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Field evaluation of mungbean varieties for resistance against pod borer complex

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Abstract

Field experiment was carried out at farmer's field in Sonakhali, Barguna sadar, Barguna to evaluate the resistance sources(s) among different verities of mungbean against the pod borer complex during the period from January to April 2016. Ten varieties viz., BARI Mung- 2, BARI Mung- 5, BARI Mung- 6, BU Mung- 1, BU Mung- 2, IPSA Mung- 5, IPSA Mung- 12, GK Mung- 27, BINA Mung- 2 and local Mung were included in the study. The variety of BARI Mung- 6, local Mung, BARI Mung- 5 and GK Mung- 27 had the highest population of *Maruca* which indicated that these varieties were highly susceptible to *Maruca* while BINA Mung- 2, BARI Mung- 2, IPSA Mung- 5 and IPSA Mung- 12 had lowest population of *Maruca* which indicated that these varieties were least susceptible to *Maruca*. Among all tested varieties, none showed complete resistance against *Maruca*. From the mean of all varieties regarding *Helicoverpa* population, BARI Mung- 6, Local Mung, IPSA Mung-12 and IPSA Mung- 5 had the highest population of *Helicoverpa* which indicated that these varieties were highly susceptible to *Helicoverpa* while BARI Mung- 5, BU Mung- 1, GK Mung- 27 and BINA Mung- 2 had lowest population of *Helicoverpa* which indicated that these varieties were least susceptible to *Helicoverpa*. Among all tested varieties, none showed complete resistance against *Helicoverpa.* BU Mung- 1 and BINA Mung-2 showed comparatively better resistance against *Maruca* and BARI Mung- 2 and BU Mung- 2 showed comparatively better resistance against *Helicoverpa*. The highest total yield was obtained from BARI Mung- 6 followed by BARI Mung- 5 and the lowest total yield was obtained from BARI Mung- 2 followed by the GK Mung- 27. BARI Mung- 6 and BARI Mung- 5 appeared to be the best varieties in terms of resistance against pod borer complex and yield.

Key words: *Maruca, Helicoverpa,* Mungbean, susceptible, resistance.

INTRODUCTION

Mungbean (*Vigna radiata* L. Wilezek) is one of the most important pulses crop belonging to the family Leguminosae grown in tropical and sub-tropical regions. The global mungbean area is about 7.3 million elaborate first hectare (ha), and the average yield is 721 kg/ha. India and Myanmar each account for 30% of global output of 5.3 million tonne (t). Other large producers are China, Indonesia, Thailand, Kenya, and Tanzania (Nair & Schreinemachers, 2020). The crop is also well known as green gram, golden gram, sonamung, mungbean but is commonly called as 'Moog' in Bangladesh. Mungbean contributed 6.5 percent of the total pulses production in the country. In Bangladesh mungbean is grown three times in a year, covering 114000 acres with an average yield of

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42000 Metric tonnes or t/acres (BBS, 2023). Pod borer complex (*Maruca vitrata* Geyer, *Helicoverpa armigera* Hubnerand *Etiella zinckenella* Treitsche) cause damage to floralparts and pods. Of these, *M. vitrata* is a destructive pest of green gram and cause economic losses of 20 to 25% and yield losses of 2 to 84% (Vishakanthaiah & Jagadeesh, 1980). Zahid *et al.* (2008) reported 20to 30% pod damage in mung bean. The larvae attack buds, bore into pods and even some time stems. Leavesmay be eaten and bound together by webs made by the caterpillars. Gram pod borer *Helicoverpa armigera* (Hübner) larvae feed on leaves and terminal buds as well as developing seeds.

