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Efficacy of combination of pesticides against whitefly (*Bemisia tabaci*) on black gram

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Abstract
A field experiment was conducted during kharif 2016 and 2017 in kharif season to evaluate the efficacy of combination of pesticide. The ten treatments were tested by using different doses of insecticides and fungicides and combinations of them. Among them higher effectiveness was observed with the application of T_2 (thiamethoxam 25 WG+ propiconazole 25 EC) @ 0.3g+1.0ml/l. by reducing whitefly 0.89 number/trifoliate followed by T_6 (thiamethoxam 25 WG) @ 0.3g/l. (1.0 numbers/trifoliate) with comparison to maximum 5.85 numbers/ trifoliate recorded in control.

Keywords: Whitefly, thiamethoxam, black gram, kharif

Introduction
Black gram, *Vigna mungo* (L.) Hepper is an important legume crop grown widely in India belonging to family Fabaceae, having the ability to fix atmospheric nitrogen into the soil and available to plants. It constitutes a balanced diet in combination with cereals. It contains protein about 24%, minerals 3.2% and carbohydrate 59.6%. It also carries 154 mg calcium, 9.1 mg iron and 38 mg β-carotene per 100g of split dal. (Bakr *et al.*, 2004) [3]. In India black gram was grown under 4.32 million hectare area with 2.17 million tonnes production and 502 kg per hectare productivity in the year 2016 to 2017 (Anonymous, 2017) [1]. In Jharkhand, it is grown in about 1.48 lakh ha area with production of 1.36 lakh tons (Anonymous, 2018) [2]. The crop is destroyed by a range of insect pests from sowing to harvest in the field as well as in storage (Lal and Sachan, 1987) [7]. Among these sucking insect pests like whitefly, jassid and thrips are of major importance (Khattak *et al.*, 2004) [6]. Whitefly, *Bemisia tabaci* (Gennadius) is the most significant insect pest causing damage by sucking cell sap from leaves or tender parts, and secretes honeydew on which sooty mold develops which hinders photosynthesis. Besides, it also acts as a vector for mungbean yellow mosaic virus, which is a serious threat to pulse production in India. Whitefly is one of potential vector of yellow mosaic virus cause damage up to 30 to 70% (Nene 1971) [8]. Indiscriminate use of insecticides resulted in the development of resistance in the target insect pest species, the resurgence of whitefly and environmental pollution (Hussain *et al*, 2001) [4]. Keeping these facts in view the present study was conducted on black gram to evaluate the efficacy of a combination of pesticides against whitefly.

Materials and Methods
The studies were conducted at research farm Birsa Agricultural University, Ranchi for the two years kharif 2016 and 2017on black gram variety Pant U 19. The experiment was laid out in randomized block design with ten treatments including control having three replications. The crop was sown at a spacing of 30×10 cm with a plot size of 5.7×4 Sqm. The treatments were

taken viz., T_1 (thiamethoxam 25 WG+ propiconazole 25 EC @ 0.2g+1.0ml/l.), T_2 (thiamethoxam 25 WG+ propiconazole 25 EC @ 0.3g+1.0ml/l.), T_3 (Spinosad 45 SC+ Propiconazole 25 EC @ 0.5ml+1.0ml/l.), T_4 (spinosad 45 SC+ propiconazole 25 EC @ 0.6ml+1.0ml/l.), T_5 (NSKE + propiconazole 25 EC @ 5%+1ml/l.), T_6 (thiamethoxam 25 WG @ 0.3g/l.), T_7 (spinosad 45 SC @ 0.6ml/l.), T_8 (NSKE 5% @ 5%), T_9 (propiconazole 25 EC @ 1.0 ml/l.) and T_{10} (control). All agronomic practices were followed as per recommendations. First spraying was done at 30 day after sowing and second spraying was done 40 days after sowing. The population of whitefly was counted one day before application and 3, 7 and 10 days after spray (DAS). The whitefly population was counted on per trifoliate of ten randomly selected plants in each plot.

