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ORIGINAL RESEARCH ARTICLE

Performance of black gram varieties to mungbean yellow mosaic disease at different sowing dates under spring and summer condition in western terai of Nepal

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ABSTRACT

A field experiment was conducted at Grain Legumes Research Program (GLRP), Khajura, Banke, Nepal during spring and summer season 2019 to elucidate the effect of date of sowing and blackgram varieties on mungbean yellow mosaic disease severity and yield. The experiment was conducted in 2 factorial randomized complete block design with 3 replications. Factor A comprised date of sowing (S1= 5th April 2019, S2= 20th April 2019, S3= 5th May 2019, S4= 20th May 2019, S5= 25th July 2019, S6= 10th August 2019, S7= 25th August 2019 and S8= 10th September 2019) and factor B (Variety): V1= Khajura Mas 1 and V2= Rampur Mas. Disease severity was scored in 1-6 scale. Results revealed that mean values for days to disease appearance, disease score and grain yield in spring season sowing was 26 days, 3.72 and 635 kg/ha, whereas for summer season sowing was 14 days, 5.04 and 185 kg/ha. Among the date of sowing, April 5th sown crop recorded minimum mean disease score (3.1) with highest yield (719 kg/ha). Whereas, September 10th sown crop recorded maximum mean disease score (5.1) with lowest yield (174 kg/ha). Black gram varieties showed significant response to mean disease score and yield at early sowing condition but when the sowing date was delayed, there was no significant response of varieties to mean disease score and yield. The contribution of regression (R^2=0.791) and (R^2= 0.655) for spring season and summer season indicate that 79% and 65% of the blackgram yield would be affected by disease for the respective season. Therefore, it is better to sow blackgram in early season to escape mungbean yellow mosaic disease and minimize yield loss.

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INTRODUCTION

Blackgram (*Vigna mungo* L.) Hepper) is popularly known as mash in Nepal and urdbean or urid in India. In Nepal, blackgram is third important crop in terms of area after lentil and soybean and is cultivated in 24500 ha producing 21633 kg with an average productivity of 882 kg/ha (MoALD, 2022). Farmers grow blackgram from terai to midhills regions of Nepal and most popularly in bunds of rice field. Despite the area under blackgram is increasing in the last 3 years, the productivity is not increased as expected. The major reasons behind low productivity of blackgram are insufficient disease resistant and high yielding varieties, biotic and abiotic factors and lack of proper crop management practices. Among different management factors, time of sowing will influence the growth and yield of the blackgram, as the population of whitefly will greatly vary on different growing conditions which will directly impact the disease incidence and disease severity. Different fungal, bacterial, viral diseases and sucking insects are the biotic factors which are detrimental for blackgram cultivation and are reported during growing season.

Among insect pest, Whitefly (*Bemisia tabaci* Gennadius) is the most important which attacks blackgram at early stage of the crop growth and reduce the plant strength by sucking the cell sap. Whitefly not only affects the plant growth but also has been identified as the only vector for natural transmission of MYMV (Arif *et al.*, 2022) which is a serious threat to blackgram and mungbean cultivation. Mungbean yellow mosaic virus causing yellow mosaic is considered as major factor for low productivity of mungbean and blackgram (Naeem *et al.*, 2022). Severe disease symptoms cause reduction in number of pods/plants, seeds/pod and seed weight contributing the yield loss (Parihar *et al.*, 2017). Depending upon the age of the crop, susceptibility of cultivars and population of whiteflies, MYMV accounts 5 to 100% yield loss every year (Mahalakshmi *et al.*, 2015).

Source of resistant varieties of blackgram against MYMV are lacking in Nepal and till now only 2 blackgram varieties namely Khajura Mas 1 and Rampur Mas has been released from the national variety release center (MoALD, 2022). As blackgram is grown in terai and mid hill of Nepal, farmers from mid hill usually grow local seed which is attacked by major disease and insect and possess low yield. Most of the farmers usually sow blackgram without considering the optimum sowing time. As a result, crop growth is affected by whitefly and MYMV which results poor quality seed and low yield. Besides this farmer apply deadly hazardous pesticides for the control of insect vector which leads to increased cost of production and environment pollution. Due to MYMV effect blackgram crop area is diverted towards other cereals crops like maize. Population of whitefly and MYMV disease is weather dependent so, forecasting the outbreak of whitefly and subsequent MYMV by weather parameters can give early warning message to the farmers to manipulate time of sowing to control vector population and escape the disease (Naeem *et al.*, 2021). Hence the present study was undertaken to identify optimum sowing date which would be helpful to develop disease management strategies for suppressing the insect pest population and MYMV incidence.

