

Effect of dates of sowing on incidence and severity of *Mungbean Yellow Mosaic Virus* and *Cercospora* Leaf spot of mungbean

M. Harunor Rashid¹, M. Sazzadul Aktar², Ismail Hossain², M. Mahbubur Rahmam¹, M. Rashed Hasnat³ and Nair RM⁴

¹Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Rahmatpur, Barisal-8211, Bangladesh

²Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh

³Instructor, Agricultural Training Institute, Faridpur, Bangladesh

⁴AVRDC, ICRISAT Campus, Hyderabad, India

Corresponding author : SSO, Plant Pathology: E-mail: md_harunor_rashid@yahoo.com

ABSTRACT

An experiment was conducted at Regional Pulses Research Station, BARI, Madaripur during 2011 in order to study the effect of dates of sowing on the incidence and severity of diseases and yield of Mungbean. Results revealed that the disease incidence of *Mungbean Yellow Mosaic Virus* (MYMV) of six varieties/lines, BMXK2 03000, BMXK2 03005-4 and BARImung-6 showed highly resistance (HR), resistant (R) and resistant to moderately resistant reaction, at the sowing time of January 15, February 01-15 and April 01 respectively. In, sowing BMXK2 03005-4 and BARImung-6 showed moderately resistance (MR). But in MYMV disease severity BMXK2 03005-4 and BARImung-6 showed 1 scoring scale starting from January 15 to March 15 sowing. In April 01, sowing disease severity of BMXK2 03005-4 and BARImung-6 showed 3 scoring scale. In case of CLS, BMXK2 03005-4 and BARImung-6 showed 1 scoring scale from January 15 to February 01 sowing. February 15 to April 01, sowing showed 2 scoring scale. The yield performance ranged from 681.30 kg/ha to 2131.00 kg/ha while the highest (2131.00 kg/ha) yield was found in S₄XE₄ i.e. March 01, 2011 sowing with BMXK₂-030005-4. The lowest (681.3 kg/ha) yield was found in S₆XE₃ i.e. April 01, 2011 sowing with BMXK₂-03000 line. A strong correlation was obtained the incidence of MYMV and yield. It means that with the increase of incidence of MYMV (%), yield of mungbean decreased. The correlation coefficient (r) was -0.797** and the contribution of the regression (R² = 0.6355) indicate that 63.55% yield to mungbean would be affected by MYMV infection.

Key word: *Vigna radiata* L. wilczek, sowing date, *Mungbean Yellow Mosaic Virus*, *Cercospora* leaf spot (CLS) and yield

1. INTRODUCTION

Mungbean (*Vigna radiata* L. wilczek) is one of the most important pulse crops in Bangladesh. The agro-ecological condition of this country is favorable for its cultivation. It can be grown in late rabi, kharif-1 and kharif-2. It is important pulse crops having global economic importance as a dietary ingredient of the staple food. It contains 55% carbohydrate, 26% protein, 10% moisture and 3% vitamins. It is also capable of fixing atmospheric nitrogen (222 kg/ha) through symbiotic relationship with *Rhizobium* in the root nodule of the crop. Mungbean is an important protein rich crop and occupies first position in price and second in acreage and third in production of Bangladesh "[1]" Though the agro-ecological condition of Bangladesh is favorable for mungbean cultivation, both its total area under cultivation and production, but yield of the crop is low compared to other pulses in Bangladesh "[2]". There are many constraints responsible for the low yield of mungbean. Among those, diseases are considered to be the most important. A total of twenty diseases of mungbean have been recorded in Bangladesh [3]. Of which four and two diseases are major in field and stored respectively. Yellow Mosaic Disease, *Cercospora* leaf spot, Powdery mildew (*Erysiphe polygoni*) and Leaf rot (*Sclerotinia sclerotiorum*) are the four major diseases found in the field. Among the diseases *Cercospora* leaf spot (*Cercospora cruenta* Sacc.) and the yellow mosaic incited by yellow mosaic virus [4] are the most important and damaging diseases of mungbean that incurred significant yield reductions every year in Bangladesh [5]. The early infected plants showed more severe symptom of yellow mosaic than that of the late infected plants [6]. The incidence and severity of

yellow mosaic virus were considered to be directly related with the availability and abundance of insect vector and depend upon the time of infection [7]. In the light of above background, the present piece of research work has been undertaken with the following objectives to find out optimum sowing time for higher yield and to study the impact of sowing time on incidence and severity of diseases of mungbean.

