and Matthews, 1986). More than 80 per cent of mungbean production comes

from 10 states of India. These are Rajasthan, Madhya Pradesh, Maharashtra, Bihar, Karnataka, Tamil Nadu, Gujarat, Andhra Pradesh, Odisha and Telangana.There can be many reasons for the low production of this mungbean crop in India in which one of the most important reasons for the deficiency are insects and from sowing to the storage of mungbean, many types of insects cause harm to it, and 64 types of species of such insects are found in India (Lal, 2008). The insect pests noted on mungbean involve whitefly (*Bemisia tabaci*, Genn.), jassid (*Empoasca kerri*, Pruthi), thrips (*Caliothrips indicus*, Bagnall), pod borers (*Helicoverpa armigera*, Hubner and *Maruca testulalis*, Geyer), green bug (*Nezara viridula*, Linn.), semilooper (*Plusia orichalcea*, Fab.), stem fly (*Ophiomyia phaseoli*, Tryon.), tortricid moth (*Cydia ptychora*, Meyr), galerucid beetle (*Madurasia obscurella*, Jacoby) and cutworm (*Agrotis ipsilon*, Hufn) (Nitharwal *et al.,* 2013).

MATERIALS AND METHODS

The experiments for this study were carried out in the field on the mungbean variety SML-668 at the Students' Instructional Farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India, during the months of *Kharif* 2022 and 2023. The experimental site is located in the subtropical climatic zone of the Indo-Gangetic plains, at 26.470 N latitude and 82.120 E longitude, at an elevation of 113 meters above mean sea level. The climate in the area is subtropical and semi-arid, with an average annual rainfall of approximately 1070 mm. The majority of the rain fell during the last weeks of June to mid-September. The experiment was laid out in Randomized Block Design with nine treatments replicated thrice in plot size of 4×3 m sown with 30 cm row to row and 10 cm plant to plant spacing by following recommended agronomic practices and fertilizer application to study the population build up of the whitefly associated with mungbean. Four systemic insecticides and four botanicals were applied, according to the treatment plan. The treatment details are as follows: T_1: Kaner powder 5 percent, T_2: Garlic extract 5 percent, T_3: Azadirectin 1500 ppm 5 ml/l, T_4: Dasparni Ark 5 percent, T_5: Flonicamid 50 WG 75 g a.i./ha, T_6: Thiamethoxam 25 WG 50 g a.i./ha, T_7: Imidacloprid 70 WG 50 g a.i./ha, T_8: Dimethoate 30 EC 300 g a.i./ha and T_9: Control (water spray).Whitefly population was recorded with the help of rectangular cage of 45 cm long, 30 cm wide and 90 cm high on randomly selected 5 places.

RESULTS AND DISCUSSION

Field experiments were conducted for two consecutive crop seasons (*Kharif* 2022 and 2023) to determine the effectiveness of treatments against whiteflies. Nine treatments including one control were evaluated against whitefly.

Economics of treatments during *Kharif* 2022

The information pertaining the economics of various treatments during *Kharif* 2022 are present in Table 1 depicted that maximum net return was found under the treatment T_6- Thiamethoxam 25 WG 50 g a.i./ha (Rs. 18449.75) and lowest in T_4- Dasparni Ark 5% (1892.00). The incremental cost: benefit ratio of dissimilar treatments revealed that T_6- Thiamethoxam 25 WG 50 g a.i./ha (1:16.47) was most economical treatment followed by T_7- Imidacloprid 70 WG 50 g a.i./ha (1:9.15), T_8- Dimethoate 30 EC 300 g a.i./ha (1:8.64), T_3- Azadirectin 1500 ppm 5 ml/l (1:7.43), T_5- Flonicamid 50 WG 75 g a.i./ha (1:6.00), T_2- Garlic extract 5% (1:3.13) and T_1- Kaner powder 5% (1:1.91).

