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Effect of salinity on diverse mash bean genotypes and their impact on different plant parameters

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Abstract

Mash bean in Pakistan is one of the third largest crops in pulse that is most commonly grown in wide range after chickpea and Mung bean. Experiment was conducted at research area of College of Agriculture, University of Sargodha, Pakistan to evaluate the varietal differences based on their performance in salinity. Eight varieties of mash bean were used to determine the effect of salinity on yield and its components. Seeds of these different varieties were grown in polythene bags and a different dose of NaCl (T1, T2, T3) were applied to check the performance of various genotypes of mash bean. T1 treatment was the controlled one other two treatments have different levels of NaCl. Randomized complete block design with two factors was used as experimental design. Different parameters were observed both at seedling and maturity stage like Germination percentage, Plant height, Pod length and Seed weight. Results showed salinity affects the vegetative and reproductive stage of mash bean reduced the yield. NM01 and UROOJ were best genotypes among all they performed well under different salinity levels. Tolerant genotypes that selected because of their good performance and can be used in breeding and improvement of mash bean genotypes.

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Introduction

Climate changes observed from the last few years ago due to increasing human population day by day, reduction of cultivation land, effect of less rainfall and due to increase in environment temperature (Ali *et al.*, 2017). Abiotic stress affects the growth and yield of the plant. Salinity is one the major type of abiotic stress which affects the productivity of the plant it hinders the vegetative and reproductive growth of the plant. About one third of the part of the world greatly affected by the salinity (Kaya *et al.*, 2002). In Pakistan 6.30 million lands is affected with salinity (Economic survey of Pakistan 2017). Salinity is the major problem for the production of crops and sustainable agriculture (FAO and ITPS, 2015).

Mash bean in Pakistan is one of the third largest crops in pulse that is most commonly grown in wide range. It belongs to Fabaceae and subfamily Papilionaceae. It is mainly grown in sub-humid to semi-arid type of climate It is cultivated on area of 1.5% from other pulses and contributing 1.4% in total production of pulses (Economic survey of Pakistan 2017). Punjab is the major producer of mash bean. It is the short duration crop if significant importance is given to the crop it gives more production and benefits to farmers at economic level (Singh *et al.*, 2015). In Pakistan and other countries, its production is low as compared to other crops due to less area of cultivation and other factors (Economic survey of Pakistan 2017). Salinity is the major factor that affects the productivity of mash bean salinity causes abnormalities in plant growth and affect the metabolic pathway of the plant (Ashraf *et al.*, 2008). Photosynthesis is an important process for growth chlorophyll is an essential element that plays important role in photosynthesis salinity reduced the growth of chlorophyll and affects the growth of photosynthesis which disturbed the whole vegetative and reproductive growth of the plant. (Velmani *et al.*, 2015). This experiment was conducted to identify which genotype were performed best under salt stress conditions and developed tolerance against salt stress conditions and will make it adaptable in salinity affected land.

Materials and methods

The field experiment was carried at College of Agriculture University of Sargodha to study the effect of salinity on germination, vegetative and reproductive stage of mash bean. For this, purpose eight versatile varieties of mash bean NMS01, NMS02, NMS03, MASH3, NMS05, MASH97, MASH14, UROOJ were selected for sowing. This field experiment was sown under Randomized Complete Block Design (RCBD) with two factors and three replication. To check the performance of genotypes three treatments of salinity were applied one control T1 (0dsm^{-1}) without application of NaCl, T2 (3dsm^{-1}) and T3 (6dsm^{-1}) these were prepared by mixing measured quantity of sodium chloride in distilled water to impose stress on various genotypes of mash bean in three doses with one week interval. Eight genotypes of mash bean were sown in polythene bag containing 17 kg soil doses of NaCl was applied at different stages i.e. Vegetative, flowering and grain filling stage. Irrigation was given at three times as germination stage then at reproductive stage then at the time of flower emergence. Different parameters were observed both at seedling and maturity stage like Germination percentage, Plant height, Pod length and Seed weight. Data that collected were examined through Excel 2016 and Statistix 8.0 software.

Results and discussion

According to results of this experiment germination percentage affected with the increase in salinity level, it slows down the ability of seed to germinate. Different genotypes showed various response on different level of salinity and showed significant differences among all traits as shown in Table 1. At 3dsm$^{-1,}$ genotypes showed 55.5% germination then at 6dsm^{-1} 46.25% at T1 which was the control one it showed maximum percentage 87.5% of germination. Salinity decreases the germination rate also described by Kandil *et al.* (2012). Maximum percentage was observed under control treatment among all two levels of salinity also reported by Naher and Alam (2010). Salinity reduces the ability of seed to start the process of germination. Crop productivity determined by the germination percentage. Urooj performed well

at control treatment and at 3dsm^{-1} level of salinity. At 6dsm^{-1} genotype, NM03 performed best.

Plant height is the important parameter. Due to the effect of salinity it reduces the height of the plant findings were agreed by Raptan *et al.* (2001). Different genotypes of mash bean performed different at different salinity levels and in control conditions.NM01 have maximum height in controlled conditions 25cm but its height decrease at more application of salinity. At 3dsm^{-1} Mash-14 performed well its average height is about 25cm while at 6dsm^{-1} NMS01 developed maximum height16cm then other genotypes of mash bean. Salinity greatly affects plant height and causes reduction as reported by Egeh and Zamora (1992).

Table 1. ANOVA table for each parameter showing significant differences among traits.

Variable analyzed	Sum of squares	Mean squares	P- value
Germination percentage	7396	3698	1.13e-15 ***
Plant height	717.4	358.7	1.02e-05 ***
Pod length	1.398	0.6988	0.048 *
Seed weight	2.591	1.2954	0.00066 ***

Salt stress reduced the length of pod NMS03 attained more pod length 4.6cm at 3dsm^{-1}. At 6dsm^{1} variety UROOJ have more pod length 4.1cm other genotypes while in controlled treatment NMS01 have more length 5.3cm. At both level of salinity, 3dsm^{-1} and 6dsm^{-1} of NaCl cause reduction in length of pods to 50% to 75% accordingly.

Table 2. Showing LSD for each parameter.

Treatments	Germination percentage	Plant height	Pod length	Seed weight
T1	87.500 a	26.0000 a	4.1500 a	4.1500 a
T2	55.500 b	55.500 b	55.500 b	3.6125 b
T3	46.625 c	46.625 c	46.625 c	4.4000 a

Seed weight was recorded at different level of salinity UROOJ and NMS01 have more seed weight then all other genotypes at 0dsm^{-1}. Mash3 performed best at 3dsm^{-1} while UROOJ have more seed weight then other mash bean genotype at 6dsm^{-1}. Weight of seed expressed considerable reduction due to increase in salinity as reported by Gill, 1979. Yield contributing traits of mash bean including Pod length, seed weight reduced significantly due to salinity reported by Ahmed. (2009). Increased level of salinity caused reduction in growth, yield attributing traits of mash bean. UROOJ and NM01 performed well they have tolerance against salinity. Qureshi *et al.,* (2013) has also stated effect of salinity on yield as showed in this experiment.

Conclusion

Mash bean genotypes were significantly affected with salinity. Control treatment showed significant differences with both level of salinity. From the result suggested that increase in salinity decreases the morphological and yield contributing parameters in mash bean genotypes. Tolerant genotypes (NM01 and UROOJ) of mash bean accomplished well under salinity conditions. These genotypes can be used for further improvement in breeding programmers and for salinity affected areas of Pakistan.

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