International Scholars Journals

International Journal of Animal Breeding and Genetics Vol. 4 (8), pp. 001-006, August, 2015. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Effects of different levels of salinity on germination of four components of lentil cultivars

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Accepted 21 January, 2015

Combat of salinity and the major issues it has brought with human struggle have been on for several thousands of years. In this way, the stress caused by it resulted to a reduction of the agricultural production capability of the outlined land. To evaluate the effects of different levels of salinity on the germination of four lentil cultivars (Kabralyaaynta, Philip 97-1L, ILL6199 and Gachsaran), a factorial experiment was conducted in a completely randomized design with 3 replications in the laboratory seed physiology of the State University of Bojnourd (Iran) Branch. Five levels of salinity treatments (0, 3, 6, 9 and 12 ds/m) were derived with the use of sodium chloride salt. The seeds planted in plastic containers with dimensions 5 × 8 × 11 cm were performed and these results showed that the speed and percent germination of all cultivars increased in salinity. Other parameters measured included length of root and stem and the decrease of salt concentration in the solution, if the dry weight of cotyledons in low salinity levels (from zero to 6 ds/m) decreased and increased in level. Among the cultivars studied, Gachsaran figure, when compared with other cultivars in terms of most parameters, was affected by salinity.

Key words: Salinity, percentage of germination, length of root and stem, lentil.

INTRODUCTION

The fight against salinity and the issues it has brought with human struggle have been on for several thousands of years. When estimated based on 7% of the world land and 3% saline, it is seen that the soil is very salty. According to studies carried out in saline soil, a general level of about 25,000,000 ha is estimated (Data and Dayal, 1991). Salinity of soil and irrigation water are the main factors limiting plant growth in most countries, especially in dry and semi-arid regions (Donovan and Day, 1989). Salinity on different aspects affecting the growth and reduction of soils, delayed germination, reduced growth and reduced production of aerial organs. Since development started sprouting, the most sensitive stage of plant life plays a very important role in the growth process (Edward and Bisson, 1996), where different plants in the environments show the ability to grow successfully. Use of resistant cultivars in salinity, is considered as one of the world's most effective methods of operation used to increase performance in salty land and low salt dry and semi-arid areas (Data and Dayal, 1991). The main features of saline environments, which are low osmotic potential and high concentration of salts, are potentially toxic to plants. Salts in soil water have the potential of decreasing root growth environment and water absorption by roots and restrict plant to a kind of physiological stress. On the other hand, high concentrations of salts in soil and subsequent absorption of sodium and chloride ions, such as the plant will create toxicity (Edward and Bisson, 1996; Ehret et al., 1990). Legumes, including common crops in dry and semi-arid regions, which are more significant in problem soils and land cultivation, are marginalized. Grain legumes with about 32 to 18% protein play an important role in providing the required human protein. Among the lentil beans (Lens Culinaris), many legumes, due to soil salinity and water-sensitive soils, and even with little salt, are of low yield. The studied germination of lentil with Babak local city showed increasing NaCl concentration on germination and stopped the decrease of germination rate. Studies also showed that seed germination percentage and speed decreased with increase in salinity

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Table 1. Variance analysis based on the measured values of (F) in lentil cultivars.

Change resources	Degrees of freedom	Percentage germination	Speed germination	Length stem	Length root	Cotyledon dry weight
Cultivars	3	4/56**	6/62**	2/43ns	9/12**	1/24^{ns}
Salinity	4	42/01**	63/11**	66/03**	98/48**	2/69*
Cultivars*salinity	12	0/57^{ns}	0/56^{ns}	1/43^{ns}	1/71^{ns}	0/94^{ns}
Error	40	-	-	-	-	-
Coefficient of variation (Cv)		6/87	9/19	7/76	6/96	9/73

(Govahi and Shaji, 2006). Effect of different levels of NaCl during germination of wheat showed that an increase in the salinity of the control solution significantly decreased the percentage of germination and the root and stem length (Hatami and Galeshi, 1998). It was reported that clover plant seed germination followed more than a percent of the land affected by salinity. The research that was conducted on quite a number of different crops indicated that an increase in salinity and in the length of stem and root decreased the dry weight of the organs significantly when compared with the control (Akram et al., 2001). Some research has reported that the saline conditions of the root stem were significantly higher under salt stress (Ejazrasell and Roa, 1997).

However, controlling the salinity of agricultural and farm management are the keys, so researches about salinity resistant cultivars are important. Since the studies in the country, in response to salinity lentil cultivars are very low, the present experiment of new lentil cultivar reaction to different levels of salinity in the germination stage is very vital as more resistant cultivars are introduced.

