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VARIETAL SCREENING OF MUNGBEAN AGAINST WHITEFLY AND APHID

MD. SAIDUR RAHMAN[1], MOHAMMAD ABDULLAH-AL-RAHAD[2], MD. ANISUR RAHMAN[3] AND SHEIK MD. SHOWKAT AZIZ[1]

[1]*Department of Agricultural Botany, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh*
[2]*Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh.*
[3]*Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh.*

Corresponding author Email: saidur34@gmail.com

Abstract

The experiment was conducted at the Research Farm of Sher-e-Bangla Agricultural University (SAU), Dhaka during the period from March to June, 2017 for varietal screening of mungbean against sucking insect pest whitefly. Different mungbean varieties i.e. BARI Mung-1, BARI Mung-2, BARI Mung-3, BARI Mung-4, BARI Mung-5 and BARI Mung-6 were used as treatment for this study. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Data on different parameter were recorded and statistically significant variation was observed for different varieties. Irrespective of varieties BARI Mung-6 showed the least whitefly and aphid population and highest resistance against whitefly and aphid infestations at different stages than all other varieties. The highest seed yield (1.82 t ha^{-1}) was recorded from BARI Mung-6, while the lowest (1.30 t ha^{-1}) was recorded from BARI Mung-4. It mean that BARI Mung-6 were superior in terms of lowest whitefly an aphid infestation and yield.

Key word: *Mungbean, infestation, vegetative, sucking insect pests.*

INTRODUCTION

Mungbean (*Vigna radiata* L. Wilczek) belongs to the family Fabaceae (Lambridges & Godwin, 2006). It is an important grain legume and is extensively grown in tropical and subtropical countries of the world (Asante et al., 2002). After chickpea, mungbean is called as poor people diet owing to its protein nature and is meeting the major protein demand of the people (Shafique et al., 2009). It is a low input short duration crop, and is priced for its seeds which have high protein level, are easily digestible and consumed as food. Because of its non-flatulent behavior (digestibility) and high protein level, it has an edge over other pulses (Ghafoor et al., 2003). It has the ability to fix nitrogen to the soil because of its root nodules (Hoorman et al., 2009).

There are 64 species of insects attacking on mungbean crop and among them sucking pests are the most notorious one (Lal, 1985). Several insect pests have been reported to infest mungbean damaging the crops during seedlings, leaves, stems, flowers, buds and pods causing considerable losses. More than twelve species of insect pests were found to infest mungbean in Bangladesh, aphid and whitefly, thrips and pod borers (Hossain et al., 2004) are important. Kabir et al. (2014), who reported that aphids, whiteflies and jassids were the major sucking insects of mungbean. These insect pests not only reduce the vigor of the plant by sucking the sap but transmit diseases and affect photosynthesis as well (Sachan et al., 1994). Incidence of insect pests considerably reduces the yield and quality of mungbean (Malik, 1994). The sap-sucking insects whitefly are the major pests of mungbean (Isman, 2008). These insects not only reduce the vigour of the plant by sucking the sap, but also transmit diseases which reduce the rate of photosynthesis and ultimately cause a reduction in yield (Asawalam & Anumelechi, 2014). In mungbean crop, whiteflies play a key role in the spread of mungbean yellow mosaic virus which is known as a serious disease of this crop (Akhtar et al., 2012). Heavy attack of whitefly cause the severe loss of cell sap of plants, make plants weakened and sickly black appearance to plants due to injection of body toxins of whitefly.

At present day, management of insect pest has largely been relied on chemical control. However, the demands for clean and ecologically sound control envisages, careful planning for rationalizing the insecticides interventions. Variety plays an important role in producing high yield of mungbean because different varieties perform differently for their genotypic characters also vary from genotype to genotype. Development of resistant varieties is an ideal component against buildup of pest population at no additional cost, compatible with other methods of pest control and free from control pollution. Various biophysical and biochemical characters of the plants play an important role by providing resistance against this pest. The exploitation of host plant resistance, an economically viable genotypes measure against insect pests has become imperative to find out resistance source with higher yield (Tamang et al., 2017). The growth process of mungbean plants under a given agro-climatic condition differs with variety. Bangladesh Agricultural Research Institute (BARI) have released different varieties of mungbean. There were no definite and conclusive screening work has been done on the comparative efficacy of those varieties against different insect pests. Therefore, the present study was undertaken to find out the resistance of the variety against whitefly and aphid and to evaluate the incidence of whitefly and aphid as a sucking pest during the cultivation period.