2. MATERIALS AND METHODS

The experiment was carried out at the Regional Pulses Research Station, Bangladesh Agricultural Research Institute (BARI), Madaripur during the period from January 2011 to April 2011 in order to study the effect of dates of sowing on the incidence and severity of diseases of Mungbean. The experimental field was high land with highly sandy loam texture belonging to the Gangatic Calcareous Flood Plain Soil. The seeds of the four lines and two varieties of mungbean viz. BMXK₂-030011-1, BMXK₂ 0300011-4, BMXK₂ 03000, BMXK₂ 03005-4 including BARI mung-5 and BARI mung-6 were collected from Pulses Research Centre, BARI, Ishurdi, Pabna. The experimental plots were prepared mechanically. Fertilizers were applied at the time of final land preparation as per recommended doses. The experiment was conducted in split plot design with three replications. Factor A (Sowing time): S₁ = 15th January 2011, S₂ = 1st February 2011, S₃ = 15th February 2011, S₄ = 1st March 2011, S₅ = 15th March 2011 and S₆ = 1st April 2011. Factor B (Line/Variety): E₁ = BMXK₂-030011-1, E₂ = BMXK₂ 0300011-4, E₃ = BMXK₂ 03000, E₄ = BMXK₂ 03005-4, E₅ = BARI Mung-5 and E₆ = BARI Mung-6. The size of the individual plot was 28.8 m² (4m×7.2m). The distance between the block was 50cm. The row length was 4m and width was 25cm. Insecticide 'Karate (0.2%)' was applied for controlling pod borer and thrips of mungbean. As per design the six sowing dates were done at interval of 15 days. The first sowing was done on the January 15, 2011 and last sowing was done on the 1st April 2011. The seeds were sown in the field at the rate of 40 kg/ha. Intercultural operations were done in order to maintain the normal hygienic condition of crop growth. Weeding was performed when necessary during the growth period of the crop. The disease incidence of yellow Mosaic was recorded at 45 DAS. The visible symptoms of the disease were critically observed and infected plants were identified according to the description [8].

$$\% \text{ Yellow Mosaic incidence} = \frac{\text{Number of infected plant/plot}}{\text{Total number of plant/plot}} \times 100$$

Yellow Mosaic severity was recorded from each plot. The severity of yellow mosaic diseases was recorded following the grade as used previously [9]. Cercospora leaf spot was recorded from each plot. The severity of yellow mosaic diseases was recorded following the grade on a 0-8 scale described earlier [10]. Data were recorded on the following parameters, Days to maturity, Plant height (cm), Number of branch/plant, Pod length (cm), Number of pods/plant, Number of Seeds/Pod (10 pods), 100 seeds weight (gm), Yield (kg/ha). The collected data were analyzed statistically. Analysis of variance and LSD test were done to find out the significant difference among the treatment means.

3. RESULTS AND DISCUSSION

The present research was carried out to find out optimum sowing time for higher yield and to study the impact of sowing time on incidence and severity of diseases of mungbean during the kharif-1 season. Four lines and two varieties of mungbean were used with six sowing date. From the result, it was observed that infection in April 01 had higher disease incidence by MYMV than other date of sowing. The highest disease incidence among the lines/varieties range from 21.96-40.94% in April 01, and lowest disease incidence range from 6.54-13.28% in January 15 and lowest disease incidence was observed in BMXK₂-030005-4 (Table 1). This is in accordance with the findings of [11]. They evaluated fourteen MYMV susceptible F3 progenies from a cross NM 92 X VC 1560D showed significant differences for MYMV disease infection. Earlier [12] reported that higher resistances to yellow mosaic have been demonstrated in the modern varieties like BARI mung-5, BARI mung-6, BINAmung-5, BUMung-1 and BUMung-2. In case of disease severity it was observed that the severity rate was less at early sowing i.e. January and February sowing and severity rate gradually increase from March to April of some varieties. From the weather report it was found that the temperature range in January was 11.50-25.54°C and in April temperature range was 25.85-35.50°C. With the increasing temperature the disease incidence was high. In past [13] it was found the similar result that with the increasing temperature the dispersal of whiteflies is more. It was

also reported that warm weather and moderated level of humidity were favorable for spread of MYMV [14].

