Reprint

ISSN 1991-3036 (Web Version)

International Journal of Sustainable Crop Production (IJSCP)

(*Int. J. Sustain. Crop Prod.*)

Volume: 7	Issue: 1	February 2012

Int. J. Sustain. Crop Prod. 7(1):12-18(February 2012)

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http://ggfagro.com/ejournals/current issues

IJSCP** issn 1991-3036, HQ:19-10 cantral place, saskatoon, saskatchewan, s7n 2s2, Canada

ISSN-1991-3036 (Online)
Int. J. Sustain. Crop Prod. 7(1):12-18(February 2012)

EFFECTS OF SALINITY ON MORPHO-PHYSIOLOGICAL ATTRIBUTES AND YIELD OF LENTIL GENOTYPES

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Accepted for publication on 15 January 2012

ABSTRACT

Islam MT, Jahan NA, Sen AK, Pramanik MHR (2012) Effects of salinity on morpho-physiological attributes and yield of lentil genotypes. *Int. J. Sustain. Crop Prod.* 7(1), 12-18.

A pot experiment was conducted at the pot yard of Bangladesh Institute of Nuclear Agriculture, Mymensingh to assess the effects of salinity on some morpho-physiological attributes and yield of lentil genotypes, namely N_1M-134, N_1M-149, N_1M-214, N_5M-507, N_5M-573, N_4M-606, E_4M-934, Binamasur-3, Barimasur-4 and L-5 during November 2005 to February 2006. There were three salinity levels *viz.* control (only water), 4 dSm^{-1} and 6 dSm^{-1}. Salinity was developed by adding salt solution of $NaCl_2$, Na_2SO_4, $NaHCO_3$, $CaCl_2$, $MgCl_2$, $MgSO_4$ at 45 days after sowing. The experiment was laid out in randomized complete block design with three replications. The results showed that plant height, number of branches, number of leaves $plant^{-1}$, leaf area, total dry matter, total chlorophyll content, nitrate reductase activity in leaves, number of pods, number of seeds $plant^{-1}$, 1000-seed weight, seed yield $plant^{-1}$ and harvest index were gradually decreased with the increase in salinity level compared to control. However, total sugar and reducing sugar content in leaves increased with increasing salinity level. The genotype N_5M-507 produced the highest root dry weight, total dry matter, number of seeds and seed yield $plant^{-1}$ under salinity. N_1M-214 also produced statistically similar yield to that of N_1M-507. So, these two genotypes indicated tolerance to salinity compared to other genotypes.

Key words: *salinity, lentil, yield and yield attributes*

INTRODUCTION

Salinity is an environmental condition which affects the physiological process of the plant and it is the most important factor which adversely affects the crop production. These adverse effects may be attributed to non-availability of water, disturbance in nutrients causing deficiency and ion-toxicity to plants. In Bangladesh, 2.85 million hectares of land are saline affected (Karim *et al.* 1990). There is a possibility of bringing these areas under cultivation with salt tolerant crop varieties in rabi season (November to February). Salt stress is more harmful during early stages of germination and seedling growth. Crop plants under salt stress show reduction in dry matter accumulation and grain yield, which is invariably attributed with pronounced changes in ionic composition. The saline soils have the problem of high soluble salts creating a condition of physiological drought which limited plant growth by inhibiting nutrient and water uptake in plants (Greenway and Munns, 1980). In the above circumstance efforts can be given to increase yield of different crops by the use of salt tolerant cultivars in the saline area. So, it is needed to develop salt tolerant high yielding varieties of crops. Recently, Bangladesh Institute of Nuclear Agriculture (BINA) is trying to develop salt tolerant varieties. Considering those points, the present work was undertaken to study salt tolerance of ten lentil genotypes (N_1M-134, N_1M-149, N_1M-214, N_5M-507, N_5M-573, N_4M-606, E_4M-934, Binamasur-3, Barimasur-4 and L-5). The characters associated with the salt tolerance of different levels are investigated in those genotypes. The objectives of the work were to observe the effect of salinity stress on growth and yield of the lentil genotypes; and to identify relative salt tolerant lentil genotype among them.

