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Efficacy of newer insecticides against sucking insect pests, whitefly (*Bemisia tabaci*), Jassid (*Empoasca kerri*) and thrips (*Caliothrips indicus*) of mungbean [*Vigna radiata* (L.) Wilczek]

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Abstract
A field experiment was conducted to find out the effective dose of some newer insecticides for the management of sucking insect pests of mungbean *viz.*, whitefly (*Bemisia tabaci*), jassid (*Empoasca kerri*) and thrips (*Caliothrips indicus*). The treatments of experiment were Diafenthiuron 50 WP @ 187.5g a.i./ha, Diafenthiuron 50 WP @ 250g a.i./ha, Diafenthiuron 50 WP @ 312.5g a.i./ha, Spiromesifen 240 SC @ 90 g a.i./ha, Spiromesifen 240 SC @ 120g a.i./ha, Spiromesifen 240 SC @ 150g a.i./ha, seed treatment with Thiamethoxam 70 WS + Thiomethoxam 25 WG @ 5 g/kg seed + 25.0 g a.i./ha, Thiamethoxam 25 WG (Std. Check) @ 25g a.i./ha and Triazophos 40 EC (Std. Check) @ 500g a.i./ha. The results of experiment revealed that among the tested insecticides, the treatment T_3 (Diafenthiuron 50 WP @ 312.5 g a.i./ha) was found most effective resulting in 85.9% and 77.8% reduction of whitefly and thrips population respectively. The treatment T_5 (Spiromesifen 240 SC@ 120 ml a.i./ha) was found most effective against jassid resulting in 77.5% reduction of population.

Keywords: Efficacy, mungbean, sucking insect pests, insecticides, whitefly, jassid, thrips

Introduction
Mungbean or green gram [*Vigna radiata* (L.) Wilczek] belongs to the family Fabaceae, is a good source of protein, carbohydrates, vitamin for mankind all over the world. It contains 24.5% protein and 59.9% carbohydrate, 75 mg calcium, 8.5 mg iron and 49 mg B- carotine per 100g of split dual (Bakr *et al.*, 2004) [2]. In India, the area under mungbean was 3.83 mha with production 1.60 million tonnes and productivity 418 kg/ha. In Uttar Pradesh, the area under mungbean was 51000 ha with production 33000 tonnes and productivity 666 kg/ha (Anonymous, 2017) [1]. The foliage and stem are also a good source of fodder for live stock as well as a green manure. Mungbean is grown in summer and *Kharif* season in northern India. In southern India, it is also grown in winter season. It requires hot climate and has the capacity to tolerate moisture stress. Mungbean is grown principally for its high quality seeds that are used in human diet, can be prepared by cooking, fermenting, milling or sprouting. They are utilized in making soups, curries, bread, sweets, noodles, salads, boiled dhal bean cake, confectionary, to fortify wheat flour in making vermicelli and many other culinary products like papad, halwah and Vari etc. (Singh *et al.*, 1988). The most serious insect pests attacking on mungbean includes whitefly (*Bemisia tabaci*), bean thrips (*Megalurothrips distalis*), gram pod borer (*Helicoverpa armigera*) and legume pod borer (*Maruca vitrata*) (Kooner *et al.*, 2006) [6]. Whitefly (*Bemisia tabaci*), jassid (*Empoasca kerri*) and flower thrips (*Caliothrips indicus*) are the major sucking insect pests of eastern Uttar Pradesh (Bairwa and Singh *et al.*, 2016) [9]. Whitefly, (*Bemisia tabaci*) is vector of Mungbean Yellow Mosaic Virus (MYMV) and even low population densities *B. tabaci*is capable for wide range of transmission of MYMV (Sastry and Singh, 1973) [8]. Pest appearance, population fluctuation, infestation rate and crop yield are very much dependent on sowing time. Most of the farmers usually sown mungbean just after harvesting them *Rabi* crops without considering optimum sowing dates (Hossain *et al.*, 2000) [4].

