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DESCRIPTION OF GROWTH AND YIELD PARAMETERS OF MUNGBEAN CULTIVARS UNDER MUNGBEAN YELLOW MOSAIC VIRUS (MYMV) STRESS CONDITIONS

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ABSTRACT

Mungbean is very nutritious pulse crop covering larger area in Pakistan. Average yield is very low than other mungbean growing countries. Among many yield limiting factors, Mungbean Yellow Mosaic Virus (MYMV) is at the leading position which can cause up to 100% yield losses in case of severe attack. Six cultivar (M-98004, NM-2006, Azri-2006, M-6, M-97001 and M-07007) were screened for their morphological characters affected by MYMV infection. Experiment was conducted in a randomized complete block design (RCBD). Data on plant height, pods plant^{-1}, pod length, seeds pod^{-1}, 1000-seed weight and number of branches plant^{-1} were recorded both from infected and healthy plants. All the parameters were found significantly affected by viral infection i.e. plant height was decreased by 19.58-28.43%, number of pods plant^{-1} by 37.81-44.68%, seeds pod^{-1} by 25.41-46.68%, 1000-seed weight by 35.41-49.94%, pod length by 28.89-47.59% and number of branches by 22.01-43.46%. By comparing the overall morphological response it can be concluded that three cultivars (M-98004, NM-2006 and M-97001) showed moderate reaction against MYMV, hence those can be recommended for better yield.

Keywords: Begomovirus, head weight, morphology, plant height, whitefly

INTRODUCTION

Pulses are the main component of Pakistani diet. Mungbean is the 2nd most important pulse after chick pea in Pakistan. It is highly prized for its excellent digestibility and nutritive value (Malik *et al*., 2014). It contains protein, carbohydrates, vitamins, fibres and fat (Iqbal *et al*. 2011). It is cultivated on 220 thousand hectares area with 140.7 thousand tons annual production (GoP, 2015). The average per hectare yield of mungbean in Pakistan is lower than developed countries (Iqbal *et al*., 2011). Low yield in Pakistan is may be due to inferior quality germplasm, deficient irrigation facilities and the occurrence of diseases (Ahmad *et al*., 2017). Although, this crop is attacked by many pathogens but Mungbean Yellow Mosaic Virus is the most destructive and widespread throughout Pakistan (John *et al*., 2008). The MYMV causes uneven green and yellow patches on mature leaves. Affected plants produce less number of pods, flowers and seeds (Mohan *et al*., 2014) which are mainly responsible for decrease in yield. The MYMV disease inflicts heavy yield losses annually and is the most destructive disease in Pakistan (Bashir *et al*., 2005). Depending on crop variety and location; losses may reach upto 100% in epidemic form (Bashir *et al*., 2006). The MYMV belongs to *Begomovirus* genus and *Geminiviridae* family. Whitefly (*Bemisia tabaci*) transmits this virus. Female insects are more efficient than males (Qazi *et al*., 2009). The incidence of MYMV is greatly influenced by planting date that affects the crop growth and yield (Sadeghipour *et al*., 2008). Early infection cause more yield losses as compared to late infection (Kang *et al*., 2005). Infected plants mature late and impair grain size and quality (Singh *et al*., 2011). Photosynthetic efficiency of infected plants decreases due to

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which crop yield is reduced (Malathi and John, 2008). On the basis of above described facts, the current experiment was under taken to compare the growth and yield factors of health and MYMV infected plants from different mungbean cultivars. The morphological traits of mungbean plants may be affected due to MYMV infection. This comparison would be helpful in further determination of high yielding mungbean varieties to be used in breeding programs and in farmer's field.

MATERIALS AND METHODS

Experimental plots and site preparation

The experiment was conducted at research area, Department of Plant Pathology, University of Agriculture Faisalabad (Pakistan). A fallow piece of sandy loam soil was selected and ploughed, followed by planking and leveling.

Germplasm collection and sowing

The seed of six cultivars and lines was collected from Ayub Agricultural Research Institute (AARI) Faisalabad. The following cultivars or lines were sown in the experiment viz: NM-2006, AZRI-2006, M-6, M-97001, M-98004 and M-07007. Each cultivar or line was planted in a 6 meter long row by maintaining 15 cm plant to plant distance and 30 cm row to row distance. All entries were sown in randomized complete block design (RCBD). One row of the most susceptible check (KM-5) was repeated after every two entries in the experiment to create disease pressure in the field.