In case of disease severity of *Cercospora* leaf spot it was observed that all the lines/varieties get 1 and 2 scoring scale which shown in January and February (Table 2). From March to April it was observed that the disease severity increased gradually and BMXK₂-030011-1 and BMXK₂-03000 were more affected. It was observed that the rapid development of leaf spot caused by *Cercospora canescens* in *Vigna mungo* was favoured by a mean temperature of 22.5-23.5⁰C, relative humidity of 79-85% [15]. First sowing date i.e. 15th January 2011 takes 70.33 days to mature while the less duration (61.67days) required when sowing in March 15, 2011. Within the six entries BARI mung-5 and BARI mung-6 required less duration to mature. With the interaction between sowing dates and entries it was found that S₅×E₅ and S₅×E₆ i.e. March 15, 2011 sowing with BARI mung-5 and BARI mung-6 take 59 days to mature. The tallest (42.12 cm) plant was found in April 01, 2011 sowing followed by March 01 and March 15 sowing (Table 2). Earlier there was observed the similar result [16, 17]. Out of six entries the tallest (39.80 cm) plant was found in BMXK₂-03000 line followed by BMXK₂-03005-4. With the combination between sowing dates and entries the tallest (49.70 cm) plant was found in S₆×E₃ i.e. April 01, 2011 sowing with BMXK₂-03000 line (Table 8). Date of sowing also affect the branch of the plant. It was found that highest number of branch (1.30) was recorded in January 15, 2011 sowing and BMXK₂-030005-4 entry gives highest number of branch (1.48). Interaction effect with the sowing time and entry The maximum branch (1.90) was observed in S₁×E₄ and S₂×E₄ i.e. January 15, 2011 sowing with BMXK₂-03005-4 and February 01, 2011 BMXK₂-03005-4 line (Table 8). It is important to note here that the plants which were not infected with viral infection interfere with the metabolic activities of plants and enzymatic activities are also affected [18]. The findings of [6] may support the findings of the present study who reported that chlorosis, stunting. The longest pod (7.02) was recorded in March 01, 2011 sowing (Table 8). The present findings agree to those of previous result [14]. BMXK₂-0300011-4 line was longest pod length (6.95) and the best combination was S₆×E₅ i.e. April 01, 2011 sowing with BARI mung-6. Highest number of pods (21.11pods/plant) was recorded in January 30, 2011 followed by March 01, 2011 (19.27pods/plant) (Table 9). It was shown that crop sown of 27 February produced more number of pods/plant than the delayed sowing [19]. Among the entries BMXK₂-03005-4 gave higher number of pods/plant. The more number of pods (27.20 pods /plant [4]) found in the combination S₂×E₄ i.e. February 01, 2011 with BMXK₂-03005-4 line. Number of seeds per pod was recorded just after harvesting plants by counting the pods from ten (10) plants in every lines/varieties of all sowing time (Table 9). There were not statistically significance differences among lines/varieties. The highest number of seeds/pod (6.93) was recorded in March 01, 2011 sowing. Similar result was found previous study [11]. BMXK₂-030005-4 line gave the highest (7.01) seeds/pods and the combination S₄×E₄ i.e. March 01, 2011 with BMXK₂-03005-4 line was best. Under present investigation it was found that in case of 100 seed weight the highest (5.42 g) weight was recorded in February 15, 2011 sowing and in case of line the highest (5.47 g) weight was recorded in BMXK₂-0300011-1 followed by BMXK₂-0300011-4 (5.01gm). 100 seed weight the highest was found highest in the combination S₁×E₂ i.e. January 15, 2011 sowing with BMXK₂-0300011-4. It was reported that infection of *Vigna radiata* plants by MYMV caused significant reduction in number of pods/plant, seed yield and 1000 seed weight [20]. These findings support the present study. The yield performance of mungbean in different sowing dates it was found that the maximum yield (1854 kg/ha) was recorded in March 01, 2011 sowing followed by February 15, 2011 sowing (Table 9). Similarly It was observed that higher grain yield was obtained from 27 February and 12 March sowing [19]. The minimum yield (997 kg/ha) was recorded in April 01, 2011 sowing followed by March 15, 2011 sowing (Table 9). There was not statistically significant mid January, 2011 sowing to mid February, 2011 sowing. Yield performance of mungbean among the lines/varieties it was found that the maximum yield (1518 kg/ha) was recorded in BMXK₂-030005-4 followed by BARI mung-6 and the minimum yield (1113 kg/ha) was recorded in BARI mung-5 followed by BMXK₂-0300011-1. With the interaction between sowing time and lines/varieties highest (681.3 kg/ha) yield was found in S₄×E₄ i.e. March 01, 2011 sowing with BMXK₂-030005-4 followed by S₄×E₆ i.e. March 01, 2011 sowing with BARI mung-6 (Table 9). The less (681.3kg/ha) yield was found in S₆×E₃ i.e. April 01, 2011 sowing with BMXK₂-03000 line. It was reported that different varieties did not show similar performance in different seasons [21].