Materials and Methods

The present study was conducted during *Kharif* season of 2017 at Genetics and Plant Breeding Research Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad, to evaluate the efficacy of different doses of newer insecticides against sucking insect pests; whitefly (*B. tabaci*), jassid (*E. kerri*) and flower thrips (*C. indicus*) of mungbean. The experiment was carried out in Randomized Block Design (RBD) consisting 10 treatments including control and these treatments were replicated thrice. Mungbean variety NDM-1 which is commonly cultivated in this area was grown in plots having 10 rows, plot size 5×4 meter in each plot. The plant spacing between rows and plants were maintained 30 cm and 10 cm, respectively. The crop was raised under normal agronomic practices. The spray mixture of each treatment was prepared by mixing required quantity of the insecticide in water to make it equivalent to 600 l/ha. The observations on whitefly and jassid population were recorded using rectangular cage, while thrips population was recorded by visual count from randomly selected five flowers from each plot at 1 day before, 3 and 7 days after spraying (DAS). The spray mixtures were freshly prepared for each treatment and amount of formulation was calculated using following formula:

$$\text{Amount of formulation} = \frac{\text{Concentration required (\%)} \times \text{Volume required (Litre)}}{\text{Concentration to toxicant in insecticidal formulation}}$$

Results and Discussion

Efficacy of different newer insecticides against whitefly

The data presented in table showed that mean whitefly population on mungbean crop at pre-treatment, population were homogeneous and non-significant between all treatments. Whitefly population in untreated control (T_{10} treatment) at after 3 days of spraying was significantly higher than all other treatments. Diafenthiuron 50 WP @312.5 g a.i./ha was most effective treatment in reducing population of whitefly followed by Thiomethoxam 25 WG (Std. check) @ 25.0 g a.i./ha, Spiromesifen 240 SC @150.0 ml a.i./ha, Diafenthiuron 50 WP @ 187.5 g a.i./ha, ST- Thiamethoxam 70WS + Thiomethoxam 25 WG @ 5 g/kg seed + 25.0 g a.i./ha, Spiromesifen 240 SC @ 90.0 ml a.i./ha, Diafenthiuron 50 WP @ 250.0 g a.i./ha, Spiromesifen 240 SC @ 120.0 ml a.i./ha and Triazophos 40 EC (Std. check) @ 500.0 ml a.i./ha. This is in accordance with Kharel *et al.*, (2016) reported that the diafenthiuron 50 WP @ 312 g a.i./ha was most promising treatment in reducing population of whitefly (*Bemisia tabaci*) after both sprays followed by Spiromesifen 240 SC @ 150 g a.i./ha as compared to standard checks, Thiamethoxam 25 WG @ 25 g a.i./ha and Triazophos 40 EC @ 500 g a.i./ha in green gram.

Efficacy of different newer insecticides against jassid

Jassid population in untreated control (T_{10} treatment) at after 3 days of spraying was significantly higher than all other treatments. Spiromesifen 240 SC @ 120.0 ml a.i./ha was found most effective insecticide for minimizing the population of jassid followed by Spiromesifen 240 SC @ 90.0 ml a.i./ha, Diafenthiuron 50 WP @312.5 g a.i./ha, Thiomethoxam 25 WG (Std. check) @ 25.0 g a.i./ha, Spiromesifen 240 SC @150.0 ml a.i./ha, Diafenthiuron 50 WP @ 250.0 g a.i./ha, Diafenthiuron 50 WP @ 187.5 g a.i./ha, Triazophos 40 EC (Std. check) @ 500.0 ml a.i./ha and ST- Thiamethoxam 70WS + Thiomethoxam 25 WG @ 5 g/kg seed + 25.0 g a.i./ha. Present findings are partial agreement with Singh *et al.*, (2016) [9] who revealed that thiomethoxam 180 g a.i./ha and acetamiprid 180 g a.i./ha were effective against jassid population.