Results and Discussion

The pretreatment population of whitefly was ranged from 4.19 to 5.28 numbers/trifoliate in different treatments including control. The post treatment effect indicated that all treatment significantly reduced the population of whitefly in the treated plots than control at 3 DAS of first spray. The whitefly population ranged from 1.30 to 2.95 number/trifoliate at 3 DAS in treated plot as against 5.35 number/trifoliate in untreated control (table 1). A significance influence of the pesticide was further seen after 7th days after treatment with ranging whitefly population from 0.79 to 3.37. After 10th days after spray of treatment a slight increase in the pest population were seen in treated plots including untreated control, except thiamethoxam treated plots. The pooled mean of all three sprays data indicated that among the tested treatments the combination of thiamethoxam 25 WG+ propiconazole 25 EC @ 0.3g+1.0ml/l. was found most effective treatment which was significantly not differed with thiamethoxam 25 WG @ 0.3g/l. and thiamethoxam 25 WG+ propiconazole 25 EC @ 0.2g+1.0ml/l but differed significantly than other treatments.

The second spray results presented in table 1 which revealed that whitefly population declined further ranged 0.80 to 3.38 and 0.66 to 3.33 numbers/trifoliate at 3rd and 7th DAS respectively. A slight increase in the pest population was observed at 10th DAS in treated plots including untreated control. The pooled mean of all three sprays data of second spray indicated that the whitefly population minimized significantly in all treated plots (0.72 to 3.35 numbers/trifoliate) against control (6.17 numbers/trifoliate).

The overall pooled mean of both first and second spray data presented in table 1 and figure 1 which revealed that among the tested treatments the combination of thiamethoxam 25 WG + propiconazole 25 EC @ 0.3g+1.0ml/l. was found most effective treatment followed by thiamethoxam 25 WG @ 0.3g/l. and thiamethoxam 25 WG+ propiconazole 25 EC @ 0.2g+1.0ml/l which were significantly not differed with each other but significantly differed with other treatments.

The present findings are accordance with findings of Yadav *et al.* (2015) [11], who reported that thiamethoxam 25% WG was most effective in reducing whitefly population. Parmar *et al.* (2015), reported that minimum whitefly population observed in thiamethoxam 25% WG treated plot. Rajawat *et al.* (2017) [10] reported that thiacloprid 21.7% SC was found significantly most effective against whitefly followed by thiamethoxam 25% WG. Khaliq *et al.* (2017) [5] reported that among tested treatments imidacloprid was found most effective treatment in reducing the whitefly population and next best treatment was thiamethoxam.

Conclusion

The application of thiamethoxam 25 WG either at the rate of 0.3g or 0.2g per liter of water with 1 ml propiconazole found most effective in reducing whitefly population. The next best treatment was T_6 Thiamethoxam 25 WG @ 0.3g/l. alone was also minimized the whitefly population.

Table 1: Efficacy of combination of pesticides for management of whitefly on black gram during *kharif* 2016 and 2017