Pod borer is highly divesting to pods. Pod borer damage starts from pod initiation to pod maturation stage. But the infestation is higher at pod initiation and pod filling stage. After hatching, the larvae bores into the flower buds and pods. Larvae bore the pods at the base and enter into the pods. The larvae remain inside the pod and feed on the seed sometimes larvae role the leaves and shift to pods. The full grown larva comes out through the infested pods and drop on the ground for pupation in the soil and plant debris. Akhgauri *et al.* (1994) showed that the pod borer community remained active from January to March, with their collective larval population being more during end of February to third week of March. Pod borer is one of the serious pre harvest pests of mungbean in Bangladesh (Rahman *et al.,* 1981) and India (Sehgal & Ujagir, 1988). Mahalakshmi *et al.* (2016) reported that the pod borer is one of the major biotic constraints for pulses production, which can cause damage to the economic plant parts such as flower buds, flowers and pods. The larvae feeds on 39 host species of legume crops. Qu & Kogan (1984) reported that the mungbean pod borer is wide spread in the tropics and subtropics and is most damaging pod borer in Asia. Sarkar *et al.* (2008) conducted field experiments in 2007 kharif-1 and 2008 kharif-1 seasons on mungbean cv. BARI mung-6 to determine the severity of major insect pests (stem fly, thrips and pod borer) attacking mungbean. Panicker *et al.* (2002) investigated the interrelationship of flower, pod and seed damages by *Maruca virata* and identified damage criteria to be considered for damage based resistance evaluation. Ganwar & Ahmed (1991) evaluated 10 mungbean varieties for seed yield and productivity, days to maturity, percentage pod damage due to pod borer *M. testulalis*. Sharma (1998) reported that stem and pod wall thickness, trichomes and podding habit are associated with resistance to *Maruca*. There is a limited report on varietal screening of mungbean in Bangladesh. Considering above facts the present study was undertaken to screen ten varieties of mungbean for their resistance against pod borer complex under field conditions.

MATERIALS AND METHODS

Experiment was conducted at the farmer’s field at Sonakali village, Barguna sadar, Barguna district, which is located between 22°10' and 22°21' north latitudes and in between 90°21' and 90°38' east longitudes. This area is adjacent to the Bay of Bengal. The soil of the experimental field belongs to the agroecological zone Ganges Tidal Floodplain. The soils of the experimental area were non-calcareous and non-saline, silty-clay to heavy clay in texture and slightly acidic (dry season) in reaction (pH 5.5-6.7 at Barguna sadar). The experiment was laid out in a Randomized Complete Block Design

(RCBD) with three replications as described by Gomez and Gomez, 1984. The whole field was divided into 3 unit blocks and each unit block was divided into 10 subunit plots. The treatments were randomly distributed to the plots within a block. The total number of the plots was 30 and the size of the individual plot was 3m x 2.0m. Each replication represented a block, which was divided into ten unit plots. The distance between two unit plots was 0.75m and between block to block was 1m. Ten recommended varieties of mungbean, namely BARI Mung- 2, BARI Mung- 5,BARI Mung- 6, BU Mung- 1, BU Mung- 2, IPSA Mung- 5, IPSA Mung- 12, GK Mung- 27, BINA Mung- 2 and local Mung were tested. The spacing was 15 cm between rows and 10 cm between plants. The seeds were sown on 1 February 2016 at the rate of 20 kg/ha. Intercultural operations were done as and when required to ensure normal growth and development of the crop. Light irrigation was applied 20 days after sowing. At first, trifoliate stage seedling was carefully thinned to retain one seedling hill^{-1}. Weeding was done 20 days after sowing.

Weekly data were collected and recorded by direct counting of pod borers at early in the afternoon (4.0 – 6.0 pm) plants selected randomly from each plot per meter square (1m× 1m) area. The number of *Maruca* and *Helicoverpa* were recorded at 28, 35, 42 and 49 DAS (Days after sowing). Matured pod was harvested two times (65 and 72 DAS, respectively), infested pods and healthy pods were recorded separately for each plot. Infested pods were collected randomly, opened and the damaged seeds were recorded. The yield of each plot was calculated and expressed as kg ha^{-1}. The collected data were analyzed following the analysis of variance (ANOVA) using WASP program and the mean differences were adjudged by CD (critical difference) values.