MATERIALS AND METHODS

The experiment was carried out at Grain Legumes Research Program, Khajura, Banke, Nepal during the period from April 2019 to May 2019 as spring sowing and July 2019 to September 2019 as summer sowing in order to study the effect of dates of sowing on the severity of mungbean yellow mosaic disease (MYMD). Geographically experiment lies between at 81^0 37" East longitudes and 28^0 06" North latitude and an altitude of 181 meters above mean sea level. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with three replications. Factor A (Sowing time): S1= 5th April 2019, S2= 20th April 2019, S3= 5th May 2019, S4= 20th May 2019, S5= 25th July 2019, S6= 10th August 2019, S7= 25th August 2019 and S8= 10th September 2019. Factor B (Variety): V1= Khajura Mas 1 and V2= Rampur Mas. Individual plot was $2m^2$ with five rows of 2 meter length at the spacing of 40cm. All the recommended agronomical practices were followed during the crop period. Chemical fertilizer was applied at field preparation at the rate of 20:40:20 NPK kg/ha which was supplied through Urea, DAP and Potash. Weather data viz., temperature °C (maximum and minimum), relative humidity %, rainfall (mm) was recorded simultaneously from the directorate of agricultural research, Khajura, Banke to study the weather impact on MYMD disease severity (Figure 1).

Mungbean yellow mosaic disease assessment

Disease scoring was done after the appearance of the disease in each plot. Whole plot disease scoring was done 3 times in 1-6 scale given by (Bashir, 2006). Where, Scale 1= No visible symptoms on leaves (HR), 2= Small yellow specks with restricted spread covering up to 5% leaf area (R), 3= Yellow mottling covering 5.1% to 15% leaf area (MR), Yellow mottling and discoloration of 15.1% to 30% leaf area (MS), 5= Pronounced yellow mottling and discoloration of leaves (covering 30.1% to 75% of area) and pods, reduction in leaf size and stunting of plants (S) and 6= Severe yellow discoloration covering more than 75% of foliage, stunting of plants and reduction in pod size (HS).

Statistical analysis

All data were analyzed statistically using MSTAT and mean comparisons were made using Duncan Multiple Range Test (DMRT).

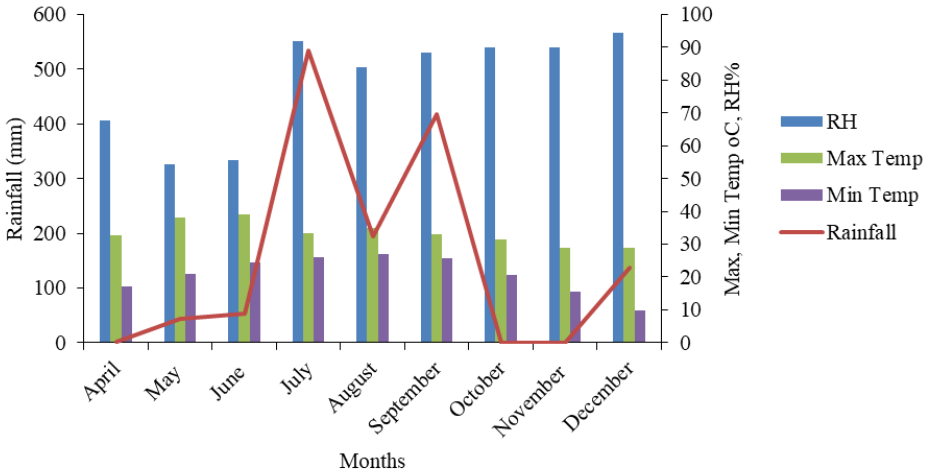

Figure 1. *Meteorological data during April to December, 2019.*

RESULTS AND DISCUSSION

Effect of date of sowing and varieties on disease severity and yield during spring season

Analysis of variance revealed highly significant difference (p≤0.01) for date of sowings for disease parameters viz., Days to disease appearance days (DDA), disease severity 1 (DS1), disease severity 2 (DS2), disease severity 3 (DS3), mean disease score and yield. In spring, 20th May sowing disease symptom appeared earlier i.e., in 22 days whereas in 20th April sowing disease symptom appeared latter i.e., in 30days. Mean disease score was lowest (3.1) and yield was highest (719 kg/ha) in 5th April sowing whereas mean disease score was highest (4.2) and yield was lowest (543 kg/ha) in 20th May sowing (Table 1). Blackgram varieties showed significant difference for DS1, DS3, mean DS and yield but DDA and DS2 were not significant. Among the genotypes Khajura mas-1 possessed low mean disease score (3.5) with yield of 666 kg/ha whereas Rampur Mas had mean disease score of (3.9) with yield (603 kg/ha) (Table 1).

