SALINITY AND ITS ROLE ON YIELD AND YIELD RELATED TRAITS OF LENTIL (*Lens culinaris* Medik.) VARITIES IN BANGLADESH

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ABSTRACT

Salinity is one of the major stresses especially in arid and semi arid regions, which severely limit crop production. It impairs seed germination, retards plant development and reduce crop yield. This study was conducted to assess the effect of salinity on yield and yield related traits of lentil (Lens culinaris Medik.) in field condition. Seeds of five variety of lentil were grown on sterilized pot condition with different level of salinity for 12 weeks. The experimental design was completely randomized block design with three replications. Data analysis was carried out in respect of seed germination, number of branch, number of flower, number of pod and total biological yield. The result of the experiment showed that the concentrations of salt have a negative impact on growth and yield of lentil, as a result when the concentrations of salt increases, the germination, number of branch, flower and pod decreases. These results clearly indicate that Nacl highly affects all the yield related traits of lentil. These results also indicate that there is a difference in salinity tolerance level among the lentil verities available in Bangladesh.

Key words- Lentil, salinity, germination, total biological yield

INTRODUCTION

Salinity is one of the most serious factors limiting the productivity of agricultural crops, with adverse effects on germination; plant vigor and crop yield (1). High salt concentration in root affects the growth and yield of many important crops (2). The salinity may reduce the crop yield by upsetting water and nutritional balance of plant.

Since grain legumes especially lentil are salt sensitive, farmers do not consider growing them in a saline environment, though there is a considerable difference in salt tolerance among lentil accessions. Lentil is an important legume in Bangladesh because it is a source of high quality protein in human diet and animal consumption. The importance of lentil lies in the fact that it is a major source of good quality protein in the common diet as the protein content can reach up to 24-30%. Lentil is popular to all classes of people, and is taken in almost all meals. Annual demand of lentil in Bangladesh is 1.8 to 2.0 million tones whereas average production in last five years (2011 to 2015) was 1.0227 million tones per year. For this Bangladesh mostly depends on imported lentil and the trends of lentil import increasing day by day because the local production can meet the country's requirement of two to three months, only 10 - 15 per cent demand is met by local production.

Agricultural productivity in coastal regions of Bangladesh is very low due to many complex factors such as accumulation of salts in soils (3). Total area under salinity is about 1.056 million ha which covered 30% of the net cultivated area. It has been estimated that about one third of total production of lentil has been affected by salinity. Differences in salt tolerance exist not only among different genera and species, but also in the different organs of the same species. Screening of large number of available lentil varieties is important to find a relative salt tolerance variety.

There are various detrimental effects of salt stress in crop plants responsible for severe decrease in the growth and yield of plants. Osmotic stress, ion imbalance and the direct toxic effect of ions on the metabolic process are the most important and widely studied physiological impairemnets caused by salt stress (3,4) (Munns 2002; Katerji *et al*. 1992). Waisel[5], Huang *et al.* [6], Hadas[7] and Dell Aquilla[8] studied the role of salt on seed germination attributed to osmotic stress or specific ion toxicity. The inhibitory effect of salinity had also been demonstrated by Dash and Panda [9] for wheat, Khan and Gulzar[10] for perennial grasses, Tiwari *et al.* [11] for oat, Agarwal *et al.* [12] for barley.

In a different experiment Meloni *et al.* [13], Jamil and Rha[14], Jennette *et al.* [15], Subbarao *et al.* [16] reported the effects of salinity on shoot and root development of *Prospis alba*, sugar beet and cabbage, Phaseolus species and pigeon pea. Mohamedin et al. [17] have also been reported that salinity induced water deficit reduced the plant growth and development sunflowers.

It was this background the objective of the present study was to evaluate the effect of salt on yield and yield related traits of lentil varieties available in Bangladesh

MATERIALS AND METHODS

The study was conducted from January 2018 to June 2018 in the laboratory of Department of Botany, University of Barisal. The seeds were collected from Bangladesh Agriculture Research Institute (BARI) and preserved at the department of Botany, University of Barishal. Seeds were hand sorted to eliminate broken, small and infected seeds. Then sterilized, hand selected seeds of BM-1, BM-3, BM-4, BM-5 and BM-7 was allowed to germinate in laboratory condition. Before beginning the experiment, solutions were prepared by dissolving sodiumsorted chloride (NaCl) in distilled water at four different concentrations (25 mMol, 50 mMol, 75 mMol and 100 mMol) and left for 48 hours to dissolve. The salt concentrations were prepared every week so that it is relatively fresh for the germinating seeds.