A negative correlation was found between the incidence of MYMV (%) and yield of mungbean. It means that with the increase of incidence of MYMV (%), yield of mungbean decreased and 63.55% (Fig. 1) yield to mungbean would be affected by MYMV infection. The findings of the study are closely related with the study of previous result [14]. They reported that yield loss due to MYMV is 63% in mungbean and 20-

100% in blackgram. There was conducted an experiment of fourteen MYMV susceptible F3 progenies from a cross NM 92 X VC 1560D showed significant differences for MYMV disease infection, yield and yield components [23]. The MYMV incidence showed significant correlation (0.526) with the decrease in 1000 seed weight. The decrease in yield and other yield components showed non significant positive correlation with MYMV incidence.

So, it is clear that February 15 and March 01 sowing of mungbean less infection of MYMV and CLS. Sowing April 01 infected with MYMV and CLS causes maximum reduction of yield and yield contributing characters. From the experiment it is observed the BMXX₂-030005-4 line gives higher yield and less infected by MYMV and CLS from other lines/varieties. It was also observed that the interaction of this line BMXX₂-03005-4 and sowing time March 01, 2011 gives higher yield (2131 kg/ha). So, optimum sowing time and variety of mungbean resulting higher production.

Acknowledgement

The authors are grateful to authority of Ministry of Science and Technology, Government of Bangladesh, Dhaka for supporting fund and successfully implementing the research work.

In References list:

- [1] Khrishi diary. 2012. Agriculture Information Service. DAE. Khamerbari, Framagate, Dhaka.
- [2] BBS. 2005. Year book of Agricultural Statistics of Bangladesh. 2005. Bangladesh Bureau of Statistics. Ministry of Planning, Govt. of the Peoples Republic of Bangladesh, Dhaka. P.135.
- [3] Bakr, M.A. and M.H. Rashid. 2007. Strategic intervention of Pulse disease research at Bangladesh Agricultural Research Institute. 42-61. Bakr, M.A., Ahmed, H.U. and M.A. Uadud Miah (eds.). 2007. Proceedings of the National workshop on "Strategic Intervention of Plant Pathological Research in Bangladesh. 11-12 February, 2007. BARI (Bangladesh Agricultural Research Institute), Joydebpur, Gazipur, 344 pp.
- [4] Nariani, T. K. 1960. Yellow Mosaic of Mungbean (*Phaseolus aurcus* L.) Indian Phytopathology.13: 24-29.
- [5] Jalaluddin, M.; Rahizuddin, M. and Razzaque, M.A. 1994. Effect of sowing dates on cercospora leaf spot, yellow mosaic and grain yield of two winter mungbean strains. Bangladesh Journal of Neuclear Agriculture. 10:83-84.
- [6] Singh, B.R., Singh, M., Yadav, M.D. and Dingar, S.M. 1982. Yield loss in mungbean due to yellow mosaic, Science and Culture, C.S. Azad University. Agric. and Technol., Kanpur, India 48 (12):435-436.
- [7] Dhingra, K. L. and Ghosh, D. K. 1993. Efficiency of whitefly vector (*Bemisia tabaci*) in transmission of mungbean yellow mosaic virus in different souece test plant combination. International Journal of Tropical Agriculture 11(2): 149-152.
- [8] Ahmad, H.U. 1985. Disease problem of pulse and oilseed cropsin Bangladesh paper presented at the First Biennial Conference of the Bangladesh Phytopathological Society, 13-14 April, 1985. BARI, Joydebpur, Gazipur, Bangladesh.
- [9] Singh, S.K., Gupta, B. R., and Chib, H.S. 1995. Relation of plant age with yellow mosaic virus infection on urd bean yield. Integrated disease management and plant health. Editors: V.K. Gupta and R.C. Sharma. Scientific Publishers, Jodhpur. 91-92p.
- [10] Haque, M.S., Rahman, M.L., and Malek, M.A. 1994. Effect of fungicides and number of spray on cercospora leaf spot of cowpea. Bangladesh J. Plant Pathol. 10 (1&2): 3-4.
- [11] Mondal, M.M.A., Malek, M.A., Reza, M.H. and Islam. 2002. Yield performance of mungbean cultivars under different dates of sowing. Bangladesh J. Nuclear Agric. Vol. 18. pp.36-44.
- [12] Afzal, M.A., Bakr, M.A. Hamid, M.A., Haque, M.M. and Akter, M.S. 2004. Mungbean in Bangladesh. Lentil, Blackgram and Mungbean development pilot project. Publication no. 23. Pulse Research Centre, Bangladesh Agricultural Research Institute, Gazipur-1701. Bangladesh. Pp 42-43.
- [13] Mohanty, A.K. and Basu, A.N. 1991. Seasonal variations in the aerial populations of the whitefly vector *Bemisia tabaci* under Delhi conditions. *Indian Phytopathology*, 44: 494-496.
- [14] Nath, P.D. and Saikia, A.K. 1985. Effects of time sowing on the incidence of mungbean yellow mosaic virus disease and white fly (*Bemisia tabaci* Genn.) population in greengram. Annals of Agricultural Research, India. 16(4): 483-484.