Effect of date of sowing on disease severity and yield during summer season

Analysis of variance revealed highly significant (p≤0.01) difference among date of sowings for disease parameters days after disease appearance (DDA), disease severity 3 (DS3), mean DS and yield. In summer, 25th July sowing took longer days (19 days) for disease symptom appearance whereas in rest of the sowing date disease symptom appeared earlier. Mean disease score was lowest (4.6) and yield was highest (205 kg/ha) in 25th July sowing whereas mean disease score was highest (5.1) and yield was lowest in (174 kg/ha) in 10th September sowing (Table 2). Blackgram varieties showed non-significant difference for disease parameter and yield. Khajura Mas 1 and Rampur Mas had same level of disease score (5) and yield was lower than spring season sowing (Table 2).

Relation of weather parameters on mungean yellow mosaic disease

20th April 2019 sowing took longer days (30 DAS) for the symptom appearance of MYMV followed by 5th May 2019 sowing (29 DAS). Whereas, 10th August 2019 and 10th September 2019 sowing dates took shorter days (12 DAS) for the first symptom appearance of MYMV. In 20th April sowing maximum, minimum temperature and relative humidity was 38.13°C and 20.87 °C and 54.5% respectively. Whereas in 10th August sowing maximum, minimum temperature and relative humidity was 34.84 °C, 26.93 °C and 84%, respectively.

Table 1. Effect of date of sowing and varieties on Mungbean yellow mosaic disease and yield during spring season, 2019.

Factor A	DDA	DS1	DS2	DS3	Mean DS	Yield (Kg/ha)
5th April, 2019	28b	2.5 b	3.1 b	3.8 c	3.1 c	719 a
20th April, 2019	30 a	2.5 b	3.8 a	4.3 b	3.5 b	662 b
5th May, 2019	29 a	2.5 b	4.0 a	5.3 a	3.9 a	616 c
20th May, 2019	22 b	3.1 a	4. 0 a	5.5 a	4.2 a	543 d
CV%	16.64	7.65	8.23	7.96	6.5	1.98
LSD	5.33**	0.253**	0.381**	0.468**	0.282**	15.58**
Factor B						
Khajura Mas-1	26	2.5 b	3.7	4.2 b	3.5 b	666 a
Rampur Mas	25	2.8 a	3.7	5.2 a	3.9 a	603 b
CV%	16.64	7.65	8.23	7.96	6.5	1.98
LSD	ns	0.179**	ns	0.109**	0.199**	11.02**

*DDA: Days to disease appearance; DS: Disease severity; Means followed by the same letter are not significantly different by DMRT (P≤0.01). **- highly significant.*

Table 2. Effect of date of sowing and varieties on Mungbean yellow mosaic disease and yield during summer season, 2019.

Factor A	DDA	DS1	DS2	DS3	Mean DS	Yield (Kg/ha)
25th July, 2019	19 a	3.8	5.0	5.16 b	4.6 a	205 a
10th August, 2019	12 b	4.3	5.5	6.0 a	5.2 a	184 b
25th August, 2019	13 b	4.1	5.3	5.8 a	5.1 a	176 b
10th September, 2019	12 b	4.0	5.6	5.8 a	5.1 a	174 b
CV%	18.31	10.17	11.21	5.57	4.71	8.56
LSD	3.25**	ns	ns	0.39**	0.92**	19.61**
Factor B						
Khajura Mas-1	15	4.0	5.3	5.7	5.0	189
Rampur Mas	13	4.1	5.4	5.6	5.0	180
CV%	18.31	10.17	11.21	5.57	4.71	8.56
LSD	ns	ns	ns	ns	ns	ns

DDA: Days to disease appearance; DS: Disease severity, Means followed by the same letter are not significantly different by DMRT (P≤0.01). **- highly significant.