RESULTS AND DISCUSSION

Population of *Maruca* recorded at different DAT on mungbean varieties: Mean number of *Maruca* per square meter was recorded on different Mungbean varieties at different days after sowing (DAS) and is presented in Table 1. At 40 DAS, the highest population of *Maruca*/m^2 (1.59) was recorded in the variety BARI Mung- 6. The lowest number of *Maruca* was observed in the variety local Mung (1.05) followed by IPSA Mung- 5 (1.18) which was statistically similar with GK Mung- 27.

At 47 DAS, the highest population of *Maruca*/plot (4.0) was recorded in the variety BARI Mung- 6. However, the lowest number of *Maruca* was observed in the variety BU Mung- 2 (1.33) followed by IPSA Mung- 12 (1.67) and IPSA Mung- 5 (2.0). At 54 DAS, significantly the highest number of *Maruca*/plot was observed in the variety BARI Mung- 6 (4.67). The lowest number of *Maruca* was observed in the variety BU Mung- 1 (2.0) followed by BU Mung- 2(2.33) and IPSA Mung- 5 (2.33) while BU Mung- 2 was statistically identical with IPSA Mung- 5.

At 61 DAS, the highest number of *Maruca* was observed in the variety local Mung (1.76). However, the lowest number of *Maruca* was observed in the variety GK Mung- 27 (1.27) followed by BARI Mung- 5 (1.18) and BU Mung- 2 (1.35).

From the mean of all varieties regarding *Maruca* population it was evident that the variety of BARI Mung- 6, local Mung, BARI Mung- 5 and GK Mung- 27 had highest population of *Maruca*, which indicated that these varieties were highly susceptible to *Maruca.* On the other hand, variety of BINA Mung- 2, BARI Mung- 2, IPSA Mung- 5 and IPSA Mung- 12 had the lowest population of *Maruca* which indicated that these varieties were least susceptible to *Maruca*. Among all tested varieties, none showed complete resistance against *Maruca*. However, BU Mung- 1 and BINA Mung-2 showed comparatively better resistance against *Maruca*. This result was similar to Rani *et al.* (2008) who reported that the *M. testulalis* was resistant to some mungbean genotypes.

Table 1. Mean number of *Maruca* on different varieties of Mungbean

Name of the Varieties	Number of *Maruca* /m^2 at days after sowing (DAS)				Mean
	40 DAS	47 DAS	54 DAS	61 DAS	
BARI Mung- 2	1.29	2.33	2.67cde	1.38	1.96bcd
GK Mung- 27	1.05	3.00	3.67abc	1.27	2.24abcd
BINA Mung-2	1.44	2.67	3.33bcd	1.49	2.23abcd
IPSA Mung- 5	1.18	2.00	2.67cde	1.56	1.85cd
IPSA Mung- 12	1.29	1.67	2.67cde	1.49	1.78cd
BU Mung- 1	1.56	1.33	2.00e	1.35	1.56d
BU Mung- 2	1.27	1.33	2.33de	1.56	1.62cd
BARI Mung- 5	1.47	3.33	3.33bcd	1.18	2.32abc
Local Mung	1.05	3.67	4.00ab	1.76	2.62ab
BARI Mung- 6	1.59	4.00	4.67a	1.68	2.98a
Level of significance	NS	NS	*	NS	*
LSD (5%)	NS	NS	*	NS	*

Means within column followed by the same letter are not significantly different from one another (LSD Test, $P > 0.05$). Values are average of three replications.

Population of *Helicoverpa* recorded at different DAT in ten selected mungbean varieties: Mean number of *Helicoverpa* per square meter was recorded on different Mungbean varieties at different days after sowing (DAS) and is presented in Table 2. At 40 DAS, the highest number of *Helicoverpa*/$m^2$was observed in the variety of BARI Mung- 6 (1.68) followed by BARI Mung-5 (1.56), BINA Mung-2 (1.46), IPSA Mung- 12 (1.38), GK Mung- 27 (1.35), BU Mung- 2 (1.35) and IPSA Mung- 5 (1.27). However, the lowest number of *Helicoverpa* was observed in BU Mung- 1 (1.05) followed by BARI Mung-2 (1.18) and local Mung (1.18) while BU Mung- 1 was statistically identical with local Mung.

