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Management of whitefly, *Bemisia tabaci* Gennadius in mungbean (*Vigna radiata* L.)

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Abstract
A field experiment was conducted on mungbean crop to evaluate different biopesticides against whitefly, *Bemisia tabaci* during *Kharif* season of 2018. The results indicated that minimum whitefly adult populations was recorded in treatment where NSKE 5% Aqueous Extract was sprayed twice (First spray : 13.6 whitefly adult/plant at 3 days after spray (DAS); Second spray : 4.13 and 4.00 adults/plant at 3 and 7DAS, respectively). Whereas, maximum grain yield (259.26 kg/ha) was obtained in treatment where NSKE 5% Methanolic extract was sprayed twice.

Keywords: Whitefly, *Bemisia tabaci*, mungbean, MH 421, biopesticide

Introduction
Mungbean (*Vigna radiata* L. Wilczek) is one of the most important grain legume, mainly consumed as human food by cooking, fermenting and milling or sprouting. Its seed contains 24% protein, 1.3% fat, 56.7% carbohydrate, 3.5% mineral, 4.1% fiber, 124 mg calcium, 326 mg phosphorus, 7.3 mg iron and energy 334 cal/ 100 g seeds. Due to its high nutritional value it is popular as poor man's meat for vegetarians. India is the world's largest mungbean producer covering 65% of world's acreage and 54% global production, (Jayappa *et al.*, 2017) [2]. Though India has distinction of being the world's largest producer of pulse crops, even then the average productivity is very low. Several factors are responsible for the low productivity of mungbean crop, of these insect-pests are the major factor. About 64 species of insect-pests are found feeding on this crop at different stages of its growth (Lal, 1985) [4]. Among sucking insect-pest, whitefly, *Bemisia tabaci* (Gennadius) is of prime concern and yield losses of cent per cent have been reported in *Vigna* sp. under severe infestation condition (Narasimhan *et al.*, 2010) [6]. Whitefly attack results into hindering of photosynthetic activity of plant due to development of sooty mould on honey dew secretion. Whitefly acts as a vector of yellow mosaic virus disease. Though whitefly can be effectively controlled by different insecticides but their indiscriminate use culminated many undesirable effects (such as insecticide resistance, resurgence, residue etc.) and also disturbs the agro-ecosystem. Bio pesticides being a part of ecological component and for their non-hazardous nature are now considered as the pivotal part of Integrated Pest Management (IPM). Neem, *Azadirachta indica* have been well studied for pest control all over the world. Therefore, present study was undertaken to evaluate the efficacy of different bio pesticides against whitefly, *B. tabaci*, in mungbean.

Materials and Methods
The present study was undertaken at the Research Farm, Pulse Section, CCS Haryana Agricultural University, Hisar during *Kharif*, 2018. Mungbean crop, variety MH 421 was sown on 7th July, 2018 in a randomized block design (RBD) with three replications having plot size of 9 sqm^2 each. Plant to plant and row to row spacing was maintained 10cm and 30 cm, respectively. All the recommended agronomic package of practices were followed to raise the good crop. Whitefly adult population were recorded from five randomly selected plants in each replication by split cage method (Nath, 1994) [7], one day before spraying of insecticide and then at 1, 3 and 7 days after spray (First spray : 30 days after sowing, second spray : 2 weeks after the first spray). Yield (kg/ha) was calculated at the time of harvest in each plot. The data was statistically analyzed with analysis of variance (ANOVA) and means were separated by using least significant difference (LSD) test at 5% level of significance.

Results and Discussion

Whitefly adults population after first and second spray: The minimum populations of whitefly were occurred in T_2: NSKE 5% Aqueous extract (13.6 whitefly/plant) which was on par with all treatments except T_8 (Neemastar) and T_9 (untreated) at three days after first spray. The present studies are in accordance with Lal and Jat (2015) [3] who reported the lowest whitefly population (1.6 and 6.4 adults/ cage/ plant) in NSKE 5% at 3 days after spray (DAS) on mungbean genotypes.

Increase in whitefly adult population was observed in all the treatments at 7 days after spray except the T_1 and T_4 where the crop was sprayed with NSKE 5% (Methanolic extract) and neem oil 2% (crude), respectively during first spray (Table 1). The present studies are somewhat in concurrence with Panghal (2006) [8] and Saini (2014) [9] who reported a drastic decrease in the adult population of whitefly after spray of NSKE 5% and NSKE 5% with ethion, respectively.