MATERIALS AND METHODS

Experimental site: The experiment was conducted at the Research Farm of Sher-e-Bangla Agricultural University (SAU), Dhaka and it was located in 24.09^0 N latitude and 90.26^0 E longitudes. The soil of experimental area was silty clay in texture. Soil pH was 6.7 and has organic carbon 0.45%.

Treatments and experimental design: BARI Mung varieties were used as the test crop of this experiment. The seeds of these mungbean varieties were collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. Different mungbean varieties i.e. BARI Mung-1, BARI Mung-2, BARI Mung-3, BARI Mung-4, BARI Mung-5 and BARI Mung-6 were used as treatment for this study. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. An area was divided into three equal blocks. Each block was divided into 6 plots resulting 18 plots in total. The size of the each unit plot was 5 m^2. The distance maintained between two blocks and two plots were 1.0 m and 0.5 m, respectively.

Planting materials: Six mungbean varieties were used in this experiment. The characteristics of different mungbean varieties (Digital Herbarium of Crop Plant, 2016) are given in bellow-

BARI Mung-1: Plant height 45-50 cm, seed color green, day neutral, protein 25.5%, planting time last February to mid March (Kharif-1); 1st August to last September (Kharif-2), 65-70 days to maturity, yield 900-1000 kg ha^{-1}, resistance to cercospora leaf spot.

BARI Mung-2: Plant height 60-65 cm, seed color green, day neutral, protein 20-24%, planting time last February to mid March (Kharif-1); 1st August to last September (Kharif-2), 60-65 days to maturity, yield 900-1100 kg ha^{-1}, resistance to cercospora leaf spot and yellow mosaic virus.

BARI Mung-3: Plant height 50-55 cm, seed color brownish green, day neutral, protein 19-21%, planting time last February to mid-March (Kharif-1); 1st August to last September (Kharif-2), 60-65 days to maturity, yield 1000-1100 kg ha^{-1}, tolerant to cercospora leaf spot and yellow mosaic virus.

BARI Mung-4: Plant height 50-55 cm, seed color green, day neutral, protein 21-24%, planting time last February to mid-March (Kharif-1); 1st August to last September (Kharif-2), 60-65 days to maturity, yield 1200-1400 kg ha^{-1}, tolerant to cercospora leaf spot and yellow mosaic virus.

BARI Mung-5: High yielding variety, plant height 40-45 cm, seed color deep green, day neutral, protein 20-22%, planting time last February to mid-March (Kharif-1); 1st August to last September (Kharif-2), 60-65 days to maturity, yield 1200-1500 kg ha^{-1}, tolerant to cercospora leaf spot and yellow mosaic virus.

BARI Mung-6: Plant height 40-45 cm, seed color deep green, day neutral, seed large shaped, pod mature at a same stage, planting time last February to mid-March (Kharif-1); 1st August to last September (Kharif-2), 55-58 days to maturity, yield 1500 kg ha^{-1}, tolerant to cercospora leaf spot and yellow mosaic virus.

Crop husbandry: The seeds of mungbean were sown in solid rows in the furrows having a depth of 2-3 cm with maintaining row to row distance 30 cm and plant to plant 10 cm. Recommended doses of fertilizers such as-urea, TSP, MoP, gypsum and boric acid were applied. All of the fertilizers were applied during final land preparation. Intercultural operations and plant protection measures were taken during plant growing stage.

Data collection: Ten pre-selected plants per plot from which different data were collected. Data on the following parameters were recorded during the course of the experiment such as: - number of whitefly and aphid at vegetative, flowering and fruiting stages, plant infestation by whitefly and aphid at early, mid and late vegetative, flowering and fruiting stage, number of pods $plant^{-1}$, pod length (cm), seeds pod^{-1} , weight of 1000 seeds and pod yield (t ha^{-1}).

The percent of plant infestation was calculated by using the following formula:

$$\text{Plant infestation (\%)} = \frac{\text{Number of infested plants}}{\text{Total number of plants}} \times 100$$

Statistical analysis: All the collected data were tabulated and analyzed statistically using analysis of variance technique and subsequently Least Significance Difference (LSD at 5%) for comparing the treatment means, by MSTAT-C software (Gomez and Gomez, 1984).