Agronomic practices and maintenance of the experiment

After germination, thinning was done to maintain 15 cm distance between the plants. Crop was irrigated at 2 weeks interval. Weeding was done frequently to keep the plot free from weeds and to facilitate observations. No insecticide was applied to any of these plots under this experiment to give maximum opportunity for the increase of the whitefly population and also the disease incidence.

Confirmation of MYMV disease

The MYMV was identified on the basis of symptomology (alternate green and yellow patches, chlorosis, reduced internodes and reduction in leaf size) and confirmed by whitefly mediated inoculation and grafting (Akhtar and Haq, 2003). Two sets containing five mungbean plants, each were sown in pots and placed in glasshouse under protected conditions for the confirmation of MYMV through whitefly and grafting, respectively. One plant in both sets was kept as control. Whiteflies were collected from symptomatic plants in the field and released on the covered plants in a glasshouse. The other set was used for grafting, in which the branches of symptomatic plants were detached and grafted on healthy plants in glasshouse. Later on symptoms were observed on both sets of plants.

Plate 1. MYMV symptoms on mungbean

Data recording

The experimental plots were inspected to look for the appearance of yellow mosaic disease symptoms at 7 days interval. Five healthy and five diseased plants were selected randomly from each plot. Moreover, the data for plant height (cm), pods plant^{-1}, pod length (cm), seeds pod^{-1}, 1000-seed weight (g) and number of branches plant^{-1} were recorded from both healthy and MYMV infected plants. Reduction (%) in growth and yield parameters were calculated by the following formula:

% Reduction = Healthy-Diseased/Diseased*100

Statistical analysis

All the data were analyzed by using Statistix 8.1 software and the means were compared by LSD at 5% level of significance (Steel *et al*., 1997).

RESULTS

There was significant difference among growth and yield parameters of mungbean cultivars or lines in both healthy and MYMV infected plants. In healthy plants maximum plant height (44.13 cm) was recorded in cultivar M-98004 that reduced to 35.49 cm in case of infected plants (Table 1). Minimum plant height (35.26 cm) was recorded in M-6 that reduced to 19.24 cm in MYMV infected plants. The number of pods plant^{-1} ranged from 20.81-28.67 and 12.32-17.83 in healthy and diseased plants, respectively. Maximum pods per plant were recorded in NM-2006 and minimum was in M-07007 in both healthy and diseased plants.

In case of seeds per pod it was found that Azri-2006 was highest and M-07007 was lowest in healthy plot (Table 2). There was significant reduction in the seeds per pod in infected plants in all entries with maximum (07.55) in Azri-2006 and minimum (06.01) in M-098004. In healthy plants, Azri-2006 exhibited maximum (39.97 g) 1000-seed weight, followed by M-6, M-97001, M-07007, NM-2006 and M-98004, in that order. In diseased plants, 1000-seed weight of all the varieties or lines significantly decreased with maximum (23.37 g) in M-97001 and minimum (16.67 g) in M-98004.

Pod length and number of branches plant^{-1} in healthy and MYMV infected mungbean is given in Table 3. Maximum pod length (09.61 cm) was recorded in Azri-2006 that reduced to 07.48 cm in M-07007. Pod length of diseased plants ranged from 03.92-05.66. Average number of branches plant^{-1} reduced from 07.48 (Azri-2006) in healthy to 03.92 (M-07007) in infected plants. Similarly, all the cultivars showed significant reduction in number of branches in diseased area when compared with healthy ones.Maximum reduction in plant height was recorded in M-6 (45.43%) and minimum reduction in M-98004 (19.58%) (Table 1). Average reduction in all the entries was 28.08%. Highest pods plant^{-1} (44.68%) was found in M-6 and minimum in NM-2006 (37.81%), while average reduction for all cultivars was 40.47%.

Seeds pod^{-1} in diseased mungbean was 36.61% less than healthy ones (Table 2). Individually the most affected line was M-98004 with 46.48% reduction and M-07007 was the least affected with 25.41% reduction in seeds pod^{-1}. Maximum (41.05%) reduction of 1000-seed weight was recorded in case of M-07007 and minimum (35.41%) in M-97001, while average reduction in all cultivars was (41.12%).

Average reduction in pod length was 38.61% in all infected germplasm whereas in variety wise comparison, maximum reduction (47.59%) was observed in M-07007 and minimum (28.89%) in M-6 (Table 3). During calculation of % reduction of number of branches plant^{-1}, minimum (22.01%) was found in M-98004 and maximum (43.46%) in NM-2006. All the varieties lines^{-1} collectively gave average 33.12% reduction in number of branches plant^{-1}.