MATERIALS AND METHODS

To determine the effects of different levels of salinity on the germination component, varieties of lentil seed were taken from the physiology research laboratory of the University of Bojnourd (Iran). A factorial experiment was conducted with a completely random design in three replicates. Four cultivars of lentil (Gachsaran, Kabralyaaynta, Philip 97-1L and ILL6199) and five salinity levels (0, 3, 6, 9 and 12 ds / m) in this study were considered. The salinity level, artificially dissolving a certain amount of sodium chloride salt, was prepared in sterile distilled water, while control levels or distilled water was used. Also, disinfected seeds with 10% sodium hypochlorite were prepared. For this work, each digit of the seeds was separated first, by 10% sodium hypochlorite and then 2000 fungicide each for 30 s was disinfected after each stage was rinsed with distilled water. The containers used for this experiment are plastic containers with the size of 5 × 8 × 11 cm. For anti-infectious containers, dishes were completely washed first with 10% sodium hypochlorite and then rinsed with distilled water. After radiation was received for 12 h UV, shingle floor for paper filters Vatmn glasses was used for 2 h in the oven and was sterilized at a temperature of 120°C. All equipment used by alcohol and UV rays were sterilized. In the next step, 30 seeds in number from each cultivar were placed inside the container, while 5 seeds per ml were added to the desired solution. Afterwards, the germinator temperature in the container was transferred to 25°C. The Petri dish was reviewed every day and the number of seedlings grown (seed and root length is at least 3 mm) (Data and Dayal, 1991) were counted. Counting of seeds continued until the tenth day of growth.

The percentage germination was calculated with the following formula (Data and Dayal, 1991):

$$PG = \frac{Ni}{N} \times 100$$

where PG is the percentage germination, Ni is the number of seed grown until i and N is the total number of seeds.

To calculate the speed of seed germination rate, the following formula was used (Data and Dayal, 1991):

$$\text{Speed of germination} = \frac{\text{Total seed germination until the day category}}{\text{Days from start testing}}$$

After the tenth day of experiment and calculation, speed and percentage germination, root length and stem samples were measured.

ANOVA table for all variables, measured using the software and mean Mstat-c formed through a least significant difference test (LSD) at 5% level, was compared. For drawing graphs, Excel software was used.

RESULTS AND DISCUSSION

Analysis of variance showed that the effect of salinity on germination, root and stem length and germination in lentil cultivars studied was significant at 1% level (Table 1).

Percentage germination

These results showed that in addition to the reduced growth rate (growth bud), the germination percentage decreased with an increase in the concentration of salt (Table 3). Lead reduced germination percentage among the cultivars studied (Table 2), so it was not a problem if the three digits (Philippe 97-1L, ILL 6199 and kabralyaaynta) in one group had statistically, a significant difference, which was not shown only with the digits in Gachsaran but with the previous figure shown. Between different levels of salinity (Table 3), the highest germination percentage and the control treatment was

Table 2. Comparing the mean percentage germination, speed germination, root length and stem and dry weight of cotyledons in different cultivars of lentil.

Cultivar	Percentage germination	Speed germination	Length stem (cm)	Length root (cm)	Cotyledon dry weight (gr)
Kabralyaaynta	$37/3^{b}$	$5/7^{b}$	$2/36^{b}$	$1/58^{c}$	$36/60^{a}$
Philip 97-1L	$43/1^{b}$	$7/1^{b}$	$2/35^{b}$	$2/48^{ab}$	$31/45^{a}$
ILL 6991	$42/4^{b}$	$6/7^{b}$	$2/77^{ab}$	$2/14^{b}$	$30/41^{a}$
Gachsaran	$58/6^{a}$	9/03a	$2/93^{a}$	$2/64^{a}$	$31/50^{a}$

In each column, mean with common letter are not statistically significant at 5% level test based on least significance (LSD).

Table 3. Comparing the mean percentage germination, speed germination, root length and stem and dry weight of cotyledons at different levels of salinity.

Different levels of salinity (d /m)	Percentage germination	Speed germination	Length stem (cm)	Length root (cm)	Cotyledon dry weight (g)
Control(zero)	$82/2^{a}$	$12/2^{a}$	$4/85^{a}$	$4/81^{a}$	$28/33^{a}$
3	$62/5^{b}$	$10/2^{b}$	$3/62^{b}$	$2/79^{b}$	$27/96^{b}$
6	$54/7^{b}$	$8/4^{c}$	$2/47^{c}$	$1/92^{c}$	$32/11^{ab}$
9	$23/3^{c}$	$3/6^{d}$	$1/55^{d}$	$1/14^{d}$	$38/58^{a}$
12	$4/1^{d}$	$0/82^{e}$	$0/52^{e}$	$0/38^{e}$	$35/64^{ab}$

In each column, mean with common letter are not statistically significant at 5% level test based on least significance (LSD).