Table.1 Disease severity was recorded at weekly interval using 0-5 scale (Bashir, 2005)			
Disease Severity	**Per cent infection**	**Infection category**	**Reaction Group**
0	All plants free of disease symptoms	Highly resistant	HR
1	1 - 10% Infection	Resistant	RR
2	11 -20% infection	Moderately resistant	MR
3	21-30% infection	Moderately susceptible	MS
4	30-50 % infection	Susceptible	S
5	More than 50%	Highly susceptible	HS

RESULTS

Whitefly population at vegetative, flowering and fruiting stage: The number of whitefly population plant^{-1} at early, mid and late vegetative, flowering and fruiting stage showed statistically significant differences due to different mungbean varieties. At early vegetative, flowering and fruiting stage, the lowest number of whitefly plant^{-1} (0.63, 2.60 and 2.00, respectively) were observed from BARI Mung-6, while the highest number of whitefly (2.73, 5.23 and 4.13, respectively) was recorded from BARI Mung-1 (Table 2). At mid vegetative, flowering and fruiting stage, the lowest number of whitefly plant^{-1} (6.43, 2.20 and 1.33, respectively) were found from BARI Mung-6, whereas the highest number of whitefly (12.13, 4.90 and 3.90, respectively) were recorded from BARI Mung-1. At late vegetative, flowering and fruiting stage, the lowest number of whitefly plant^{-1} (3.72, 1.77 and 0.63, respectively) were found from BARI Mung-6, while the highest number of whitefly (7.60, 4.43 and 2.73, respectively) were recorded from BARI Mung-1.

Table 2.Whitefly populations plant^{-1} at early, mid and late vegetative, flowering and fruiting stages due to different mungbean varieties

Treatments	Number of whitefly plant^{-1} at the stage of								
	Vegetative			Flowering			Fruiting		
	Early			Early			Early		
BARI Mung-1	2.73 a	12.13 a	.60 a	5.23 a	4.90 a	.43 a	4.13 a	3.90 a	.73 a
BARI Mung-2	2.33 ab	10.67 b	.30 a	4.73 a	4.30 a	.13 a	3.33 b	3.30 b	.33 b
BARI Mung-3	2.17 b	10.24 b	.00 b	4.03 b	3.87 b	.67 b	3.10 b	3.00 b	.17 b
BARI Mung-4	1.03 d	8.91 c	.96 c	3.33 c	3.03 c	.27 d	2.17 d	1.93 d	.03 d
BARI Mung-5	1.70 c	7.56 d	.12 d	3.83 bc	3.63 bc	.07 c	2.60 c	2.30 c	.70 c
BARI Mung-6	0.63 d	6.43 d	.72 d	2.60 d	2.20 d	.77 e	2.00 d	1.33 e	.63 e
LSD$_{(0.05)}$	0.413	1.206	.873	0.613	0.824	.382	0.411	0.503	.316
CV (%)									

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

Plant infestation at vegetative stage by whitefly: Number of healthy plants, infested plants and percent infestation of plant by whitefly showed statistically significant differences at early, mid and late vegetative stage for different mungbean varieties. At early, mid and late vegetative stage, the highest number of healthy plants m^{-2} (29.67, 30.00 and 28.67, respectively) were recorded in BARI Mung-6, while the lowest number of healthy plants m^{-2} (28.00, 27.33 and 27.00, respectively) were found in BARI Mung-1 (Table 3). The lowest number of infested plants m^{-2} (3.33, 4.00 and 4.33, respectively) were observed from BARI Mung-6, whereas the highest number (6.00, 6.67 and 7.00, respectively) were observed in BARI Mung-1. The lowest infestation (10.09, 11.76 and 13.12%, respectively) were attained in BARI Mung-6, whereas the highest infestation (17.65, 19.62 and 20.59%, respectively) were observed in BARI Mung-1.

Plant infestation at flowering stage by whitefly: Number of healthy plants, infested plants and per cent infestation of plant by whitefly showed statistically significant differences at early, mid and late flowering stage for different mungbean varieties. At early, mid and late flowering stage, the highest number of healthy plants m^{-2} (28.33, 28.00 and 28.33, respectively) were recorded in BARI Mung-6, while the lowest number of healthy plants m^{-2} (27.00, 26.33 and 26.33, respectively) were found in BARI Mung-1 (Table 4). The lowest number of infested plants m^{-2} (1.33, 2.00 and 2.33, respectively) were observed in BARI Mung-6, whereas the highest number (3.00, 3.67 and 3.67, respectively) were observed in BARI Mung-1. The lowest infestation (4.48, 6.67 and 7.60%, respectively) were attained in BARI Mung-6, whereas the highest infestation (10.00, 12.23 and 12.23%, respectively) were recorded in BARI Mung-1.