- [15] Sad, V.K. and B.M. Singh. 1984. Effect of environmental factors on the development of leaf spot (*Cercospora canescens*) in mungbean. *Indian Phytopathology*. 37(3): 511-515.
- [16] Khalil, S. K. 1989. Response of mungbean cultivars to different planting dates. *Shrhad J. Agric.* 5(6): 555-560.
- [17] Venkateswarlu, M. S. and Rajan, M. S. S. 1991. Influence of season on growth and yield attributes of blackgram (*Phaseolus mungo*). *Indian J. Agro.* 36(suppl.): 119-123.
- [18] Singh, S. j. and Sastry, K. S. M. 1979. Effect of alternate spraying of insecticides and oil on the incidence of tomato leaf curl virus. *Pesticide India. Indian Ins. Hort. Res., Banlore, India.* 9(9), 45-56.
- [19] Bhingrade, M.T. and Dumbre, A.D. 1994. Effect of sowing dates and seed size on yield and quality in mungbean under summer condition. *J. Maharasta Agril. Univ.* 19(3): 410-412.
- [20] Babu, R.C., Rathinaswamy, R., Srivasan, P.S., Natarajaratnam, N. and Sreerangssamy, S.R. 1984. Certain physiological changes in green gram plants infected by mungbean mosaic virus. *Madras Agricultural Journal.* 71(12): 795-798.
- [21] Dugue, F. F. and pessanha, G. G. 1990. Behavior of ten mungbean varieties during the rainy seasons under field conditions. *Pesquisa Agropecuaria Brasileira.* 25(7): 963-969.
- [22] Afzal, M.A., Bakr, M.A. and Rahman, M.L. 1999. Blackgram cultivation in Bangladesh. Lentil, Blackgram and Mungbean development pilot project. Publication no. 19. Pulse Research Centre, Bangladesh Agricultural Research Institute, Gazipur-1701. Bangladesh. 64p.
- [23] Khattak, G.S.S., Haq, M.A., Rana, S.A., Abass, G. and Irfag, M. 2000. Effect of Mungbean Yellow Mosaic Virus (MYMV) on Yield and Yield Components of Mungbean (*Vigna radiata* (L.) Wilczek). *Kasetsart J. (Nat. Sci.)* 34 : 12 – 16.

IJOART

Table 1. MYMV incidence (%) of six-mungbean lines/variety during Kharif-1 season at RPRS, Madaripur

Name of lines/var.	January 15, 2011	February 01, 2011	February 15, 2011	March 01, 2011	March 15, 2011	April 01, 2011
BMXK ₂ -030011-1	12.30	14.20	15.59	21.25	28.66	28.00
BMXK ₂ 0300011-4	11.86	11.03	15.09	18.03	26.57	29.09
BMXK ₂ 03000	6.83	16.15	19.43	18.95	27.92	32.98
BMXK ₂ 030005-4	6.54	11.29	12.8	11.94	16.67	21.96
BARI Mung-5	13.28	10.09	15.41	26.13	38.51	40.74
BARI Mung-6	7.26	12.90	14.86	13.57	23.86	26.63

Table 2. MYMV severity (1-9 scale) of six-mungbean lines/variety during Kharif-1 season at RPRS, Madaripur

Name of lines/var.	January 15, 2011	February 01, 2011	February 15, 2011	March 01, 2011	March 15, 2011	April 01, 2011
BMXK ₂ -030011-1	1	1	3	3	3	5
BMXK ₂ -0300011-4	1	1	3	3	3	3
BMXK ₂ -03000	1	1	3	3	3	3
BMXK ₂ -03005-4	1	1	1	1	1	3
BARI Mung-5	1	1	1	3	3	3
BARI Mung-6	1	1	1	1	1	3

Disease severity (1-9 scale)

Table 3. Cercospora leaf spot severity of six-mungbean lines/variety during Kharif-1 season at RPRS, Madaripur

Name of lines/var.	January 15, 2011	February 01, 2011	February 15, 2011	March 01, 2011	March 15, 2011	April 01, 2011
BMXK ₂ -030011-1	1	2	2	3	3	4
BMXK ₂ 0300011-4	1	1	1	2	2	3
BMXK ₂ 03000	1	2	2	3	4	4
BMXK ₂ -030005-4	1	2	2	2	2	2
BARI Mung-5	1	2	2	3	3	3
BARI Mung-6	1	1	1	2	2	2