Efficacy of different newer insecticides against flower thrips

The data presented in table showed that mean thrips population on mungbean crop at pre-treatment population were homogeneous and non-significant between all treatments. Thrips population in untreated control (T_{10} treatment) at after 3 days of spraying was significantly higher than all other treatments. Diafenthiuron 50 WP @312.5 g a.i./ha was more effective treatment in reducing thrips population followed by Spiromesifen 240 SC @150.0 ml a.i./ha, Diafenthiuron 50 WP @ 250.0 g a.i./ha, Spiromesifen 240 SC @ 120.0 ml a.i./ha, Spiromesifen 240 SC @ 90.0 ml a.i./ha, Diafenthiuron 50 WP @ 187.5 g a.i./ha, Thiomethoxam 25 WG (Std. check) @ 25.0 g a.i./ha, ST-Thiamethoxam 70WS + Thiomethoxam 25 WG @ 5 g/kg seed + 25.0 g a.i./ha and Triazophos 40 EC (Std. check) @ 500.0 ml a.i./ha. Present findings supported by Kharel*et al.*, (2016) reported that the diafenthiuron 50 WP @ 312 g a.i./ha was most promising treatment in reducing population of flower thrips (*Caliothrips indicus*) after both sprays followed by Spiromesifen 240 SC @ 150 g a.i./ha as compared to standard checks, Thiamethoxam 25 WG @ 25 g a.i./ha and Triazophos 40 EC @ 500 g a.i./ha in green gram. This is also in accordance with Masood Khan *et al.* (2004) who found that the acetameprid 20 SP, thiamethoxam 25 WG, diafenthiuron 500 EC, acephate 60 SL and imidacloprid 200 SL were reduced the population of thrips on greengramupto 10 days after spray.

Table: Efficacy of different treatments against sucking pests in mungbean during *Kharif* 2017

S. No.	Treatments	Dose g/ml a.i./ha	No. of white fly/cage			No. of jassid/cage			No. of thrips/5 plants		
			Before one day of spray	After 3 days of spray	After 7 days of spray	Before one day of spray	After 3 days of spray	After 7 days of spray	Before one day of spray	After 3 days of spray	After 7 days of spray
1	Diafenthiuron 50 WP (T_1)	187.5	6.6 (2.66)	2.2 (1.64)	2.2 (1.65)	5.8 (2.51)	3.5 (1.99)	2.6 (1.77)	3.2 (1.92)	1.6 (1.46)	1.1 (1.24)
2	Diafenthiuron 50 WP (T_2)	250.0	6.2 (2.59)	3.2 (1.92))	2.4 (1.70)	6.1 (2.57)	3.0 (1.81)	2.4 (1.71)	3.4 (1.97)	1.5 (1.42)	0.9 (1.17)
3	Diafenthiuron 50 WP (T_3)	312.5	6.8 (2.70)	1.9 (1.54)	1.0 (1.20)	5.7 (2.49)	2.7 (1.77)	2.0 (1.58)	3.0 (1.87)	1.2 (1.29)	0.8 (1.13)
4	Spiromesifen 240 SC (T_4)	90.0	7.3 (2.79)	2.4 (1.70)	2.3 (1.66)	5.4 (2.43)	2.2 (1.64)	2.0 (1.58)	2.9 (1.84)	1.8 (1.51)	1.1 (1.24)
5	Spiromesifen 240 SC (T_5)	120.0	6.7 (2.68)	2.3 (1.66)	2.4 (1.70)	5.9 (2.53)	3.2 (1.92)	1.8 (1.52)	3.3 (1.95)	2.1 (1.62)	0.9 (1.19)
6	Spiromesifen 240 SC (T_6)	150.0	6.5	3.2	2.1	6.0	2.5	2.4	3.1	1.6	0.8

			(2.65)	(1.92)	(1.62)	(2.55)	(1.73)	(1.70)	(1.90)	(1.46)	(1.16)
7	ST- Thiamethoxam 70WS + Thiomethoxam 25 WG (T_7)	5g/kg seed + 25.0g	6.4 (2.63)	2.2 (1.64)	2.2 (1.64)	5.8 (2.51)	3.7 (1.98)	3.3 (1.95)	3.6 (2.02)	2.1 (1.62)	1.4 (1.36)
8	Thiomethoxam 25 WG (Std. check) (T_8)	25.0	6.8 (2.70)	1.8 (1.50)	1.7 (1.49)	6.1 (2.57)	2.5 (1.73)	2.2 (1.64)	3.2 (1.92)	2.2 (1.64)	1.2 (1.30)
9	Triazophos 40 EC (Std. check) (T_9)	500.0	7.3 (2.79)	2.6 (1.76)	2.5 (1.73)	5.7 (2.49)	4.0 (2.08)	3.1 (1.89)	3.5 (2.00)	2.4 (1.70)	1.5 (1.40)
10	Untreated Control (T_{10})	-	7.0 (2.74)	6.9 (2.72)	7.1 (2.76)	6.2 (2.59)	6.3 (2.61)	8.0 (2.92)	3.6 (2.02)	3.8 (2.06)	3.6 (2.02)
	SEm±		-	0.05	0.07	-	0.13	0.10	-	0.05	0.09
	C.D. (p = 0.05)		NS	0.15	0.22	NS	0.39	0.29	NS	0.14	0.28