MATERIAL AND METHODS

The experiment was conducted with 10 genotypes of lentil namely- N_1M-134, N_1M-149, N_1M-214, N_5M-507, N_5M-573, N_4M-606, E_4M-934, Binamasur-3, Barimasur-4 and L-5 at the pot yard of BINA, Mymensingh, during the period from 10 November 2005 to 20 February 2006. A total of 180 (10×3 ×3×2) plastic pots were used. The diameter of each pot was 24 cm at the top and 18 cm at the bottom. The depth of each pot was 22 cm. Each pot contained 7.5 kg of dried soil of BINA farm. Urea, TSP and MP were applied as 0.09, 0.15 and 0.15 g respectively, at the rate of 18, 30 and 36 kg ha^{-1} of N, P, K, respectively. According to Burman *et al.* (2002) six salts *viz*. NaCl, Na_2SO_4, $NaHCO_3$, $CaCl_2$, $MgCl_2$ and $MgSO_4$ were used at the percentage of 50, 15, 10, 10, 10 and 5, respectively. Separately, a total of 7.56 and 11.34 g salts were added to each pot at 45 days after sowing (DAS). Amount of salt calculation for salinity development was done according to Michael (1978) and Ponnamperuma (1984). Sixty % FC was maintained of the soils in pots after application of salts. Then soil samples from different salinity treatments were analyzed. Average soil salinity was found 0.22 (Control), 4 and 6 dSm^{-1} approximately. The experiment was laid out in randomized complete block design with three replications. Data on biochemical parameters were recorded from harvested leaf samples of the lentil genotypes at 55 DAS. Total chlorophyll, nitrate reductase activity, total sugar and reducing sugar content in leaves were estimated following the methods of Arnon (1949), Stewart and Orebamjo (1979), Dubois *et al*. (1956), Somogyi (1952) and Nelson (1944), respectively. Plants of one group were harvested at 60 DAS for morpho-physiological attributes and the other group was harvested at maturity for yield and yield attributes. Data were analyzed with statistical program MSTAT-C. Duncan's Multiple Range Test (DMRT) was used to compare the means.

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RESULTS AND DISCUSSION

The results showed that plant height decreased with the increase in salinity level (Table 1). The results are in agreement with that of Islam *et al.* (2006) who reported decreased plant height in lentil under salinity. Decreased plant height could be due to inhibition of cell division or cell enlargement by salinity stress. The maximum plant height was recorded at 60 DAS in N_1M-149 and the minimum in Barimasur-4. At maturity, the tallest plant was found in N_1M-134 with same rank with N_1M-149, N_1M-214, N_5M-573, N_4M-606, Binamasur-3 and L-5.