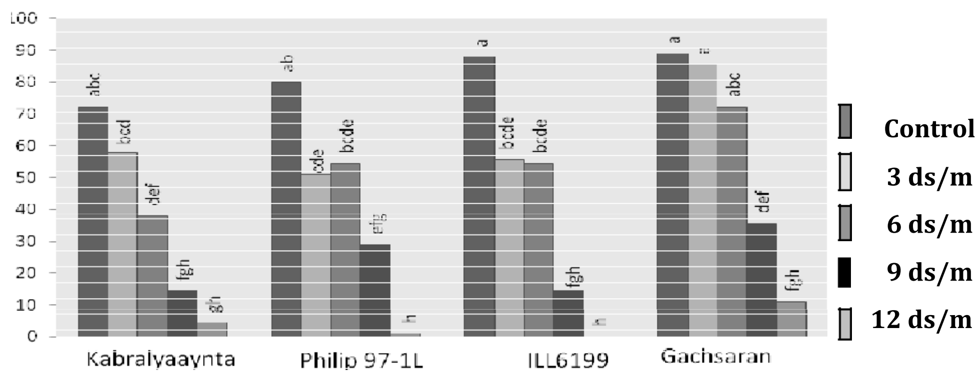

Figure 1. The interaction comparison of cultivar × salinity concentrations on percentage of germination.

82% and 12 dS/ m treatment, while the lowest rate was 4%. This was also seen with the increasing salinity from the control (zero) to 15 dS/ m treatment. However, Jojoba seed germination reduced from 82/6 to 42% (Kayani et al., 1990). Reduction in germination due to increased salt concentration and the results of other researchers are also expressed. Although germination figures depend on their genetic characteristics, it can still be medially placed. Obviously, the mechanism of action with an increase in salinity seed disorder is likely a result of the concentration of salt ions and also, the sprouting of the solution. In the same year, it was reported that among the different anions, ion had the most effect in reducing germination (Donovan et al., 1989). In the study of the interaction between cultivar × salinity on percentage germination traits (Figure 1), it was observed that concentration 6 dS/ m figure Gachsaran with 88/9% germination was higher than other cultivars, while the salinity of ILL6199 figure 12 dS/ m has the lowest germination percentage among the cultivars (Figure 1).

Root length

Comparison of traits in the cultivars studied showed that cultivar Gachsaran with root length of 2/64 cm was the

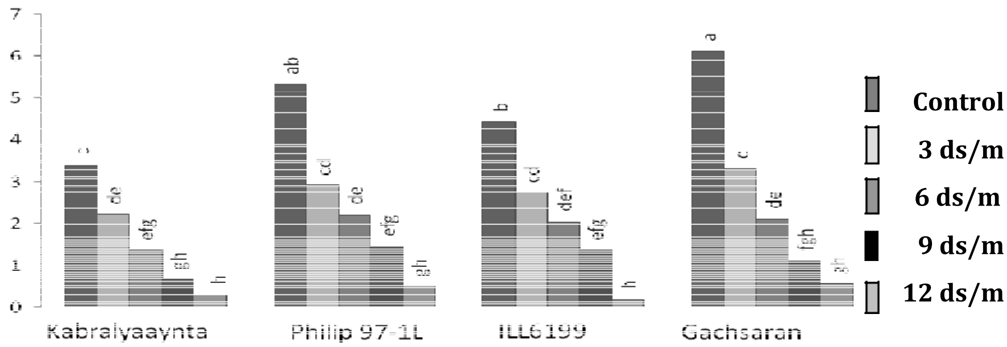

Figure 2. The interaction comparison of cultivar × salinity concentrations on root length.

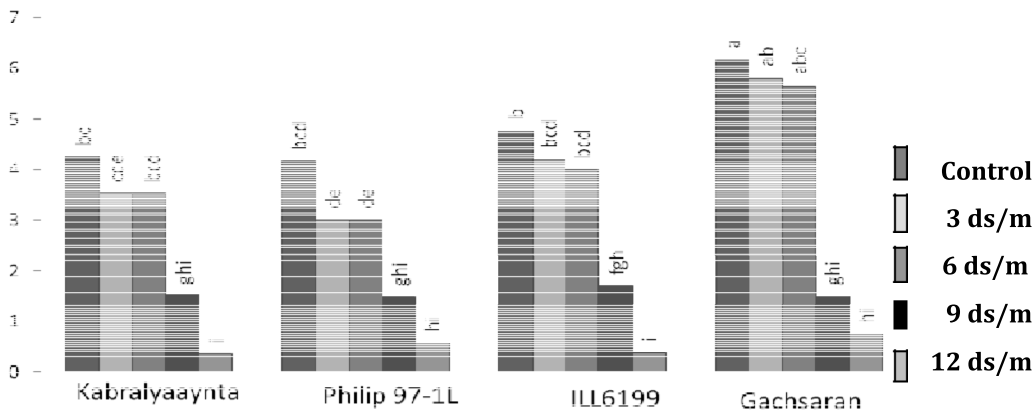

Figure 3. The interaction comparison of cultivar × salinity concentrations on stem length.