Whitefly adult population showed non-significant differences among different treatments before spray during both i.e. first and second spray. Significant differences were observed on 1, 3 and 7 days after second spray. Whitefly adult population was lowest at 7 DAS in NSKE 5% (Aqueous extract) (4.00 whitefly adult/cage/plant) which was at par with NSKE 5% (Methanolic extract) (5.80 whitefly adult/cage/plant), Neem oil 1% (crude) (5.60 whitefly adult/cage/plant), Neem oil 2% (crude) (5.73 whitefly adult/cage/plant) and foliar spray of *Beauveria bassiana* @ 1250 g/ha (8.20 whitefly adult/cage/plant) during second spray. The studies are in accordance with Mehra *et al*. 2018 [5] who reported spray of nimbeecidine 300 ppm @ 5ml/l as most effective at 5 days interval. However, it was found maximum in untreated control (20.0 whitefly adults/ cage/ plant). Maximum grain yield was obtained in plot where crop was sprayed twice with NSKE 5% Methanolic extract (259.26 kg/ha) i.e. T_1 and it was on par with T_2 (NSKE 5% Aqueous extract 217.41 kg/ha) and Neem oil 2% crude (221.11 kg/ha). The lowest yield (152.22 kg/ha) was recorded in the untreated control (T_9) and it was found at par with T6 (*Beauveria bassiana* @ 1250g/ha alternated with NSKE 5% Methanolic extract : 192.59 kg/ha), T7 *Beauveria bassiana* @ 1250g/ha alternated with neem oil 2% : 187.41 kg/ha) and T8 (Neemastra : 168.52 kg/ha), respectively. The results are somewhat in support with the findings of Asawalam and Constance (2018) [1] who conducted the experiment to determine the efficacy of plant extracts from seven plant species and insecticide karate against insect pests of mungbean and reported non significant differences between the plant extracts and karate. Highest seed yield was recorded in plots treated with extracts of *Azadirachta indica* and *Curcuma longa*.

Conclusion

The present study shows the status of different biorational for whitefly management in mungbean. Whitefly population was found minimum when NSKE 5% aqueous extract was sprayed twice. Thus NSKE can be used for the effective management of whitefly in mungbean.

Table 1: Evaluation of different biopesticides against whitefly on mungbean Variety, MH – 421

Treatments	Whitefly adult/ cage/ plant (1st spray)				Whitefly adult/ cage/ plant (2nd spray)				Yield (kg/ha)
	Before spray	1 DAS	3 DAS	7 DAS	Before spray	1 DAS	3 DAS	7 DAS	
T_1 : NSKE 5% (Methanolic extract)	34.87 (5.97)	22.33 (4.70)	20.10 (4.59)	10.13 (3.32)	15.80 (4.08)	5.60 (2.55)	5.53 (2.55)	5.80 (2.61)	259.26
T_2 : NSKE 5% (Aqueous extract)	34.07 (5.91)	13.93 (3.80)	13.60 (3.81)	14.93 (3.99)	13.53 (3.78)	6.33 (2.71)	4.13 (2.27)	4.00 (2.22)	217.41
T_3 : Neem oil 1% (Crude)	28.00 (5.29)	13.67 (3.83)	13.73 (3.81)	15.33 (4.02)	12.97 (3.71)	4.33 (2.30)	5.80 (2.59)	5.60 (2.56)	197.04
T_4 : Neem oil 2% (Crude)	29.27 (5.47)	17.33 (4.15)	18.40 (4.34)	17.80 (4.28)	12.97 (3.73)	6.00 (2.64)	5.27 (2.50)	5.73 (2.57)	221.11
T_5 : Foliar spray of *Beauveria bassiana* @ 1250 g/ha	30.60 (5.61)	20.00 (4.53)	17.33 (4.27)	27.60 (5.33)	12.47 (3.64)	6.33 (2.71)	6.07 (2.62)	8.20 (3.02)	198.89
T_6 : *Beauveria bassiana* @1250 g/ha alternated with NSKE 5% (Methanolic)	37.33 (6.17)	37.00 (5.91)	20.47 (4.62)	25.60 (5.13)	14.53 (3.82)	10.6 (3.40)	7.53 (2.92)	10.0 (3.24)	192.59
T_7 : *Beauveria bassiana* @1250 g/ha alternated with Neem oil 2%	39.53 (6.30)	38.00 (6.05)	18.93 (4.39)	22.67 (4.84)	22.33 (4.77)	10.07 (3.32)	13.40 (3.69)	12.67 (3.67)	187.41
T_8 : Neemastar	35.67 (5.97)	35.33 (5.93)	23.13 (4.85)	23.67 (4.95)	23.00 (4.86)	9.67 (3.26)	19.27 (4.49)	12.47 (3.67)	168.52
T_9 : Untreated (Control)	29.93 (5.56)	29.00 (5.47)	44.10 (6.66)	39.27 (6.33)	27.33 (5.26)	24.27 (5.02)	23.67 (4.94)	20 .0 (4.57)	152.22
C.D (P=0.05)	(N.S.)	(N.S.)	(0.97)	(0.91)	(N.S.)	(0.45)	(0.7)	(0.8)	42.07
SE(m)±	(0.4)	(0.59)	(0.32)	(0.3)	(0.45)	(0.15)	(0.22)	(0.25)	13.91

DAS : Days after spray.

Value in parenthesis are square root transformation values.

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