At 47 DAS, the highest number of *Helicoverpa* (3.67) was observed in local Mung which was statistically similar to BARI Mung- 6 (3.33). Whereas the lowest number of *Helicoverpa* was observed in BARI Mung- 2 (1.00) followed by BU Mung- 2 (1.33) and BINA Mung-2 (1.67). At 54 DAS, significantly the highest number of *Helicoverpa* (4.0) was observed in local Mung. However, the lowest number of *Helicoverpa* was observed

in BARI Mung- 2 (1.33) followed by BU Mung- 2 (1.67) and BINA Mung-2 (2.0). At 61 DAS, the highest population of *Helicoverpa* (1.68) was recorded in the variety local Mung. However, the lowest number of *Helicoverpa* was found in BU Mung- 1 (1.05) followed by GK Mung- 27 (1.18) and BU Mung- 2 (1.29).

From the mean of all varieties regarding *Helicoverpa* population, it was evident that the variety of BARI Mung- 6, local Mung, IPSA Mung-12, and IPSA Mung- 5 had highest population of *Helicoverpa*, which indicated that these varieties were highly susceptible to *Helicoverp*a. On the other hand, BARI Mung-5, BU Mung-1, GK Mung- 27 and BINA Mung-2 had lowest population of *Helicoverpa* which indicated that these varieties were least susceptible to *Helicoverpa*. Among all tested varieties, none showed complete resistance against *Helicoverpa*, however, BARI Mung-2 and BU Mung-2 showed better resistance against *Helicoverpa*. This results was similar to the results of Soundararajan & Chitra (2017) who also reported that the *Helicoverpa armigera* was resistant to some genotypes of mungbean.

Table 2. Mean number of *Helicoverpa* on different varieties Mungbean in different dates of observation

Varieties Name	Number of *Helicoverpa* /m^2at days after sowing (DAS)				Mean
	40 DAS	47 DAS	54 DAS	61 DAS	
BARI Mung- 2	1.18	1.00e	1.33e	1.38	1.26d
GK Mung- 27	1.35	2.0bcde	2.33bcd	1.18	1.76bcd
BINA Mung-2	1.46	1.67cde	2.00 cde	1.47	1.65cd
IPSA Mung- 5	1.27	2.67abcd	3.00 abcd	1.53	2.16abc
IPSA Mung- 12	1.38	3.00 abc	3.67abc	1.56	2.41ab
BU Mung- 1	1.05	2.67abcd	3.33abc	1.05	2.03abc
BU Mung- 2	1.35	1.33de	1.67de	1.29	1.41cd
BARI Mung- 5	1.56	2.33abcde	3.00 abcd	1.47	2.09abc
Local Mung	1.18	3.67ab	4.00 a	1.68	2.64a
BARI Mung- 6	1.68	3.33ab	3.33abc	1.57	2.48a
LSD (5% & 1%)	**NS**	*****	*****	**NS**	******
CV (%)	**27.19**	**37.00**	**29.42**	**21.42**	**25.25**

Means within column followed by the same letter are not significantly different from one another (LSD Test, P > 0.01). Values are average of three replications.

Percentage of pod infestation by pod borer at ripening stage: The percentage of Mungbean infested pods by pod borers at per square meter plants from each sub-plot in the field is presented in the Figure 1. A significant variation was observed among the varieties with respect to the percentage of pods infested by pod borer. The percentage of infested pods ranged from 21 to 35%. The highest infestation was observed in BU Mung-2 (35%) followed by BARI Mung-6, BARI Mung-2, IPSA Mung-5 and local Mung. The lowest infestation was in BINA Mung-1 (20.5). The results agree with the findings of

Islam *et al.* (2008) who reported that the population of pod borer complex the resistance of different Mungbean depends on varieties.