Table 1. Effect of salinity on some morphological attributes of lentil genotypes

Treatment (dSm^{-1})		Plant height (cm)		Number of branch $plant^{-1}$		Number of leaves $plant^{-1}$ at 60 DAS	Leaf area $plant^{-1}$ at 60 DAS (cm^2)
		At 60 DAS	At maturity	At 60 DAS	At maturity		
Control		26.36a	26.30a	5.56a	4.93a	65.94a	189.76a
4		23.03b	22.93b	4.20b	4.03b	41.30b	102.80b
6		19.86c	18.63c	2.86c	3.06c	22.60c	47.26c
Genotypes							
N_1M-134		24.11bc	24.33a	4.00bc	3.66c	49.81abc	115.66bc
N_1M-149		27.55a	23.88ab	5.00a	4.66ab	57.22a	73.00c
N_1M-214		25.00b	24.11a	4.66ab	4.66ab	55.66ab	79.55c
N_5M-507		21.88c	21.88bc	3.88cd	3.66c	44.44bcd	73.22c
N_5M-573		21.77c	22.88abc	4.66ab	5.11a	40.00cd	60.88c
N_4M-606		21.66c	22.55abc	3.66cd	3.66c	25.55e	40.88c
E_4M-934		22.77bc	21.11c	3.66cd	3.44c	33.55de	65.77c
Binamasur-3		23.11bc	23.88ab	4.22bc	4.11bc	41.77cd	68.11c
Barimasur-4		19.44d	18.77d	3.22d	3.66c	36.11de	386.00a
L-5		23.55bc	22.77abc	5.11a	3.44c	48.66abc	169.66b
Interaction							
	Control	27.66ab	30.00a	5.33b-e	4.66a-e	76.44a	198.66cd
N_1M-134	4	24.00b-g	24.00b-g	3.66f-j	3.66c-f	47.00b-f	100.00de
	6	20.66e-h	19.00i-l	3.00h-k	2.66f	26.00f-k	48.33e
	Control	29.33a	26.00bc	6.33ab	6.33a	78.66a	102.66de
N_1M-149	4	27.66ab	24.66b-f	5.33b-e	4.00b-f	60.00a-e	79.00de
	6	25.66a-d	21.00f-k	3.33g-k	3.66 c-f	33.00f-j	37.33e
	Control	28.33ab	27.66ab	6.33ab	5.66ab	76. 33a	116.33de
N_1M-214	4	24.33b-f	25.00b-e	4.66c-g	5.33abc	67.33abc	85.00de
	6	22.33d-h	19.66h-l	3.00h-k	3.00ef	23.33g-k	37.33e
	Control	24.00b-g	25.66bcd	5.33b-e	5.33abc	66.00a-d	127.00de
N_5M-507	4	22.00d-h	22.00d-i	3.66f-j	3.33def	45.00c-g	69.00de
	6	19.66gh	18.00j-m	2.66ijk	2.33f	22.33g-k	23.66e
	Control	25.66a-d	27.33ab	7.00a	6. 33a	72.33a	126.00de
N_5M-573	4	20.66e-h	24.00b-g	4.33d-h	5.00a-d	27.00f-k	32.00e
	6	19.00h	17.33klm	2.66ijk	4.00b-f	20.66h-k	24.66e
	Control	24.00b-g	25.00b-e	5.00b-f	4.00b-f	40.00e-k	58.00de
N_4M-606	4	22.33d-h	23.00c-h	4.00e-i	4.00b-f	25.66f-k	43.66e
	6	18.66h	19.66h-l	2.00k	3.00ef	11.00jk	21.00e
	Control	25.00a-e	25.33b-e	4.66c-g	4.00b-f	59.66a-e	104.33de
E_4M-934	4	23.00c-h	21.66e-j	3.66f-j	3.66c-f	24.66f-k	57.00de
	6	20.33fgh	16.33lm	2.66ijk	2.66f	16.33ijk	36.00e
	Control	27.33abc	27.66ab	6.00abc	5.00a-d	56.00a-e	116.66de
Binamasur-3	4	22.66d-h	23.33c-h	4.00e-i	4.00b-f	39.33e-i	57.66de
	6	19.33h	20.66g-k	2.66ijk	3.33def	30.00f-k	30.00e
	Control	26.33a-d	22.33c-i	4.00e-i	4.00b-f	65.33a-d	679.00a
Barimasur-4	4	19.66gh	19.00i-l	3.33g-k	4.00b-f	33.33f-j	343.00b
	6	12.33i	15.00m	2.33jk	3.00ef	9.66k	136.00de
	Control	26.00a-d	26.00bc	5.66a-d	4.00b-f	68.66ab	269.00bc
L-5	4	24.00b-g	22.66c-i	5.33b-e	3.33def	43.66d-h	161.66cde
	6	20.66e-h	19.66h-l	4.33d-h	3.00ef	33.66f-j	78.33de

In a column figures followed by different letter(s) are statistically significant at 5% level as per DMRT

The shortest plant was observed in Barimasur-4. The differences in plant height of the genotypes might be due to different genetic make up of the genotypes. At 60 DAS, the tallest plant was found in N_1M-149 in control and the shortest in Barimasur-4 at 6 dSm^{-1} salinity level. At maturity, the maximum plant height was recorded in

N_1M-134 in control with same rank with N_1M-214, N_5M-573 and Binamasur-3 in control. The minimum plant height was observed in Barimasur-4 at 6 dSm^{-1}.