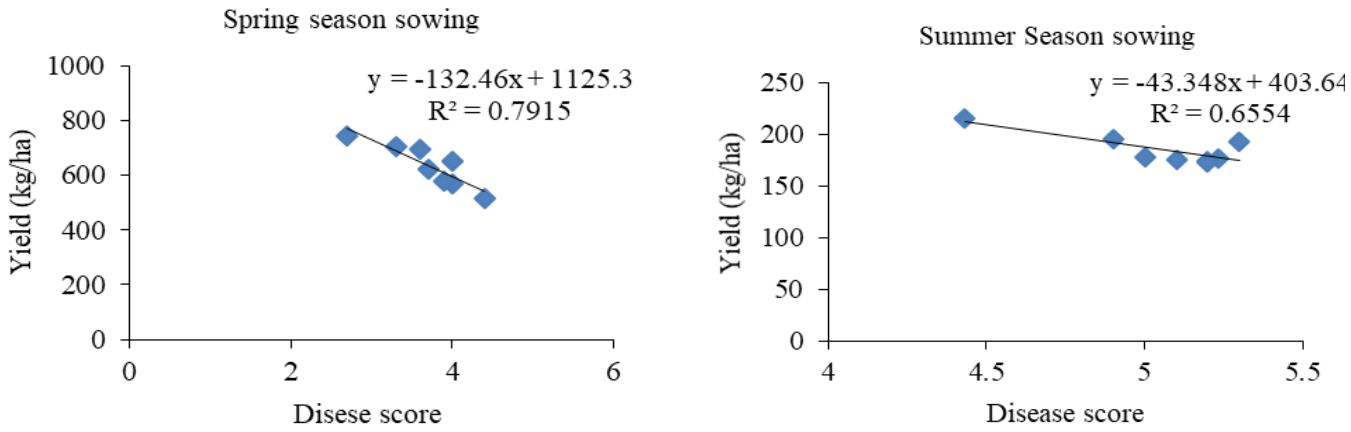

Figure 2. *Estimated linear correlation between disease score and yield of blackgram at different sowing dates under spring and summer season.*

From the result it was observed that as the sowing days was delayed the severity of Mungbean yellow mosaic disease increased in both spring and summer season sowing with decrease in crop yield. Similar results were also observed by Prasad *et al.* (2022). Highest rains in the months of July interfered with growth and multiplication of whitefly population thus leading to lowest disease incidence in early sowing condition. Similar result was reported by Meghashree and Mallikarjun (2018). Hadiya *et al.* (2020) found significant positive correlation between MYMV and whitefly population at different growth stage of crops indicating that increasing whitefly population cause increase MYMV and vice versa. Naveed *et al.* (2015) also studied effect of eight different dates of Meghashree and Mallikarjun (May 26th, June 2nd, June 9th, June 16th, June 23rd, June 30th, July 7th and July 14th) on incidence of MYMV and found lowest incidence of MYMV with highest yield (1990 kg/ ha) in June 2nd sown crop. Highest incidence and lowest yield were observed in July 14th sown crop. Similar results were observed in our study that early sowing i.e., 5th April sowing had lower disease score with higher yield and disease score increased with delayed sowing. Maximum temperature beyond 35°C, minimum temperature below 8°C and moderate to high rainfall are very detrimental factors for successful population build up of whitefly. Garg and Patel (2018) from the experiment reported that the whitefly population was high when maximum temperature, minimum temperature and rainfall were 30.72°C, 23.22 °C and 1 mm, respectively. He also reported whitefly population was negatively correlated with rainfall. In spring sowing blackgram, the maximum temperature was high and relative temperature was low. This created hot and dry condition which was detrimental for whitefly population to transmit mungbean yellow mosaic disease so it took longer days for first symptom appearance in the field. But in summer sowing blackgram, the temperature was below 35°c with 85% relative humidity, this condition might have created favorable environment for the whitefly population for transmitting disease.

Regression study

Regression study states that in spring season sowing, disease governs 79% for yield and for summer season sowing disease governs 65%. Remaining factors for yield decline are contributed by other unknown factors (Figure 2).

Conclusion

Date of sowing has direct impact on incidence of MYMV. The experimental results conclude that early sowing of blackgram can escape the disease incidence and delayed sowing leads to higher disease incidence with lower yield. So, in the western terai of Nepal farmers can manipulate the date of sowing to escape white fly infestation causing mungbean yellow mosaic disease and minimize the use of deadly hazardous insecticide for the management of the disease.

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Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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