Treatments	Doses	Whitefly (numbers/trifoliate)									
		Before Spray	1st Spray (30 Days after sowing)				2nd Spray (40 Days after sowing)				Overall Mean
			3 DAS	7 DAS	10 DAS	Mean	3 DAS	7 DAS	10 DAS	Mean	
T_1 (Thiamethoxam 25 WG + propiconazole 25 EC)	0.2g+1.0ml/l.	4.91	1.68 (1.44)	1.40 (1.35)	1.33 (1.33)	1.47 (1.38)	1.15 (1.27)	1.01 (1.22)	1.04 (1.22)	1.02 (1.23)	1.25 (1.32)
T_2 (Thiamethoxam 25 WG + propiconazole 25 EC)	0.3g+1.0ml/l.	4.96	1.30 (1.31)	0.91 (1.16)	0.95 (1.18)	1.05 (1.22)	0.80(1.12)	0.66 (1.07)	0.70 (1.08)	0.72 (1.09)	0.89 (1.16)
T_3 (Spinosad 45 SC + Propiconazole 25 EC)	0.5ml+1.0ml/l.	5.21	2.18 (1.60)	1.72 (1.47)	1.71 (1.46)	1.87 (1.51)	1.54 (1.42)	1.38 (1.36)	1.44 (1.38)	1.45 (1.39)	1.66 (1.45)
T_4 (Spinosad 45 SC + Propiconazole 25 EC)	0.6ml+1.0ml/l.	5.20	2.33 (1.66)	1.57 (1.41)	1.49 (1.38)	1.80 (1.49)	1.24 (1.31)	1.06 (1.24)	1.16 (1.28)	1.15 (1.27)	1.47 (1.39)
T_5 (NSKE + Propiconazole 25 EC)	5%+1ml/l.	5.19	2.25 (1.63)	1.47 (1.38)	1.38 (1.36)	1.70 (1.45)	1.26 (1.31)	1.09 (1.25)	1.14 (1.27)	1.21 (1.31)	1.46 (1.39)
T_6 (Thiamethoxam 25 WG)	0.3g/l.	5.15	1.91 (1.53)	0.79 (1.12)	0.92 (1.17)	1.21 (1.29)	0.80 (1.12)	0.76 (1.10)	0.81 (1.13)	0.79 (1.12)	1.00 (1.21)
T_7 (Spinosad 45 SC)	0.6ml/l.	5.24	2.07 (1.58)	1.30 (1.33)	1.39 (1.36)	1.59 (1.43)	1.15 (1.27)	1.07 (1.24)	1.19 (1.28)	1.13 (1.26)	1.36 (1.35)
T_8 (NSKE 5%)	5%	4.95	2.59 (1.74)	2.52 (1.70)	2.54 (1.72)	2.55 (1.73)	2.45 (1.69)	2.10 (1.58)	2.29 (1.64)	2.28 (1.63)	2.42 (1.68)
T_9 (Propiconazole 25 EC)	1.0 ml/l.	5.19	2.95 (1.84)	3.37 (1.96)	3.44 (1.98)	3.25 (1.93)	3.38 (1.96)	3.33 (1.95)	3.34 (1.95)	3.35 (1.96)	3.30 (1.94)
T_{10} Control (Only spray water)		5.28	5.35 (2.41)	5.51 (2.45)	5.71 (2.49)	5.53 (2.45)	5.92 (2.53)	6.20 (2.59)	6.39 (2.62)	6.17 (2.58)	5.85 (2.52)
SEm (±)		--	0.07	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.04
CD at 5%		NS	0.19	0.17	0.18	0.18	0.15	0.16	0.18	0.18	0.12
CV (%)		--	9.63	9.48	9.77	6.60	8.38	9.35	10.28	7.16	6.87

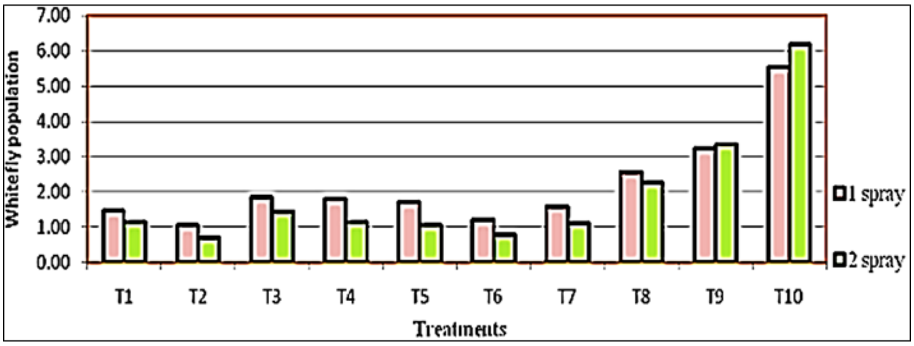

Fig 1: Efficacy of combination of pesticides against whitefly population during *kharif* 2016 and 2017

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