Number of branch $plant^{-1}$ at 60 DAS decreased with increasing salinity compared to that in control (Table 1). Similar trend was observed. The results are in conformity with those of Islam *et al*. (2006) who found decreased number of ranches in lentil under salinity. At 60 DAS, the highest number of branch $plant^{-1}$ was recorded in L-5 with same rank with N_1M-149, N_1M-214 and N_5M-573, respectively. The lowest number of branches $plant^{-1}$ was noticed in Barimasur-4. At maturity, the highest number of branch $plant^{-1}$ was recorded in N_5M-573 with same rank with N_1M-149 and N_1M-214. Other genotypes had lower number of branches. At 60 DAS, the highest number of branch $plant^{-1}$ was found in control in N_5M-573 and the lowest in N_4M-606 at 6 dSm^{-1}. At maturity, the highest number of branch $plant^{-1}$ was recorded in N_1M-149 and N_5M-573 in control and the lowest in N_5M-507 at 6 dSm^{-1}. Number of leaves $plant^{-1}$ decreased with the increase in salinity level (Table 1). At 60 DAS, the highest number of leaves $plant^{-1}$ was recorded in N_1M-149 with same rank with N_1M-134, N_1M-214 and L-5 and the lowest in N_4M-606. This might be due to different genetic make up of the genotypes. At 60 DAS, the highest number of leaves $plant^{-1}$ was noticed in N_1M-149 in control and the lowest in Barimasur-4 at 6 dSm^{-1}. Leaf area $plant^{-1}$ decreased with the increase in salinity level (Table 1). The results are in agreement with that of Chakrabarti and Mukherji (2002) who reported decreased leaf area in mungbean under salinity. At 60 DAS, Barimasur-4 produced the highest leaf area and the lowest in N_4M-606 with same rank with N_1M-149, N_1M-214, N_5M-507, N_5M-573, E_4M-934 and Binamasur-3. The highest leaf area was recorded in Barimasur-4 in control and the lowest in N_4M-606 in 6 dSm^{-1} salinity level.

Root dry weight progressively decreased with increasing salinity level (Table 2). Root dry weight was the maximum in N_5M-507 with same rank with N_1M-134 and L-5 and the minimum in N_4M-606. The highest root dry weight $plant^{-1}$ was observed in N_5M-507 in control and the lowest in E_4M-934 at 6 dSm^{-1}. Table 2 showed that the stem dry weight progressively decreased with increasing salinity level. At 60 DAS, stem dry weight was the maximum in N_1M-149 and the minimum in Barimasur-4 with same rank with N_4M-606. The highest stem dry weight $plant^{-1}$ was obtained from N_1M-149 in control with same rank with N_1M-134 and N_5M-573 in control. The lowest stem dry weight $plant^{-1}$ was recorded in Barimasur-4 at 6 dSm^{-1} with same rank with N_4M-606 and Binamasur-3 at 6 dSm^{-1}. Leaf dry weight $plant^{-1}$ progressively decreased with increasing salinity level (Table 2). At 60 DAS, N_1M-134, N_1M-149 and N_1M-214 had higher leaf dry weights than those of N_4M-606 and Barimasur-4. Leaf dry weights of other genotypes were similar to these genotypes. The highest leaf dry weight $plant^{-1}$ was recorded in N_1M-134 in control and the lowest in Barimasur-4 at 6 dSm^{-1} with same rank with N_5M-507 at 6 dSm^{-1}. Pod dry weight gradually decreased with the increasing salinity level (Table 2). Pod dry weights of N_1M-149 and N_1M-214 were higher than that of N5M-573 and Barimasur-4. Pod dry weights of other genotypes were similar to those of other genotypes. The maximum pod dry weight $plant^{-1}$ was obtained from N_1M-149 in control with same rank with N_1M-214, E_4M-934, Binamasur-3 and L-5 and the minimum in N_5M-573 at 6 dSm^{-1} with same rank with Barimasur-4.

Salinity decreased dry matter production at 60 DAT but not at maturity (Table 2). At 60 DAS, the highest TDM $plant^{-1}$ was produced by N_1M-149 with same rank with N_1M-214 and L-5 and the lowest in Barimasur-4 with same rank with N_4M-606. At maturity, the highest TDM $plant^{-1}$ was in N_5M-507 with same rank with N_4M-606 and the lowest in N_1M-149 with same rank with L-5. At 60 DAS, the maximum TDM $plant^{-1}$ was found in N_1M-149 in control with same rank with N_1M-214 and L-5 and the minimum in Barimasur-4 at 6 dSm^{-1} salinity levels. At maturity, the highest TDM $plant^{-1}$ was recorded in N_5M-507 in all treatments and the lowest in E_4M-934 at 6 dSm^{-1}. The findings of Patil *et al.* (1996) were partially in consonance with the present findings. They reported that dry matter production reduced with increasing salinity.