Pod infestation at fruiting stage by whitefly: Number of healthy pods, infested pods and percent infestation of pod by whitefly showed statistically significant differences at early, mid and late fruiting stage due to different mungbean varieties. At early, mid and late fruiting stage, the highest number of healthy plants m^{-2} (34.73, 36.43 and 35.87, respectively) were recorded in BARI Mung-6, whereas the lowest number of healthy plants m^{-2} (24.53, 31.63 and 28.63, respectively) were found in BARI Mung-1 (Table 5). The lowest number of infested plants m^{-2} (1.17, 1.73 and 1.20, respectively) were recorded in BARI Mung-6, while the highest number (2.53, 3.53 and 3.53, respectively) were observed in BARI Mung-1. The lowest infestation (3.26, 4.53 and 3.24%, respectively) were found in BARI Mung-6, whereas the highest infestation (9.35, 10.04 and 10.98%, respectively) were recorded in BARI Mung-1.

Aphid population at vegetative, flowering and fruiting stage: The number of aphid population plant^{-1} at early, mid and late vegetative, flowering and fruiting stage showed statistically significant differences due to different mungbean varieties. At early vegetative, flowering and fruiting stage, the lowest number of aphid plant^{-1} (2.63, 2.23 and 3.73, respectively) were observed from BARI Mung-6, while the highest number of aphid (4.73, 3.63 and 4.83, respectively) were recorded from BARI Mung-1 (Table 6). At mid vegetative, flowering and fruiting stage, the lowest number of aphid plant^{-1} (5.43, 3.00 and 3.27, respectively) were found from BARI Mung-6, whereas the highest number of aphid (12.31, 3.77 and 4.27, respectively) were recorded from BARI Mung-1. At late vegetative, flowering and fruiting stage, the lowest number of aphid plant^{-1} (5.72, 3.00 and 2.10, respectively) were found from BARI Mung-6, while the highest number of aphid (7.26, 4.47 and 3.07, respectively) were recorded from BARI Mung-1.

Plant infestation at vegetative stage by aphid: Number of healthy plants, infested plants and percent infestation of plant by aphid showed statistically significant differences at early, mid and late vegetative stage for different mungbean varieties. At early, mid and late vegetative stage, the highest number of healthy plants m^{-2} (29.33, 29.00 and 28.67, respectively) were recorded in BARI Mung-6, while the lowest number of healthy plants m^{-2} (28.00, 27.33 and 27.00, respectively) were found in BARI Mung-1 (Table 7). The lowest number of infested plants m^{-2} (0.67, 1.00 and 1.67, respectively) were recorded in BARI Mung-6, whereas the highest number (2.33, 3.33 and 3.67, respectively) were observed in BARI Mung-1. The lowest infestation (2.23, 3.33 and 5.50%, respectively) were attained in BARI Mung-6, whereas the highest infestation (7.68, 10.86 and 11.97%, respectively) were recorded in BARI Mung-1.

Plant infestation at flowering stage by aphid: Number of healthy plants, infested plants and percent infestation of plant by aphid showed statistically significant differences at early, mid and late flowering stage for different mungbean varieties. At early, mid and late flowering stage, the highest number of healthy plants m^{-2} (28.33, 28.00 and 27.67, respectively) were recorded in BARI Mung-6, while the lowest number of healthy plants m^{-2} (27.00, 26.33 and 26.33, respectively) were found in BARI Mung-1 (Table 8). The lowest number of infested plants m^{-2} (1.67, 2.00 and 2.00, respectively) were recorded in BARI Mung-6, whereas the highest number (3.67, 4.33 and 4.67, respectively) were observed in BARI Mung-1. The lowest infestation (5.57, 6.67 and 6.74%, respectively) were attained in BARI Mung-6, whereas the highest infestation (11.97, 14.12 and 15.06%, respectively) were recorded in BARI Mung-1.