Table 4. Mean effect of sowing time on days to maturity, plant height, no. of branch/plant and pod length of mungbean at during kharif-1 season at RPRS, Madaripur

Sowing time	Days to mature	Plant height (cm)	No. of Branch/ plant	Pod length (cm)
15.01.11	70.33b	28.91d	1.28a	6.63
30.01.11	73.00a	33.07c	1.30a	6.57
15.02.11	66.50c	32.88c	1.10ab	6.47
01.03.11	63.00e	37.07b	1.058b	7.02
15.03.11	61.67f	38.22b	1.000b	6.97
01.04.11	64.58d	42.12a	1.067b	6.90
CV (%)	0.91	5.84	19.69	5.61
LSD (0.05%)	0.6182	2.754	0.2072	0.5890

Table 5. Mean effect of sowing time on no. of pods/plant, no. of seeds/pod, 100 seed wt and yield of mungbean at during kharif-1 season at RPRS, Madaripur

Sowing time	No. of pod/plant	No. of seeds/pod	100 seed wt. (gm)	Yield (kg/ha)
15.01.11	18.12b	6.92	5.37a	1108bc
30.01.11	21.11a	6.47	5.31a	1168bc
15.02.11	16.99b	6.27	5.42a	1295b
01.03.11	19.27ab	6.93	5.17a	1854a
15.03.11	7.90d	6.75	5.09ab	1068c
01.04.11	11.50c	6.33	4.81b	997c
CV (%)	9.25	9.29	3.02	8.78
LSD (0.05%)	2.660	0.6752	0.3401	223.8

Table 6. Mean effect different entries on days to maturity, plant height, no. of branch/plant and pod length of mungbean during kharif-1 season at RPRS, Madaripur

Name of entries	Days to mature	Plant height (cm)	No. of Branch/plant	Pod length (cm)
BMXK ₂ -0300011-1	65.83b	33.20c	1.00cd	6.81ab
BMXK ₂ -0300011-4	65.92b	35.77b	1.00cd	6.95a
BMXK ₂ -03000	68.83a	39.80a	1.34ab	6.60ab
BMXK ₂ -030005-4	68.50a	39.58a	1.48a	6.80ab
BARImung-5	64.83c	30.87d	1.00cd	6.85ab
BARImung-6	65.17c	33.05c	1.16bc	6.54b
CV (%)	0.91	5.84	19.69	5.61
LSD (0.05%)	0.5065	1.721	0.1864	0.3164

Table 7. Mean effect different entries no. of pods/plant, no. of seeds/pod, 100 seed weight and yield of mungbean during kharif-1 season at RPRS, Madaripur

Name of entries	No. of pod/plant	No. of seeds/pod	100 seed wt. (gm)	Yield (kg/ha)
BMXK ₂ -0300011-1	16.28b	6.32bc	5.47a	1145d
BMXK ₂ -0300011-4	15.59bc	6.21c	5.41a	1244bc
BMXK ₂ -03000	15.89bc	6.85ab	4.90b	1180cd
BMXK ₂ -030005-4	18.30a	7.01a	5.01b	1518a
BARImung-5	13.93d	6.52abc	5.39a	1113d
BARImung-6	14.91cd	6.75abc	4.99b	1289b
CV (%)	9.25	9.29	3.02	8.78
LSD (0.05%)	1.220	0.5119	0.1318	91.37