Table 2. Effect of salinity on dry matter production and distribution of lentil genotypes

Treatment (dSm^{-1})		Amount of dry matter $plant^{-1}$ at 60 DAS				Total dry matter (g)	
		Root (g)	Stem (g)	Leaf (g)	Pod (g)	At 60 DAS	At maturity
Control		0.121a	0.57a	0.56a	0.59a	1.73a	1.98a
4		0.069b	0.33b	0.35b	0.25b	1.01b	1.98a
6		0.03c	0.19c	0.16c	0.08c	0.48c	1.92a
Genotypes							
N_1M-134		0.09ab	0.46ab	0.44a	0.23ab	0.90cd	1.94c
N_1M-149		0.08b	0.60a	0.47a	0.46a	1.62a	1.70d
N_1M-214		0.07bc	0.43bc	0.45a	0.45a	1.41ab	2.18b
N_5M-507		0.11a	0.30bcd	0.31ab	0.25ab	0.98bcd	2.60a
N_5M-573		0.06bc	0.37bcd	0.36ab	0.18b	0.98bcd	1.86cd
N_4M-606		0.04c	0.23d	0.25b	0.31ab	0.84d	2.43a
E_4M-934		0.07bc	0.34bcd	0.30ab	0.36ab	1.09bcd	1.53e
Binamasur-3		0.06bc	0.26cd	0.29ab	0.31ab	0.93cd	1.81cd
Barimasur-4		0.07bc	0.21d	0.21b	0.18b	0.67d	1.80cd
L-5		0.08ab	0.43bc	0.46a	0.33ab	1.31abc	1.75d
Interaction							
N_1M-134	Control	0.18ab	0.71ab	0.77a	0.45b-e	1.11d-k	2.04cde
	4	0.07d-h	0.42b-i	0.39b-h	0.22b-f	1.10d-k	1.97cde
	6	0.03gh	0.25e-i	0.18d-h	0.04ef	0.50ijkl	1.83efg
N_1M-149	Control	0.11cde	0.94a	0.67ab	0.92a	2.66a	1.78efg
	4	0.08c-h	0.53b-f	0.51a-d	0.36b-f	1.50b-g	1.72e-h
	6	0.04fgh	0.33c-i	0.24c-h	0.09c-f	0.71g-l	1.60fgh
N_1M-214	Control	0.09c-g	0.57bcd	0.66ab	0.89a	2.23ab	2.21bc
	4	0.07c-g	0.49b-g	0.48a-f	0.30b-f	1.36c-h	2.18bcd
	6	0.04gh	0.23f-i	0.21c-h	0.16c-f	0.64h-l	2.16bcd
N_5M-507	Control	0.19a	0.46b-h	0.55abc	0.38b-f	1.59b-f	2.45ab
	4	0.10c-f	0.27d-i	0.30c-h	0.29b-f	0.96e-l	2.71a
	6	0.04fgh	0.16hi	0.10h	0.09c-f	0.39kl	2.64a
N_5M-573	Control	0.11cde	0.72ab	0.56abc	0.46bcd	1.86bcd	1.92c-f
	4	0.05fgh	0.22f-i	0.38b-h	0.06def	0.71g-l	1.87d-g
	6	0.03gh	0.18ghi	0.15fgh	0.01f	0.38kl	1.80efg
N_4M-606	Control	0.06e-h	0.31c-i	0.36b-h	0.50bc	1.20d-k	2.45ab
	4	0.03gh	0.27d-i	0.27c-h	0.33b-f	0.91f-l	2.43ab
	6	0.03gh	0.12i	0.13gh	0.12c-f	0.41jkl	2.42ab
E_4M-934	Control	0.13bc	0.55b-e	0.48a-g	0.59ab	1.75b-e	1.60fgh
	4	0.05e-h	0.28d-i	0.26c-h	0.37b-f	1.02e-l	1.54gh
	6	0.02h	0.18ghi	0.16e-h	0.12c-f	0.49ijkl	1.44h
Binamasur-3	Control	0.07d-h	0.45b-h	0.50a-e	0.59ab	1.62b-f	1.82efg
	4	0.06e-h	0.23f-i	0.24c-h	0.26b-f	0.81f-l	1.81efg
	6	0.04fgh	0.11i	0.13gh	0.08c-f	0.37kl	1.80efg
Barimasur-4	Control	0.10c-f	0.33c-i	0.37b-h	0.45b-e	1.26c-i	1.82efg
	4	0.07e-h	0.19ghi	0.18d-h	0.07def	0.52ijkl	1.80efg
	6	0.03gh	0.10i	0.07h	0.03f	0.23l	1.78efg
L-5	Control	0.13bcd	0.61bc	0.65ab	0.63ab	2.03abc	1.77efg
	4	0.06e-h	0.40b-i	0.50a-e	0.25b-f	1.22d-j	1.75e-h
	6	0.05e-h	0.28d-i	0.23c-h	0.10c-f	0.68g-l	1.73e-h