Economics of treatments during *Kharif* 2023

During *Kharif* 2023, the maximum net return was recorded from T_6- Thiamethoxam 25 WG 50 g a.i./ha (Rs. 19031.75). The incremental cost: benefit ratio of different treatment revealed that T_6- Thiamethoxam 25 WG 50 g a.i./ha (1:16.99) was the most economical treatment followed by T_7- Imidacloprid 70 WG 50 g a.i./ha (1:11.38), T_8- Dimethoate 30 EC 300 g a.i./ha (1:8.53), T_5- Flonicamid 50 WG 75 g a.i./ha (1:6.24), T_3- Azadirectin 1500 ppm

5ml/l (1:4.99), T_2- Garlic extract 5% (1:3.19) and T_1- Kaner powder 5% (1:1.84). T_4- Dasparni Ark 5% (1:1.68) was the least economic treatment (Table 2).

Economics of treatments during *Kharif* 2022 and 2023

The pooled data *Kharif* 2022 and 2023 pertaining to economics of various treatments are presented in Table 3 shows that highest net return was recorded from the treatment T_6- Thiamethoxam 25 WG 50 g a.i./ha (Rs. 18740.75) and minimum in T_4- Dasparni Ark 5% (Rs. 2255.75). Maximum incremental cost: benefit ratio was obtain from T_6- Thiamethoxam 25 WG 50 g a.i./ha (1:16.73) followed by T_7- Imidacloprid 70 WG 50 g a.i./ha (1:10.27), T_8- Dimethoate 30 EC 300 g a.i./ha (1:8.59), T_3- Azadirectin 1500 ppm 5ml/l (1:6.21), T_5- Flonicamid 50 WG 75 g a.i./ha (1:6.10), T_2- Garlic extract 5% (1:3.13) and T_1- Kaner powder 5% (1:1.84). T_4-Dasparni Ark 5% (1:1.40) had the least economic impact (Table 3).

The current findings are in partial agreement with the findings of Singh *et al.,* (2015). Among insecticides were seed treated with thiamethoxam 120g a.i./ha (1:5.25), thiamethoxam 180g a.i./ha (1:5.10) and minimum obtained triazophos 400g a.i./ha (1:4.67). Balabantaray *et al.,*(2018). thiamethoxam 25 WG @ 40 g/acre + Neem Baan 1500 ppm @ 1.0 l/acre) as compare to other treatments. However, the maximum yield was obtained in nimbecidine 300 ppm @ 1l/acre treated plots hence, the BC ratio.

CONCLUSION

The economics of certain newer insecticides and botanicals against the white fly in mungbean were explored, and when the results from both years of experiments were merged, it emerged that Thiamethoxam 25 WG (50 g a.i./ha) (1:16.73) was the most effective insecticide among all the treatments, with maximum population reduction over control. Imidacloprid 70 WG (50 g a.i./ha) (1:10.27) was the second best treatment against white fly. The most efficient botanical against whitefly infestation in mungbean was Azadirectin 1500 ppm (5 ml/l) (1:6.21), which might be used as a eco friendly alternative for traditional pesticides in the management of whitefly infestation in mungbean.

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Table 1: Economics of treatments against whitefly during *Kharif*, 2022

Tr. No.	Treatments	Dose	Total cost of Treatments (Rs/ha) (labour + sprayer charge + insecticides cost)	Grain Yield (q/ha)	Saved Yield (q/ha)	Value of Saved Yield (Rs/ha)	Net Returns	Cost Benefit Ratio (C:B)
T_1	Kaner powder	5%	1100.00	6.67	0.44	3201.00	2101.00	1:1.91
T_2	Garlic extract	5%	1354.00	7.00	0.77	5601.75	4247.75	1:3.13
T_3	Azadirectin 1500ppm	5ml/l	1250.00	7.68	1.45	10548.75	9298.75	1:7.43
T_4	Dasparni Ark	5%	1600.00	6.71	0.48	3492.00	1892.00	1:1.18
T_5	Flonicamid 50 WG	75 g a.i/ha	2099.00	8.25	2.02	14695.50	12596.50	1:6.00
T_6	Thiamethoxam 25 WG	50 g a.i./ha	1120.00	8.92	2.69	19569.75	18449.75	1:16.47
T_7	Imidacloprid 70 WG	50 g a.i./ha	1433.00	8.23	2.00	14550.00	13117.00	1:9.15
T_8	Dimethoate 30 EC	300 g a.i./ha	1350.00	8.02	1.79	13022.25	11672.25	1:8.64
T_9	Control (Water spray)	_		6.23	-	-	-	-