Pod infestation at fruiting stage by aphid: Number of healthy pods, infested pods and per cent infestation of pod by aphid showed statistically significant differences at early, mid and late fruiting stage due to different mungbean varieties. At early, mid and late fruiting stage, the highest number of healthy plants m^{-2} (34.73, 36.43 and 35.87, respectively) were recorded in BARI Mung-6, whereas the lowest number of healthy plants m^{-2} (24.53, 31.63 and 28.63, respectively) were found in BARI Mung-1 (Table 9). The lowest number of infested plants m^{-2} (1.13, 1.77 and 1.77, respectively) were recorded in BARI Mung-6, while the highest number (2.73, 2.97 and 3.77, respectively) were observed in BARI Mung-1. The lowest infestation (3.15, 4.63 and 4.70%, respectively) were found in BARI Mung-6, whereas the highest infestation (10.01, 8.58 and 11.64%, respectively) were recorded in BARI Mung-1.

Yield attributes and yield of mungbean: Different yield attributes and yield of mungbean showed statistically significant differences due to different varieties. The highest number of pods plant^{-1}, pod length, number of seeds pod^{-1}, 1000-seeds weight and seed yield ha^{-1} (35.53, 8.48cm, 11.30, 41.10 g and 1.82 t ha^{-1}, respectively) were recorded from BARI Mung-6, whereas the lowest number of pods plant^{-1}, pod length and 1000-seeds weight (32.00, 7.73cm and 35.50 g, respectively) were recorded in BARI Mung-1 and number of seeds pod^{-1} and seed yield ha^{-1} (10.07 and 1.30 t ha^{-1}, respectively) were recorded in BARI Mung-4 (Table 10). BARI Mung-6 showed the highest yield and yield attributing parameter due to more resistance against sucking insect pests and less infection or attack caused by sucking insect pests like as whitefly and aphid, on the other hand other BARI Mung varieties are comparatively less resistance than BARI Mung-6 varieties against sucking insect pests and more attack caused by whitefly and aphid that's why yield and yield attributing parameter are less than BARI Mung-6 variety.

Table 3. Plant infestation by whitefly at early, mid and late vegetative stages due to different mungbean varieties

Treatments	Early vegetative stage			Mid vegetative stage			Late vegetative stage		
	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)
BARI Mung-1	28.00 b	6.00 a	17.65 a	27.33 c	6.67 a	19.62 a	27.00 b	7.00 a	20.59 a
BARI Mung-2	28.33 ab	5.67 a	16.68 a	27.67 bc	6.33 a	18.62 a	27.00 b	7.00 a	20.59 a
BARI Mung-3	29.33 a	4.33 c	12.86 c	27.36 c	5.64 b	17.09 b	27.67 ab	5.33 b	16.15 b
BARI Mung-4	29.00 a	5.00 bc	14.71 b	28.33 b	5.67 b	16.68 b	28.00 a	6.00 b	17.65 b
BARI Mung-5	29.33 a	4.67 c	13.74 b	28.67 ab	5.33 b	15.68 bc	28.33 a	4.67 bc	14.15 c
BARI Mung-6	29.67 a	3.33 d	10.09 d	30.00 a	4.00 c	11.76 d	28.67 a	4.33 c	13.12 c
$LSD_{(0.05)}$	0.893	0.534	1.231	1.452	0.503	1.231	0.714	0.684	1.562
CV(%)									

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

Table 4. Plant infestation by whitefly at early, mid and late flowering stages due to different mungbean varieties

Treatments	Early flowering stage			Mid flowering stage			Late flowering stage		
	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)
BARI Mung-1	27.00 b	3.00 a	10.00 a	26.33 c	3.67 a	12.23 a	26.33 c	3.67 a	12.23 a
BARI Mung-2	27.67 ab	2.33 b	7.77 b	26.67 c	3.33 ab	11.10 b	26.67 bc	3.33 b	11.10 b
BARI Mung-3	27.67 ab	2.33 b	7.77 b	27.00 bc	3.00 b	10.00 c	27.00 b	3.00 c	10.00 c
BARI Mung-4	28.00 a	2.00 bc	6.67 c	27.33 ab	2.67 bc	8.90 d	27.33 ab	2.67 d	8.90 d
BARI Mung-5	28.33 a	1.67 bc	5.57 d	27.67 a	2.33 c	7.77 e	27.67 a	2.33 e	7.77 e
BARI Mung-6	28.33 a	1.33 c	4.48 e	28.00 a	2.00 c	6.67 f	28.33 a	2.33 e	7.60 e
$LSD_{(0.05)}$	0.892	0.562	0.943	0.615	0.351	1.012	1.121	0.281	1.003
CV (%)	7.11	4.17	5.46	6.33	5.48	7.03	8.13	3.78	5.64