In a column figures followed by different letter(s) are statistically significant at 5% level as per DMRT

Both the salinity levels decreased total chlorophyll content in leaves similarly (Table 3). Among the genotypes, total chlorophyll content was not significant. The highest total chlorophyll content was estimated in Barimasur-4 in control and the lowest in the same variety. This observation is in agreement with the findings of Gopi *et al.* (1999) who reported decreased chlorophyll content in the leaves of cowpea. Nitrate reductase (NR) activity in leaves decreased with increasing salinity level (Table 3). The genotype N_4M-606 had higher NR activity than N_5M-573 and other genotypes had similar NR activity compared to these two genotypes. The maximum NR activity was found in N_4M-606 in control with same rank with E_4M-934, Binamasur-3 and Barimasur-4 in control and the minimum in N_1M-149 at 6 dSm^{-1}. Salinity increased total sugar content in leaves (Table 3). The highest total sugar content was found in N_1M-149 and the lowest in E_4M-934. The maximum total sugar content was obtained from N_1M-149 at 6 dSm^{-1} salinity level with same rank with N_1M-134 and the lowest in E_4M-934 in control. Salinity level gradually increased reducing sugar content in leaves (Table 3). The highest reducing sugar content was found in N_5M-573 with same rank with N_1M-149, N_5M-507, E_4M-934, Binamasur-3, Barimasur-4 and L-5. The lowest reducing sugar content was estimated in N_4M-606 with same rank with N_1M-134. The maximum reducing sugar content was obtained from N_5M-507 and N_5M-573 at 6 dSm^{-1} and the minimum in N_4M-606 in control with same rank with N_1M-134 and N_1M-606 at 4 dSm^{-1}.

Table 3. Effect of salinity on biochemical attributes of lentil genotypes

Treatment (dSm^{-1})		Total chlorophyll (mg gfw^{-1})	Nitrate reductase activity (μ moles NO_2 gfw^{-1} $hour^{-1}$)	Total sugar (mg gfw^{-1})	Reducing sugar (mg gfw^{-1})
Control		2.26a	3.53a	49.81c	14.91c
4		2.05b	3.19b	51.20b	15.86b
6		1.96b	2.71c	52.56a	16.82a
Genotypes					
N_1M-134		2.03 a	3.00ab	53.57b	14.49c
N_1M-149		2.00a	2.96ab	54.14a	16.27ab
N_1M-214		2.04a	3.03ab	50.39f	15.53b
N_5M-507		2.04a	3.08ab	51.02e	16.57a
N_5M-573		2.16a	2.89b	51.14e	16.78a
N_4M-606		2.17a	3.38a	52.02d	13.66c
E_4M-934		2.11a	3.18ab	47.01h	16.59a
Binamasur-3		2.13a	3.34ab	51.06e	16.47ab
Barimasur-4		2.06a	3.34ab	48.98g	15.96ab
L-5		2.16a	3.23ab	52.55c	16.33ab
Interaction					
	Control	2.11a-e	3.33a-f	52.00f	13.54ij
N_1M-134	4	2.10a-e	3.09a-h	53.69d	14.55f-i
	6	1.89cde	2.58e-h	55.02ab	15.39c-h
	Control	2.26a-d	3.55a-d	52.96e	15.61c-h
N_1M-149	4	1.96a-e	3.00a-h	54.23c	16.32b-f
	6	1.79de	2.34h	55.22a	16.88bcd
	Control	2.09a-e	3.36a-f	47.67jk	14.22ghi
N_1M-214	4	1.95b-e	3.03a-h	51.00g	15.81c-h
	6	2.07a-e	2.72b-h	52.50ef	16.57b-e
	Control	2.18a-e	3.52a-d	50.01h	15.02d-i
N_5M-507	4	2.08a-e	3.20a-g	51.02g	15.79c-h
	6	1.86de	2.53fgh	52.04f	18.90a
	Control	2.39abc	3.34a-f	50.04h	15.78c-h
N_5M-573	4	2.07a-e	2.92b-h	51.00g	16.73bcd
	6	2.02a-e	2.43gh	52.38f	17.85ab
	Control	2.20a-d	3.79a	51.02g	12.41j
N_4M-606	4	2.12a-e	3.47a-d	52.01f	14.04h-j
	6	2.19a-e	2.90b-h	53.02e	14.55f-i
	Control	2.46ab	3.68ab	46.01m	16.03b-g
E_4M-934	4	1.89cde	3.27a-f	47.01l	16.58b-e
	6	1.99a-e	2.60e-h	48.01j	17.16bc
	Control	2.18a-e	3.66ab	50.04h	16.21b-f
Binamasur-3	4	2.12a-e	3.30a-f	51.01g	16.46b-f
	6	2.10a-e	3.05a-h	52.13f	16.74bcd
	Control	2.47a	3.57abc	47.31kl	14.66e-i
Barimasur-4	4	2.04a-e	3.30a-f	49.01i	16.25b-f
	6	1.68e	3.16a-h	50.63g	16.96bcd
	Control	2.28a-d	3.52a-d	51.02g	15.67c-h
L-5	4	2.19a-e	3.37a-e	52.01f	16.08b-g
	6	2.02a-e	2.81c-h	54.64bc	17.24abc