For seedling growth sterilized sand was used that were collected near university campus. Fifteen surface sterilized uniform seeds of each lentil varieties were sown in the plastic pots at uniform depth and distance. Pots were arranged in CRBD, replicate three times and irrigated with equal 100 ml of (25 mMol, 50 mMol, 75 mMol and 100 mMol) salt solutions and tap water as control. Hogland solutuions were used as nutrient source of the seedlings. Treatment application with the same amount of salt solutions continued every other day and the germination was recorded at 24 hours interval for 15 days.

Data collection

Germination percentage: The emergence of radical (root) and shoot from each pots were assessed every 2 days after sowing. Then the salt tolerance rate was calculated using the following formula -

Salt tolerance = germination in salt treated seed * 100/ Germination in control

Number of branches per plant: The number of branches emerging directly from the main stem was counted at the time of maturity on five randomly (From each treatment) selected plants from each variety and average was recorded.

Number of flowers per plant: Total number of flowers from each variety was counted and the average was recorded.

Number of pods per plant: Total number of seeds bearing pods from each variety was counted and the average was recorded.

Data analysis: The data will be subjected to analysis using Least Significance Difference test (LSD) at 5% level of significance.

RESULTS AND DISCUSSION

Seed germination

The effect of varying concentration of salts on germination has been presented in Figure 1. It is evident that percentage of germination gradually decreased with the increases concentration of NaCl in all variety of lentil used in the present investigation, but the extent of reduction under high concentration stress (100 mMol) was much greater than that under low stress. Inhibition of germination due to salinity has been also reported by Buchade and Karadge[18] on five legume crops; *Dolichos biflorus, Lens esculanta* Moench, *Phaseolus aureus, P. acnitifolius,* and *Trigonella foenum graceum.*

No significant difference was observed among the variety under control condition however the varietal difference observed under salt stress. Seed germination percentage of BM-3, BM-4, BM-5 and BM-7 were not affected by 25 mMol of NaCl, whereas in this salt concentration germination percentage was significantly decreased for BM-1 variety of lentil. However, germination percentage was significantly decreased at all level of NaCl concentration used in this investigation. At 100 mMol salt stress level, seed germination percentage of all variety highly reduced compared with non stress condition. In this concentration no germination was observed in BM-1 and BM-5, very low germination occurred in BM-3, BM-4 and BM-7.

Relevant results in legumes were reported by Gunjaca and Sarcevic [19], Al mansouri *et al.* [20]. They reported that increasing OP in saline condition decrease water uptake and finally collapse seed germination.

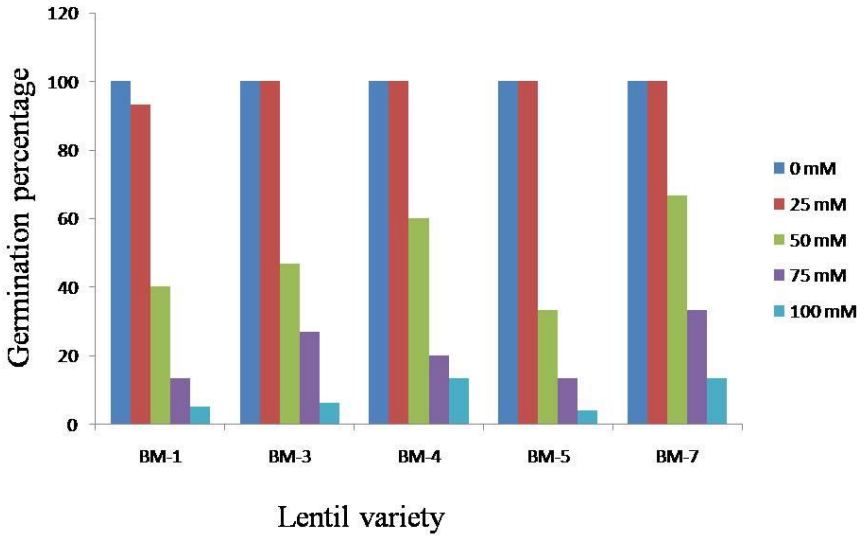

Figure 1. Germination rate of five BARI masur varieties of lentil at different salt stress condition (25-150 mMol NaCl).

Number of Branches per plant

Results presented in Table 1 indicated that a significant reduction of branches per plant was observed when salinity stress was increased from 0 to 100 mMol. At the higher salt concentration the number of branch was extremely affected and made the seedlings less thrived for the stress.

These results have been confirmed by the results of Karen *et al.* [21] in chickpea, Raul *et al.* [22] with their study on cowpea. They reported that the treatment of sodium chloride reduced the number of leaves compared with control plants.