Rent of sprayer @ Rs. 100/day = Rs.200/, Labour charge @ Rs. 250/day = Rs. 500/, Cost of mungbean seed-Rs. 7275/q

Table 2: Economics of treatments against whitefly during *Kharif*, 2023

Tr. No.	Treatments	Dose	Total cost of Treatments (Rs/ha) (labour + sprayer charge + insecticides cost)	Grain Yield (q/ha)	Saved Yield (q/ha)	Value of Saved Yield (Rs/ha)	Net Returns	Cost Benefit Ratio (C:B)
T_1	Kaner powder	5%	1100.00	7.63	0.43	3128.25	2028.25	1:1.84
T_2	Garlic extract	5%	1354.00	7.98	0.78	5674.50	4320.50	1:3.19
T_3	Azadirectin 1500ppm	5ml/l	1250.00	8.23	1.03	7493.25	6243.25	1:4.99
T_4	Dasparni Ark	5%	1600.00	7.79	0.59	4292.25	2692.25	1:1.68
T_5	Flonicamid 50 WG	75 g a.i/ha	2099.00	9.29	2.09	15204.75	13105.75	1:6.24
T_6	Thiamethoxam 25 WG	50 g a.i./ha	1120.00	9.97	2.77	20151.75	19031.75	1:16.99
T_7	Imidacloprid 70 WG	50 g a.i./ha	1433.00	9.64	2.44	17751.00	16318.00	1:11.38
T_8	Dimethoate 30 EC	300 g a.i./ha	1350.00	8.97	1.77	12876.75	11526.75	1:8.53
T_9	Control (Water spray)	_		7.20	-	-	-	-

Rent of sprayer @ Rs. 100/day = Rs.200/, Labour charge @ Rs. 250/day = Rs. 500/, Cost of mungbean seed-Rs. 7275/q

Table 3: Economics of treatments against whitefly during *Kharif* 2022 & 2023 (Pooled)

Tr. No.	Treatments	Dose	Total cost of Treatments (Rs/ha) (labour + sprayer charge + insecticides cost)	Grain Yield (q/ha)	Saved Yield (q/ha)	Value of Saved Yield (Rs/ha)	Net Returns	Cost Benefit Ratio (C:B)
T_1	Kaner powder	5%	1100.00	7.15	0.43	3128.25	2028.25	1:1.84
T_2	Garlic extract	5%	1354.00	7.49	0.77	5601.75	4247.75	1:3.13
T_3	Azadirectin 1500ppm	5ml/l	1250.00	7.96	1.24	9021.00	7771.00	1:6.21
T_4	Dasparni Ark	5%	1600.00	7.25	0.53	3855.75	2255.75	1:1.40
T_5	Flonicamid 50 WG	75 g a.i/ha	2099.00	8.77	2.05	14913.75	12814.75	1:6.10
T_6	Thiamethoxam 25 WG	50 g a.i./ha	1120.00	9.45	2.73	19860.75	18740.75	1:16.73
T_7	Imidacloprid 70 WG	50 g a.i./ha	1433.00	8.94	2.22	16150.50	14717.50	1:10.27
T_8	Dimethoate 30 EC	300 g a.i./ha	1350.00	8.50	1.78	12949.50	11599.50	1:8.59
T_9	Control (Water spray)	_		6.72	-	-	-	-

Rent of sprayer @ Rs. 100/day = Rs.200/, Labour charge @ Rs. 250/day = Rs. 500/, Cost of mungbean seed-Rs. 7275/q

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