In a column figures followed by different letter(s) are statistically significant at 5% level as per DMRT

Number of pods $plant^{-1}$ decreased with the increase in salinity level (Table 4). The results are in conformity with those of Patil *et al.* (1996) who reported that increasing salinity decreased number of filled pods $plant^{-1}$. Small number of pods under salinity might be due to less translocation of assimilates towards reproductive organ. The genotype N_1M-149 produced the maximum number of pods $plant^{-1}$ with same rank with N_5M-507. The genotype N_4M-606 and E_4M-934 showed the minimum number of pods $plant^{-1}$. The maximum number of pods $plant^{-1}$ was obtained from N_1M-149 in control and the minimum from N_1M-134 at 6 dSm^{-1} salinity level.

Table 4. Effect of salinity on yield and yield attributes of lentil genotypes

Treatment (dSm^{-1})		Number of pods $plant^{-1}$	Number of seeds $plant^{-1}$	1000-seed weight (g)	Seed yield per plant (g)	Harvest index (%)
Control		29.76a	42.53a	16.84a	0.71a	35.83a
4		24.96b	38.33b	16.58ab	0.64b	32.98b
6		22.30c	34.56c	16.23b	0.57c	30.08c
Genotypes						
N_1M-134		21.44e	31.44d	14.40fg	0.46d	23.51d
N_1M-149		32.22a	43.66a	14.05g	0.62bc	36.34b
N_1M-214		25.88bc	38.44b	19.88a	0.77a	35.28b
N_5M-507		32.00a	44.77a	17.70bc	0.80a	29.45c
N_5M-573		27.55b	39.66b	16.16de	0.64bc	34.81b
N_4M-606		23.88d	38.22b	16.72cd	0.64bc	26.54c
E_4M-934		23.88d	42.88a	15.23ef	0.64bc	42.03a
Binamasur-3		24.66cd	34.55c	17.63bc	0.62bc	34.40b
Barimasur-4		21.22e	33.55cd	17.87b	0.60bc	33.71b
L-5		24.00cd	37.55b	15.84de	0.58c	33.55b
Interaction						
	Control	28.00de	41.00d-h	14.76d-g	0.61fg	13.06e-j
N_1M-134	4	21.33j-m	31.00lm	14.26fg	0.45h	22.93k
	6	15.00n	22.33n	14.16fg	0.32i	17.53l
	Control	45.33a	53.66a	14.23fg	0.77abc	43.43a
N_1M-149	4	29.33cd	44.00c-f	14.20fg	0.63efg	36.70bcd
	6	22.00h-m	33.33klm	13.73g	0.46h	28.90g-j
	Control	26.66d-g	39.66e-j	20.00a	0.79abc	35.90cde
N_1M-214	4	25.66e-h	38.00g-k	19.90a	0.77bc	35.26c-f
	6	25.33e-i	37.66g-k	19.76a	0.75bcd	34.70d-g
	Control	34.66b	48.33bc	17.86b	0.87a	31.20d-j
N_5M-507	4	31.66bc	44.33cde	17.80b	0.80ab	29.43f-j
	6	29.66cd	41.66d-h	17.43bc	0.73b-e	27.73h-k
	Control	35.00b	50.66ab	16.76bcd	0.83ab	43.83a
N_5M-573	4	27.33def	39.00f-j	16.33b-e	0.64efg	35.06d-g
	6	20.33lm	29.33m	15.40c-g	0.45h	25.53jk
	Control	24.33e-k	39.00f-j	16.86bcd	0.66d-g	26.96ijk
N_4M-606	4	24.00f-l	38.33g-k	16.70bcd	0.65efg	26.66ijk
	6	23.33g-l	37.33h-k	16.60b-e	0.63efg	26.00jk
	Control	32.00bc	45.00cd	16.10b-f	0.69c-f	43.40k
E_4M-934	4	20.33lm	43.00d-g	15.06d-g	0.63efg	41.80ab
	6	19.33m	40.66d-i	14.53e-g	0.59fg	40.90abc
	Control	25.33e-i	35.33i-l	17.70b	0.63efg	34.86d-g
Binamasur-3	4	24.66e-j	35.00j-l	17.66b	0.62fg	34.50d-g
	6	24.00f-l	33.33klm	17.53b	0.61fg	33.83d-h
	Control	21.66i-m	34.33j-m	17.90b	0.62fg	34.20d-g
Barimasur-4	4	21.33j-m	33.33klm	17.86b	0.60fg	33.66d-h
	6	20.66k-m	33.00klm	17.86b	0.59fg	33.26d-h
	Control	24.66e-j	38.33g-k	16.36b-e	0.61fg	34.46d-g
L-5	4	24.00f-l	37.33h-k	16.03b-f	0.59fg	33.80d-h
	6	23.33g-l	37.00h-k	15.13d-g	0.56g	32.40d-i