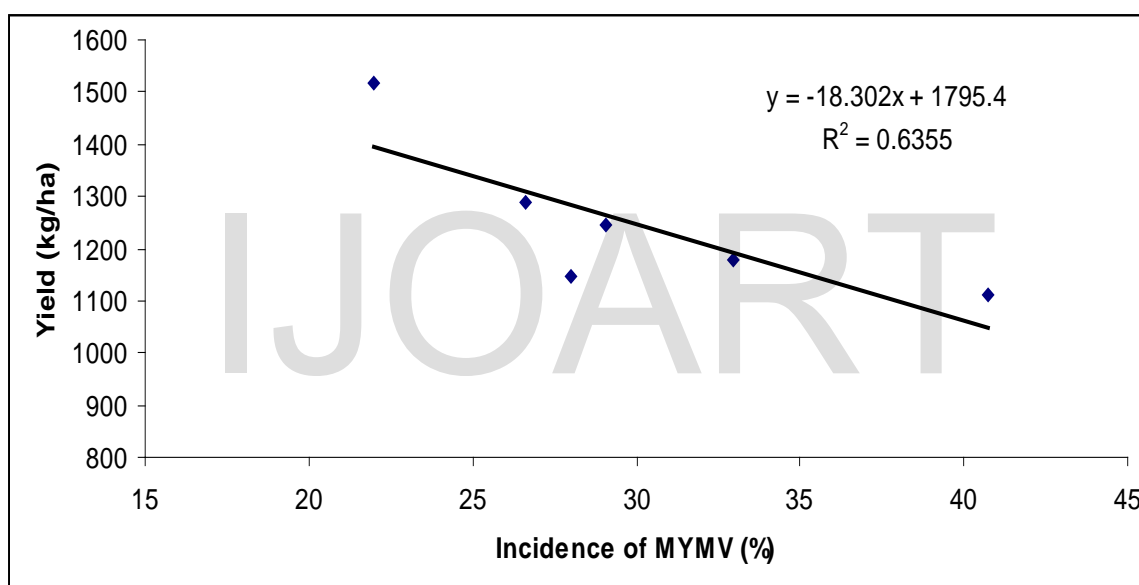


Fig. 1. Relationship between incidence of MYMV (%) and yield (kg plant⁻¹)

Table 8. Interaction effects of sowing time and different entries days to maturity, plant height, no. of branch/plant and pod length of of mungbean during kharif-1 season at RPRS, Madaripur

Sowing time X var./entries	Days to mature	Plant height (cm)	No. of branch/plant	Pod length (cm)
S ₁ ×E ₁	70.00de	24.70 q	1.20 b-f	6.72 -f
S ₁ ×E ₂	70.00de	29.50 l-p	1.20 b-f	7.02 a-d
S ₁ ×E ₃	71.00cd	32.40 i-m	1.00 c-g	6.47 a-f
S ₁ ×E ₄	71.00cd	32.75 i-m	1.90 a	7.07 a-d
S ₁ ×E ₅	70.00de	25.60 pq	1.20 b-f	6.45 a-f
S ₁ ×E ₆	70.00de	28.50 m-q	1.20 b-f	6.05 ef
S ₂ ×E ₁	72.00bc	32.50 i-m	1.10 c-f	6.55 a-f
S ₂ ×E ₂	72.00bc	35.60 f-k	1.20 b-f	6.90 a-e
S ₂ ×E ₃	74.00a	33.10 i-m	1.50 abc	6.30 b-f
S ₂ ×E ₄	74.00a	37.30 e-i	1.90 a	6.80 a-f
S ₂ ×E ₅	73.00ab	27.40 n-q	0.90 d-h	6.70 a-f
S ₂ ×E ₆	73.00ab	32.50 i-m	1.20 b-f	6.20 d-f
S ₃ ×E ₁	66.00hi	32.00 j-n	1.50 abc	6.90 a-e
S ₃ ×E ₂	67.00gh	32.50 i-m	0.75 e-h	6.75 a-f
S ₃ ×E ₃	69.00ef	35.90 f-k	1.15 c-f	5.90 f
S ₃ ×E ₄	68.00fg	38.40 d-h	1.20 b-f	6.25 c-f
S ₃ ×E ₅	64.00jk	27.00 opq	0.50 gh	6.55 b-f
S ₃ ×E ₆	65.00ij	31.50 k-o	1.50 abc	6.45 b-f
S ₄ ×E ₁	63.50kl	34.72 h-k	0.90 d-h	7.20 a-b
S ₄ ×E ₂	62.00mn	38.60 d-h	1.00 c-g	6.90 a-e
S ₄ ×E ₃	65.50i	42.70 bcd	1.40 a-d	6.95 a-e
S ₄ ×E ₄	65.00ij	39.70 c-g	1.10 c-f	7.15 abc
S ₄ ×E ₅	60.50op	32.40 i-m	0.85 d-h	6.95 a-e
S ₄ ×E ₆	61.50mno	34.30 h-l	1.10 c-f	6.95 a-e
S ₅ ×E ₁	60.00pq	34.80 g-k	0.40 h	6.95 a-e
S ₅ ×E ₂	61.00nop	36.80 e-j	0.80 e-h	7.15 abc
S ₅ ×E ₃	66.00hi	45.00 b	1.30 b-e	6.90 a-e
S ₅ ×E ₄	65.00ij	45.10 b	1.30 b-e	6.85 a-e
S ₅ ×E ₅	59.00 q	34.50 h-k	1.00 c-g	7.10 a-d
S ₅ ×E ₆	59.00 q	33.10 i-m	1.20 b-f	6.85 a-e
S ₆ ×E ₁	63.50 kl	40.50 b-f	0.90 d-h	6.55 a-f
S ₆ ×E ₂	63.50 kl	41.60 b-e	0.70 f-h	7.00 a-d
S ₆ ×E ₃	67.50 g	49.70 a	1.70 ab	7.10 a-d
S ₆ ×E ₄	68.00 fg	44.20 bc	1.50 abc	6.65 a-f
S ₆ ×E ₅	62.50 lm	38.30 d-h	0.80 e-h	7.35 a
S ₆ ×E ₆	62.50 lm	38.40 d-h	0.80 e-h	6.75 a-f
CV (%)	0.91	5.84	19.69	5.61
LSD (0.05%)	1.241	4.216	0.4567	07750