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

Table 5. Pod infestation by whitefly at early, mid and late fruiting stages due to different mungbean varieties

Treatments	Early fruiting stage			Mid fruiting stage			Late fruiting stage		
	Healthy pods (No.)	Infested pods (No.)	Pod infestation (%)	Healthy pods (No.)	Infested pods (No.)	% pod infestation	Healthy pods (No.)	Infested pods (No.)	% pod infestation
BARI Mung-1	24.53 e	2.53 a	9.35 a	31.63 d	3.53 a	10.04 a	28.63 e	3.53 a	10.98 a
BARI Mung-2	27.73 d	2.17 b	7.26 b	33.77 c	2.97 b	8.08 b	30.73 d	2.63 b	7.88 b
BARI Mung-3	31.43 c	2.00 b	5.98 c	34.20 b	2.17 bc	5.97 c	32.47 c	2.10 c	6.07 c

Continued table 5

BARI Mung-4	32.10 b	1.83 b	5.39 c	35.30 ab	1.97 c	5.29 c	34.50 b	1.43 d	3.98 d
BARI Mung-5	32.63 b	1.20 c	3.55 d	36.33 a	1.83 cd	4.80 cd	34.57 b	1.53 d	4.24 d
BARI Mung-6	34.73 a	1.17 c	3.26 d	36.43 a	1.73 d	4.53 d	35.87 a	1.20 e	3.24 e
$LSD_{(0.05)}$	1.451	0.342	0.856	1.241	0.214	1.045	1.217	0.242	0.341
CV (%)									

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

Table 6. Aphid populations plant^{-1} at early, mid and late vegetative, flowering and fruiting stages due to different mungbean varieties

Treatments	Number of aphids plant^{-1} at the stages of								
	Vegetative			Flowering			Fruiting		
	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late
BARI Mung-1	4.37 a	12.31 a	7. 26 a	3.67 a	3.77 a	4.47 a	4.83 a	4.27 a	3.07 a
BARI Mung-2	4.33 a	11.46 b	7.73 a	3.17 b	3.63 a	4.37 a	4.77 a	3.90 a	2.37 b
BARI Mung-3	4.17 a	10.45 c	6.45 b	2.97 b	3.67 a	4.00 b	4.67 a	3.80 a	2.43 b
BARI Mung-4	3.03 c	8.98 d	5.96 b	2.87 b	3.33 bc	3.77 c	3.87 b	3.27 b	2.37 b
BARI Mung-5	3.70 b	7.43 e	5.12 c	2.93 b	3.20 bc	3.07 d	4.40 ab	3.60 ab	2.17 c
BARI Mung-6	2.63 d	5.43 f	5.72 b	2.23 c	3.00 c	3.00 d	3.73 b	3.27 b	2.10 c
$LSD_{(0.05)}$	0.341	0.741	0.541	0.455	0.281	0.246	0.362	0.474	0.196
CV (%)	4.24	7.91	5.61	6.23	3.41	5.04	4.38	6.00	4.22

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

Table 7. Plant infestation by aphid at early, mid and late vegetative stages due to different mungbean varieties

Treatments	Early vegetative stage			Mid vegetative stage			Late vegetative stage		
	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)
BARI Mung-1	28.00 b	2.33 a	7.68 a	27.33 b	3.33 a	10.86 a	27.00 b	3.67 a	11.97 a
BARI Mung-2	28.33 b	2.00 b	6.59 b	27.67 b	2.67 b	8.80 b	27.00 b	3.00 b	10.00 b
BARI Mung-3	28.67 ab	1.67 c	5.50 c	28.00 ab	2.33 c	7.68 c	27.67 ab	2.67 c	8.80 c
BARI Mung-4	29.33 a	1.00 e	3.30 e	28.33 a	1.67 d	5.57 d	28.00 a	2.33 d	7.68 d
BARI Mung-5	29.00 a	1.33 d	4.39 d	28.67 a	1.33 e	4.43 e	28.33 a	2.00 e	6.59 e
BARI Mung-6	29.33 a	0.67 f	2.23 f	29.00 a	1.00 f	3.33 f	28.67 a	1.67 f	5.50 f
$LSD_{(0.05)}$	0.512	0.263	0.693	0.363	0.271	0.962	0.793	0.254	0.803
CV (%)									