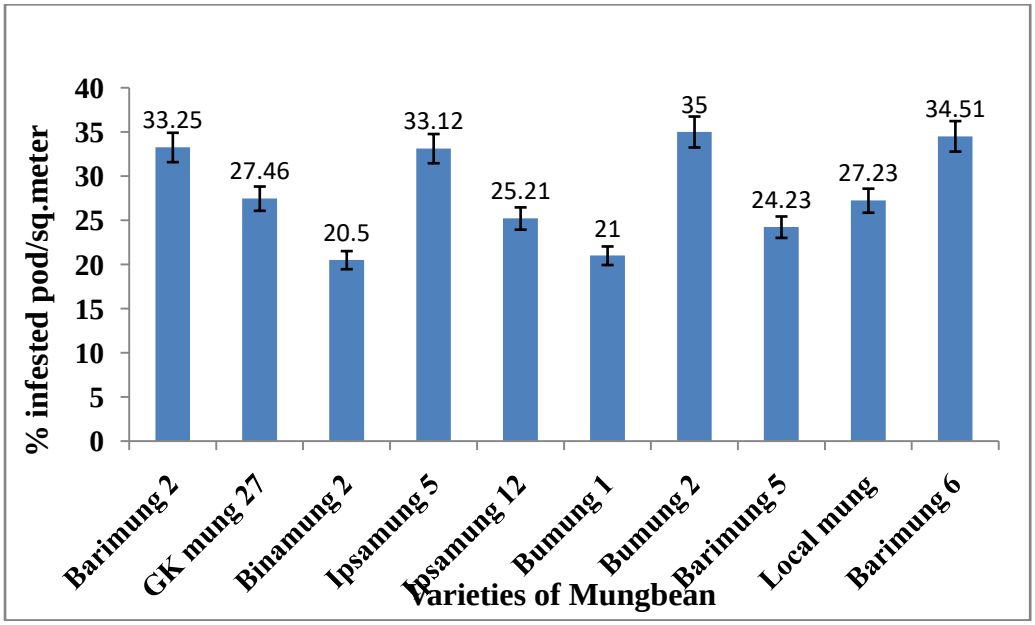

Fig.1. Percent infested pods per meter square in different varieties of Mungbean

Relationship between pod borer infestation and yield: A strong negative relationship between percent pod borer infestation and total yield was found in different varieties (Figure 2.) which indicated that with the increase of pod borer infestation there was progressive fall in the yield. A linear regression was fitted between pod borer infestation and total yield. The correlation coefficient (r) was 0.289 and the contribution of the regression (R^2 = 0.8262, when Y = - 10.555x + 909.07) was 82%. Ogunwolu (1990)and Gangwar & Ahmed (1991) reported similar relationship between pod borer infestation and yield of the mungbean varieties.

Yield of Mungbean: The total yield at different harvesting period obtained from ten varieties is presented in Table 3. The highest yield (723.22 kg ha-^{1}) was obtained from BARI Mung- 6 followed by BARI Mung- 5 (680.0 kg ha-^{1}), BU Mung- 1 (653.33 kg ha-^{1}), BU Mung- 2 (645.00 kg ha-^{1}), IPSA Mung- 12 (626.67 kg ha-^{1}), IPSA Mung- 5 (616.67 kg ha-^{1}). The lowest total yield was obtained from BARI Mung- 2 (530.00 kg ha-^{1}) followed by the GK Mung- 27 (543.33 kg ha-^{1}), BINA Mung-2 (551.67 kg ha-^{1}) and local Mung (593.33 kg ha-^{1}). The yield of ten Mungbean varieties obtained in the present study is dissimilar to other researchers Mannan & Chowdhury (2001) and Bakr (1998). However, the results contradict with the findings of others due to inherent characteristics of variety, ecology difference and influence of some other factors including pests and diseases. In studies on screening of germplasm of mungbean against pod borer complex, the minimum pod damage infestation by *H. armigera* and *M. vitrata* were observed in

germplasm OBGG 109 and BM-4, respectively. The highest yield of mungbean was recorded in KM 2241 (Kol *et al*., 2022).