Table 9. Interaction effects of sowing time and different entries on no. of pods/plant, no. of seeds/pod, 100 seed wt and yield of mungbean during kharif-1 season at RPRS, Madaripur

Sowing time X var./entries	No. of pod/plant	No. of seeds/pod	100 seed wt. (gm)	Yield (kg/ha)
S ₁ ×E ₁	17.51e-i	6.22 a-d	5.60 abc	793.8 mn
S ₁ ×E ₂	18.15 d-i	6.83a-d	5.85 a	815.0 lmn
S ₁ ×E ₃	19.65 b-f	7.17 ab	4.95 h-l	1331.f-i
S ₁ ×E ₄	21.70 bc	7.52 a	5.20d-i	1447.efg
S ₁ ×E ₅	15.95 g-k	6.62a-d	5.60 abc	925.0 k-n
S ₁ ×E ₆	15.75 h-l	7.12 abc	5.00 h-k	1334 f-i
S ₂ ×E ₁	18.75 c-h	5.80 bcd	5.65 ab	1038.j-m
S ₂ ×E ₂	21.00 b-e	6.30 a-d	5.65 ab	1348.f-i
S ₂ ×E ₃	19.45 b-g	6.95 a-d	5.10 f-j	1163.h-k
S ₂ ×E ₄	27.20 a	6.85 a-d	5.20 d-i	1483.e-f
S ₂ ×E ₅	19.35 c-g	6.80 a-d	5.50 a-e	906.9 k-n
S ₂ ×E ₆	20.90 b-e	6.10 a-d	4.75 j-m	1069.jkl
S ₃ ×E ₁	19.40 b-g	5.85 bcd	5.40 b-g	1481.ef
S ₃ ×E ₂	17.65 e-i	5.45 d	5.40 c-g	1566.def
S ₃ ×E ₃	16.70 f-k	6.75 a-d	5.40 d-g	1144.h-k
S ₃ ×E ₄	18.40 c-i	7.05 abc	5.50 a-e	1434.efg
S ₃ ×E ₅	14.05 j-m	6.10 abcd	5.75 ab	984.3 j-m
S ₃ ×E ₆	15.75 h-l	6.40 a-d	5.05 g-k	1163.h-k
S ₄ ×E ₁	21.60 bcd	7.30 ab	5.50 a-e	1775.bcd
S ₄ ×E ₂	17.10 f-j	6.40 a-d	5.55 a-d	1659.cde
S ₄ ×E ₃	22.85 b	6.60 a-d	4.60 lm	1772.bcd
S ₄ ×E ₄	20.90 b-e	7.55 a	4.70 klm	2131 a
S ₄ ×E ₅	15.00 i-m	6.30 a-d	5.45 b-f	1866 bc
S ₄ ×E ₆	18.20 c-i	7.45 a	5.25 d-h	1919.ab
S ₅ ×E ₁	8.40 pq	6.70 a-d	5.20 e-i	959.0 j-m
S ₅ ×E ₂	7.25 pq	6.65 a-d	5.15 e-i	1144.h-k
S ₅ ×E ₃	6.05 q	7.25 ab	4.95 h-l	987.5 j-m
S ₅ ×E ₄	8.00 pq	6.80 a-d	5.00 h-k	1222.g-j
S ₅ ×E ₅	9.45 op	6.40 a-d	5.10 f-j	959.4 j-m
S ₅ ×E ₆	8.25 pq	6.70 a-d	5.15 e-i	1138.h-k
S ₆ ×E ₁	12.0 mno	6.05 a-d	5.45 b-f	825.0 lmn
S ₆ ×E ₂	12.40l-o	5.65 cd	4.85 i-l	931.3 k-n
S ₆ ×E ₃	10.65 nop	6.40 a-d	4.40 m	681.3 n
S ₆ ×E ₄	13.60 k-n	6.30 a-d	4.45 m	1394.fgh
S ₆ ×E ₅	9.750 op	6.90 a-d	4.95 h-l	1038.j-m
S ₆ ×E ₆	10.60 nop	6.70 a-d	4.75 j-m	1113.ijk
CV (%)	9.25	9.29	3.02	8.78
LSD (0.05%)	2.988	1.254	0.3229	223.8