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

Table 8. Plant infestation by aphid at early, mid and late flowering stages due to different mungbean varieties

Treatments	Early flowering stage			Mid flowering stage			Late flowering stage		
	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)	Healthy plants (No.)	Infested plants (No.)	Plant infestation (%)
BARI Mung-1	27.00 b	3.67 a	11.97 a	26.33 b	4.33 a	14.12 a	26.33 b	4.67 a	15.06 a
BARI Mung-2	27.67 ab	2.67 b	8.80 b	26.67 b	3.67 b	12.10 b	26.67 b	3.67 b	12.10 b
BARI Mung-3	27.67 ab	2.33 b	7.77 c	27.00 ab	3.33 c	10.98 c	27.00 ab	3.33 b	10.98 c
BARI Mung-4	28.00 a	2.33 b	7.68 c	27.33 a	2.67 d	8.90 d	27.33 a	2.67 c	8.90 d
BARI Mung-5	28.33 a	2.00 bc	6.59 d	27.67 a	2.67 d	8.80 d	27.67 a	2.33 cd	7.77 e
BARI Mung-6	28.33 a	1.67 c	5.57 e	28.00 a	2.00 e	6.67 e	27.67 a	2.00 d	6.74 f
$LSD_{(0.05)}$	0.682	0.382	0.894	0.672	0.312	1.134	0.678	0.372	0.896
CV (%)	7.04	5.47	6.35	4.88	6.24	5.98	5.89	4.56	6.22

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

Table 9. Pod infestation by aphid at early, mid and late fruiting stages due to different mungbean varieties

Treatments	Early fruiting stage			Mid fruiting stage			Late fruiting stage		
	Healthy pods (No.)	Infested pods (No.)	Pod infestation (%)	Healthy pods (No.)	Infested pods (No.)	Pod infestation (%)	Healthy pods (No.)	Infested pods (No.)	Pod infestation (%)
BARI Mung-1	24.53 e	2.73 a	10.01 a	31.63 d	2.97 a	8.58 a	28.63 e	3.77 a	11.64 a
BARI Mung-2	27.73 d	2.47 b	8.18 b	33.77 c	2.83 a	7.73 b	30.73 d	2.97 b	8.81 b
BARI Mung-3	31.43 c	2.13 c	6.35 c	34.20 b	2.63 a	7.14 b	32.47 c	2.43 c	6.96 c
BARI Mung-4	32.10 b	1.97 c	5.78 d	35.30 ab	1.97 b	5.29 c	34.50 b	2.13 d	5.81 d
BARI Mung-5	32.63 b	1.43 d	4.20 e	36.33 a	1.97 b	5.14 c	34.57 b	2.00 d	5.47 d
BARI Mung-6	34.73 a	1.13 e	3.15 f	36.43 a	1.77 b	4.63 d	35.87 a	1.77 e	4.70 e
$LSD_{(0.05)}$	1.451	0.263	0.794	1.241	0.481	0.304	1.217	0.254	0.782
CV (%)	8.09	4.10	6.13	6.76	5.34	6.22	7.15	3.69	6.02

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

Table 10. Yield and yield contributing characters of different mungbean varieties

Treatments	Number of pods plant^{-1}	Pod length (cm)	Number of Seeds pod^{-1}	Weight of 1000 seeds (g)	Seed yield (t ha^{-1})
BARI Mung-1	32.00 c	7.73 c	10.23 c	35.50 e	1.50 b
BARI Mung-2	33.87 b	7.90 bc	10.83 b	40.53 b	1.67 ab
BARI Mung-3	33.60 b	7.85 bc	10.50 bc	39.78 c	1.61 b
BARI Mung-4	29.33 d	7.42 c	10.07 cd	37.41 d	1.30 c
BARI Mung-5	33.53 b	8.46 a	10.83 b	40.78 ab	1.75 a
BARI Mung-6	35.53 a	8.48 a	11.30 a	41.10 a	1.82 a
$LSD_{(0.05)}$	1.421	0.352	0.402	0.386	0.124
CV (%)					