Figures in parentheses indicates transformed value (x+0.5)

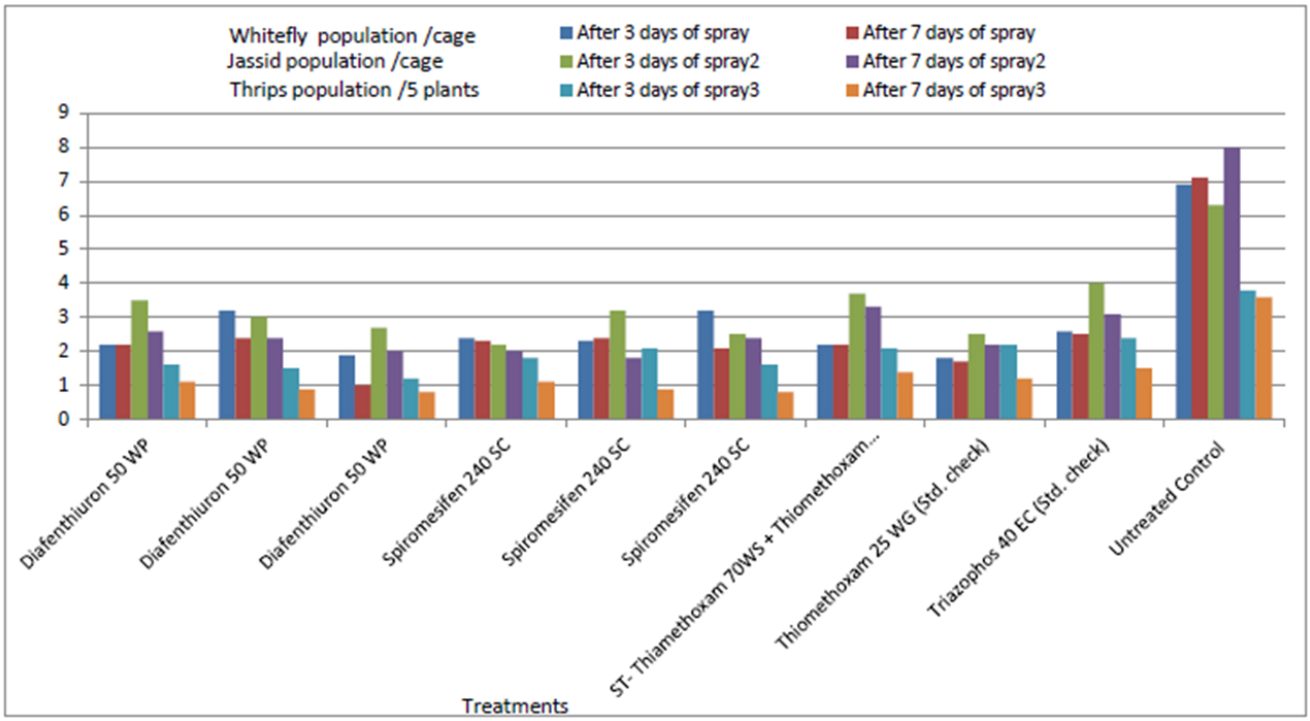

Fig 1: Efficacy of different treatments against sucking pests in mungbean during *Kharif* 2017

Conclusion

Most effective treatment was found Diafenthiuron 50 WP @ 312.5 g a.i./ha which reducing population of whitefly and thrips.In case of jassid, Spiromesifen 240 SC @ 120.0 ml a.i./ha was found most effective insecticide for minimizing the population of jassid. In other hands othertreatments with Thiomethoxam 25 WG (Std. check) @ 25.0 g a.i./ha, Spiromesifen 240 SC @ 150.0 ml a.i./ha and Spiromesifen 240 SC @ 90.0 ml a.i./ha was also found to be effective incontrolling the insect pest population.

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