Table 1. Effect of MYMV on plant height and number of pods plant^{-1}

Varieties/ lines	Plant height (cm)			Number of pods plant^{-1}		
	Healthy	Diseased	% Decrease	Healthy	Diseased	% Decrease
M-98004	44.13	35.49	19.58a	23.13	13.99	39.52ab
NM-2006	38.34	27.45	28.41d	28.67	17.83	37.81a
Azri-2006	41.13	32.17	21.78b	25.09	14.63	41.69b
M-6	35.26	19.24	45.43e	27.42	15.17	44.68c
M-97001	37.11	26.56	28.43d	21.11	13.03	38.28a
M-07007	40.91	30.75	24.84c	20.81	12.32	40.81b
Overall decrease		28.08		40.47		

Values in column with same letters are non-significant at 5% probability

Table 2. Effect of MYMV on seeds plant^{-1} and 1000-seed weight

Varieties/ lines	Seeds pod^{-1}			1000-seed weight (g)		
	Healthy	Diseased	% Decrease	Healthy	Diseased	% Decrease
M-98004	11.23	06.01	46.48e	28.16	16.67	40.82bc
NM-2006	12.95	07.14	44.86d	30.32	18.53	38.89b
Azri-2006	13.26	07.55	43.06d	39.97	20.01	49.94d
M-6	10.37	07.04	32.11c	37.25	22.12	40.62bc
M-97001	10.44	07.55	27.68b	36.18	23.37	35.41a
M-07007	09.13	06.81	25.41a	32.49	19.15	41.05c
Overall decrease			36.61	41.12		

Values in column with same letters are non-significant at 5% probability

Table 3. Effect of MYMV on pod length and number of branches plant^{-1}

Varieties/ lines	Pod length (cm)			Number of branches plant^{-1}		
	Healthy	Healthy	% Decrease	Healthy	Diseased	% Decrease
M-98004	08.13	05.57	31.49b	05.68	04.43	22.01a
NM-2006	08.98	05.08	43.43d	07.34	04.15	43.46d
Azri-2006	09.61	05.13	46.62e	07.48	04.28	42.78d
M-6	07.96	05.66	28.89a	06.22	04.53	27.17b
M-97001	08.05	05.34	33.66c	06.78	04.39	35.25c
M-07007	07.48	03.92	47.59e	05.45	03.92	28.07b
Overall decrease		38.61		33.12		

Values in column with same letters are non-significant at 5% probability

DISCUSSION

The study revealed that MYMV infection considerably minimized all the yield contribution factors (plant height, number of pods plant^{-1}, number of seeds pod^{-1}, pod length, 1000-seed weight and number of branches plant^{-1}). These results are supported by Singh (1981) who reported the reduction in growth components and plant height of mungbean due to MYMV infection. According to Chand and Verma (1983) more than 65% yield reduction along with 25% reduction in 1000-seed weight was recorded in MYMV infected plants. Babu *et al*. (1984) checked *Vigna radiata* plants against MYMV and recorded less number of pods plant^{-1}, seed yield and 1000-seed weight as compared to healthy ones. Significant decrease in pod number, pod size, seeds pod^{-1} and plant yield was described by Ayub *et al*. (1989).

The differences in yield components of mungbean cultivars in the present study may be due to their varied genetic makeup. These differences could also be described on the basis of time of infection (Miah *et al*., 2009). Early infection causes reduction in number of pods and high disease incidence (Mondal *et al.,* 2002). Siddique *et al*. (2006) stated that yield and yield parameters depicted significant differences among mungbean lines based on infection time and stage. Varied morphological attributes may also be the result of varying photo assimilates production by different mungbean cultivars (Wahid and Rasul, 2004). In virus infected plants chlorophyll contents are reduced (Mali *et al*., 2000). Low chlorophyll concentration limits the photosynthetic rate and ultimately decreases the plant growth and yield (Richardson *et al*., 2002). Intensity of disease also responsible for significant differences in growth and yield parameters of mungbean (Naveed *et al*., 2015). Reduction in agronomic and yield attributes in epidemic form was demonstrated by Soomro and Khan (2003).

CONCLUSION

Based on the above results, it can be concluded that cultivars M-98004, NM-2006 and M-97004 are less affected as compared to other varietal lines. So, it can be recommended that these cultivars may be included in future breeding programs for better yield results.

AUTHOR'S CONTRIBUTION

M. A. Zeshan: Conducted research and write up.
S. Ali: Supervisor.
N. Ahmed: Data analysis.
M. Yousaf: Proof reading and assisted in research.
R. Binyamin: Designed layout of the experiment.

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