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability

DISCUSSION

Previous workers like Chhabara and Kooner (1991); Sahoo and Hota (1991); Chhabra and Kooner (1993) and Chhabra and Kosoner (1994) have evaluated mungbean cultivars against their resistance to insect pests and screened a large numbers of mungbean genotypes for resistance/ susceptibility against sucking pests. Our present findings are in accordance to the results reported by Naqvi et al. (1995) who have screened ten cultivar of mungbean and found none of them were complete resistant against sucking pests as we have in our study. They tested 10 genotypes of mungbean against insects and found only two cultivars, M-8-20 and M-1030 resistant against insects compared to others. Nadeem et al. (2014) showed the significant variations in the population levels of whiteflies, aphid, thrips and jassids observed per leaf basis in different mungbean cultivars in response to yield of grains. Among the tested cultivars, none showed complete resistance against whiteflies however, MH 3153 (advance genotype/cultivar) showed comparatively better resistance against sucking insects. Consistent results to our findings has been reported by Khattak et al. (2004) who has screened five cultivars of mungbean viz., NM 92, NM 98, NM 121-125, M-1 and NCM-209 for resistance against whiteflies, jassid and thrips and found none has complete resistance. Whereas, mungbean varieties, NM-92 and NM-98 showed comparatively better resistant cultivars regarding low mean population of whiteflies as compared to other tested varieties. Farooq et al. (2018) showed the screening experiment of 100 mungbean cultivars against MYMV which vector is whitefly. None of the variety showed complete resistance or immune reaction against MYMV. Out of 100 varieties/accessions only seven mung bean accessions showed moderately resistant response against MYMV infestation. The MYMV vector, whitefly (*Bemesia tabaci* Genn) appeared to inhabit plant soon after the emergence and remained till maturity and with the passage of time, disease severity increased significantly. Results are also in accordance with Iqbal et al. (2011). Mung bean yellow mosaic virus is DNA Begomovirus and it is transmitted in persistent manner by whitefly *Bemesia tabacai* (Islam et al., 2002). There was only one variety of mung bean (Plant-U30) that was resistant to whitefly and MYMV (Khattak et al., 2003). A rare resistance in mung bean genotypes though presence of resistance was found in urdbean and soybean genotypes (Lavanya et al., 2008). Resistance against MYMV was rare in mung bean, but was found in urdbean (*Vigna mungo*) and soybean (*Glycine max*), which led them to successful hybridization and inter-specific transfer of resistance (Nair and Nene, 1973). Similarly, Ahmed (1975) evaluated 157 local and exotic mungbean varieties but no resistant variety was found, however 6 out of 34 local collections showed resistance response to disease. Tamang et al. (2017) find out the differential responses of 5 mungbean varieties to insect pests where none of the genotype/line was found to be highly resistant to insect pest. Among the mungbean varieties, Bireswar (WBM-34-1-1) and Sukumar (WBM-29) showed comparatively better resistant cultivars regarding low mean population of sucking pest as compared to other tested varieties. There was only one variety of mungbean (Plant-U30) that was resistant to whitefly and yellow mosaic disease (Sahoo & Hota, 1991). Results are also in accordance with Patel et al. (2010), who reported maximum population of aphid (10.22 aphids/10 cm twig) on mungbean. Shafique et al. (2009) observed the check variety for resistance against chickpea pod borer (CPB), *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) infestation in a field trial during 2006-2007. None of the tested genotypes showed complete resistance against CPB after studying larval population, pod damage and grain yield parameters. Bhople et al. (2017) evaluated the ten genotypes of mungbean. Among them PHULE M-702-1 was found resistance to aphid and PKV GREEN GOLD to whitefly as these genotypes recorded significantly the lowest population of respective pests in mungbean. Ahmad et al. (2007) reported that the aphid population ranged from 64.0 to 234.0 (Av. of 90 observations) per 2.5 cm terminal shoot length and foliar damage index ranged from 0.6 to 3.5 per plant on mungbean genotypes. The present study is in agreement with that of Singh and Singh (2014) who screened 30 genotypes of mungbean [*Vigna radiata* (L.) Wilezek] against white fly (*Bemisia tabaci*), and reported minimum population of white fly was recorded on genotype TMB-36, followed by RMG-1004 and maximum in BM-2003-2 and HUM-12. Results are also in accordance with Khaliq et al. (2017).

CONCLUSIONS

Results of the present findings lead towards a conclusion that, among the six tested cultivars, none of the variety showed complete resistance or immune reaction against whitefly and aphid. Among the six BARI mungbean varieties BARI Mung-6 was found resistance and least affected by sucking insects in terms of lowest whitefly and aphid infestation and gave the higher yield followed by BARI Mung-5 and BARI Mung-4 than other mungbean varieties.

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