In a column figures followed by different letter(s) are statistically significant at 5% level as per DMRT

Number of seeds $plant^{-1}$ decreased with the increase in salinity level (Table 4). The genotype E_4M-934 produced the maximum number of seeds $plant^{-1}$ with same rank with N_1M-149 and N_5M-507 and N_1M-134 produced the minimum. The maximum number of seeds $plant^{-1}$ was obtained from N_1M-149 in control with same rank with N_5M-573 in control and the minimum in N_1M-134 at 6 dSm^{-1} salinity level. Thousand seed weight represents grain size. It decreased only with 6 dSm^{-1} salinity level (Table 4). The genotype N_1M-214 produced the maximum 1000-seed weight and N_1M-149 showed the minimum. From the findings, it may be concluded that there were varietal differences in size of the seeds. The highest 1000-seed weight was found in N_1M-214 in control with same rank with that of 4 and 6 dSm^{-1}. Thousand seed weight was the lowest in N_1M-149 at 6 dSm^{-1}.

Seed yield decreased with increasing salinity level (Table 4). The results are in conformity with those of Islam *et al.* (2006) who found decreased seed yield in lentil under salinity. Decreased seed yield under salinity might be due to less translocation of assimilates towards reproductive organ. The maximum seed yield $plant^{-1}$ was noticed in N_5M-507 with same rank with N_1M-214 and the minimum in N_1M-134. From the results, it is evident that the different varieties had different degrees of salinity tolerance for seed yield plant^{-1}. The highest seed yield plant^{-1} was found in N_5M-507 in control with same rank with N_1M-149, N_1M-214, N_5M-573 and the lowest seed yield plant^{-1} was obtained from N_1M-134 at 6 dSm^{-1}. From Table 4 it was observed that harvest index decreased with the increase in salinity level. Higher harvest index indicates higher translocation ability to reproductive organ (grain). The highest harvest index was obtained from E_4M-934 and the lowest from N_1M-134. The highest harvest index was observed in N_5M-573 in control with same rank with N_1M-149. The lowest harvest index was in N_1M-134 at 6 dSm^{-1}. The results are in conformity with those Patil *et al.* (1996) who reported decreased harvest index under salinity.

CONCLUSION

Plant height, number of branch, number of leaves, leaf area, root, stem, leaf, pod and total dry matter plant^{-1}, total chlorophyll and nitrate activity in leaves, number of pods, number of seeds, 1000-seed weight, seed yield plant^{-1} and harvest index decreased and total sugar and reducing sugar content in leaves increased with the increase in salinity level. N_5M-507 showed relative tolerance to salinity producing the highest root dry weight, total dry matter, number of seeds and seed yield plant^{-1} under salinity. N_5M-214 also showed statistically similar seed yield to that of N_5M-507 under salinity. As it was a one year experiment in pot culture, so several field trials should be done in saline areas for final recommendation.

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