Table 1. Effect of salinity with different concentrations of NaCl on the number of branches per plant of lentil.

Lentil variety	Salinity level				
	0mM	25mM	50mM	75mM	100mM
BM-1	13.3	11.0	11.0	4.20	2.66
BM-3	12.2	11.4	11.22	4.22	1.25
BM-4	15.8	14.7	10.11	4.6	1.50
BM-5	13.5	13.6	11.2	4.44	1.0
BM-7	16.9	13.6	9.57	4.7	1.75

Number of flowers per plant

Analysis of variance of the data for flower formation showed that NaCl treatment had a significantly adverse effect on flower formation. Different variety responded differently to NaCl treatment. It was observed that mean value of flower ranged from 7.2 to 9.2 at control, 6.7 to 9.0 at 25 mMol, 3.2 to 4.8 at 50 mMol, 1.0 to 2.6 at 75 mMol and 0.2 to 1.7 at 100 mMol salinity level. The maximum flower was recorded in BM-3 and BM-7 variety whereas the minimum was recorded in BM-4 variety of lentil (Table 2).

Table 2. Effect of salinity with different concentrations of NaCl on the number of flowers of lentil.

Lentil variety	Salinity level				
	0mM	25mM	50mM	75mM	100mM
BM-1	7.2	6.7	3.2	1.4	0.8
BM-3	8.6	8.4	4.7	2.3	1.2
BM-4	9	7.4	3.1	1.0	0.2
BM-5	8.2	7.8	2.3	1.4	0.6
BM-7	9.2	9	4.8	2.6	1.7

Number of pods per plant

From this experiment it was observed that like flower formation; pod formation was also affected by NaCl treatment. At 25 mMol NaCl concentration maximum pod formation was recorded in BM-7 variety of lentil (Table 3). It was observed that mean value of pod formation ranged from 5.7 to 8.2 at control, 3.7 to 4.9 at 25 mMol, 1.2 to 2.8 at 50 mMol, 0 to 1.2 at 75 mMol and 0 to 1.0 at 100 mMol salinity level. At 100 mMol NaCl concentration no pod formation was observed in BM-1 and BM-5 variety of lentil.

Table 3. Effect of salinity on formation of pods of lentil variety.

Lentil variety		Salinity level			
	0	25	50	75	100
BM-1	5.7.	3.7	1.2	0	0
BM-3	7.6	4.4	1.7	1	0.8
BM-4	7.9	3.4	1.1	0.2	0.2
BM-5	7.8	2.8	1.3	0.4	0
BM-7	8.2	4.9	2.8	1.2	1.0

Effect of salinity on total biological yield of lentil

Statistical analysis of total biological yield showed that there were significant variation among variety and salinity level. Varieties were responded differently to entire salinity and their value of total biological yield in different ranges (Figure 2)

The result revealed that increment of salinity causes decrement of total biological yield and at higher salinity level salinity prevented the plant from production of sufficient biological yield.

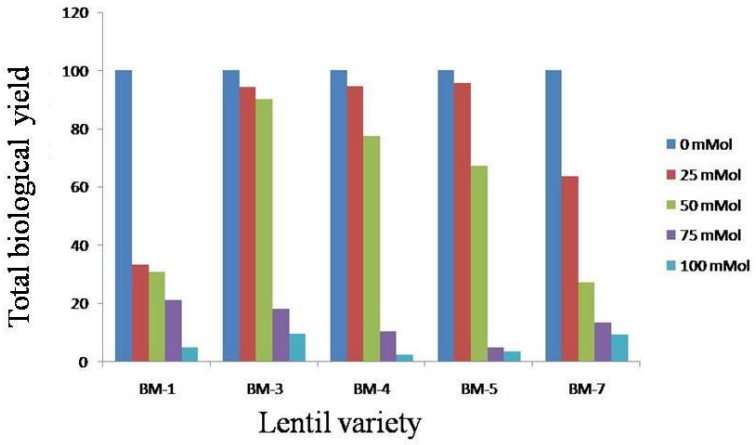

Figure 2. Effect of salt stress on total biological yield of five BARI masur varieties of lentil.

CONCLUSION

From this study it is imperative to conclude that, the concentration of salt affects seed germination, plant growth and yield of lentil varieties available in Bangladesh. In general, all the five variety of lentil showed healthy growth under control condition but they showed different response to higher level of salinity where as it shows variation in different level of salinity. These results clearly explain that genetic variation exists among lentil varieties in terms of germination percentage under salt stress. Out of five lentil variety BM-3 and BM-7 showed most tolerance in most of the parameter as result this can be suggested for cultivation under salt stress condition.

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