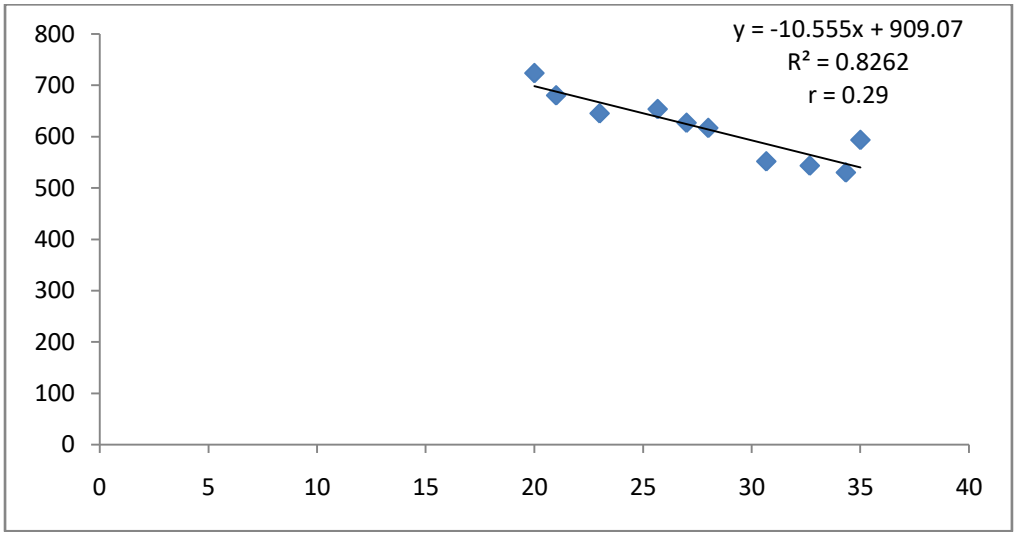

Fig. 2. Relationship between pod borer infestation and yield of different Mungbean varieties

Table 3.Yield of different Mungbean varieties obtained from two consecutive harvests

Varieties Name	1st harvest 65DAS(kg ha-1)	2nd harvest 72DAS(kg ha-1)	Total yield (kg ha-1)
BARI Mung- 2	410.00e	120.00e	530.00
GK Mung- 27	410.00e	133.33de	543.33
BINA Mung-2	416.67e	135.00cde	551.67
IPSA Mung- 5	458.33d	158.33bcd	616.67
IPSA Mung- 12	463.33d	163.33bcd	626.67
BU Mung- 1	476.67cd	176.67b	653.33
BU Mung- 2	490.00c	155.00bcd	645.00
BARI Mung- 5	536.67b	143.33cde	680.00
Local Mung	246.67f	346.67a	593.33
BARI Mung- 6	556.67a	166.60bc	723.33
LSD (1%)	**	**	-
CV (%)	2.51	11.17	-

Means within column followed by the same letter are not significantly different from one another(LSD Test, P > 0.01). Values are average of three replications.

The susceptibility of 50 mung bean germplasm accessions was evaluated against pod borer complex. The least incidence of larvae was observed in the accession NDMK 15-513 (1.12 larvae/ 5 plants) in comparison to the checks SML 1811 and ML 623 (2.20 and 7.20 larvae/ 5 plants, respectively). The pod damage was the least with accession IPM 14-

7 (1.33%) in contrast to the checks SML 1811 (3.33%) and ML 623 (8.80%).As per the pest susceptibility rating, three accessions viz., ML 2410, IPM 14-7 and NDMK 15-513 can be categorized as the least susceptible (Chauhan *et al.*, 2021). From the findings of the present study, it may be concluded that the BARI Mung- 6 and BARI Mung- 5 are the most suitable variety regarding yield and tolerance to pod borer complex.

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