most committed and their differences with other cultivars were quite significant in that cultivar Kabralyaaynta had a root length of 1/58 cm which was the lowest (Table 2). The comparison data in the salinity treatments showed that root length with increasing salinity in all cultivars studied decreased and the difference (length root) with increasing salinity was quite significant than in the control treatment (Table 3). The results of the cultivar × salinity interaction on the traits mentioned showed that the control (zero) cultivar Gachsaran was the superior cultivar and other cultivars in ILL 6199 salinity 12 dS/ m were the weaker cultivars (Figure 2). Reports showed that the increasing salt concentration of seedbed, such as calcium and magnesium ions absorbed by roots and stems of plants increased (Weimberg, 1987). The importance of these ions, especially calcium and membrane characteristics of cell growth, is that they can increase root growth in low levels of stress. In addition, salinity can probably establish osmotic balance effectively between the environments of seeds. With excess salt, decreased water potential or increasing the concentration of harmful salts growth medium decreased during root growth. In such circumstances, the major part of energy spent on root nutrient absorption is required in the energy assigned to the decreased root growth. In an experiment conducted to evaluate salt tolerance of tomato cultivars, higher tolerance to salinity itself indicated that the report fully applied the results of the tolerance (El-melegy et al., 2004).

Length of stem

The mean results of the figures showed that the traits of stem length in cultivar Gachsaran was the highest with a stem length of 2/93 cm, while cultivar Philippe 97-1L was the lowest with a stem length of 2/35 cm (Philippe 97-1L and Kabralyaaynta are in a statistical group) (Table 2). Comparison of the study results determined that low levels of salinity increased stem length; as such, the stem length of stress levels decreased (Table 3). The interaction of cultivar × salinity stem length was significant and the results of the comparison showed that the salinity in all cultivars with 6 dS/ m length of the stem was not affected by stress, while the treatments were statistically affected in a group. The highest salinity levels were observed in cultivar Gachsaran with 4/78% cm, while the lowest was observed in Kabralyaaynta with 0/36 cm (Figure 3). In addition, increased salinity, dissolved water absorption by seeds of disorder, secretion of

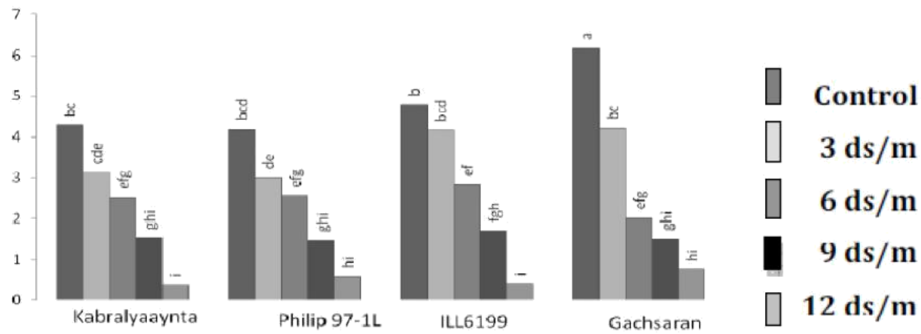

Figure 4. The interaction comparison of cultivar × salinity concentrations on cotyledon dry weight.

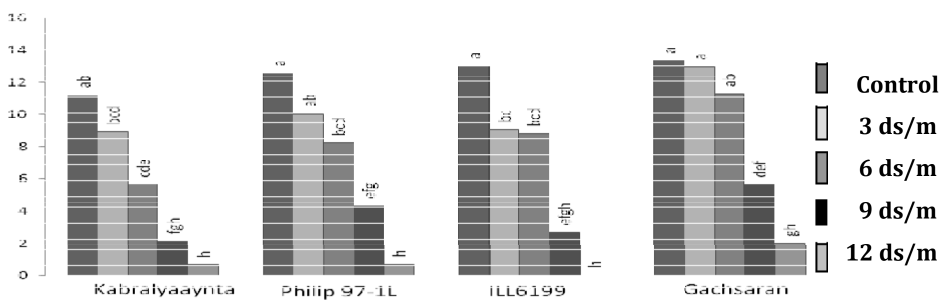

Figure 5. The interaction comparison of cultivar × salinity concentrations on speed germination**.**

hormones and enzyme activity, which results in less depletion all affected seedling growth.

Cotyledon dry weight

A comparison study showed that the characteristics of low salinity levels (control, 3 and 6 dS/ m) in the dry weight of cotyledons decreased, while more salts (9 and 12 dS/m) increased in the dry weight of the cotyledon (Table 3). The mean of the study showed that significant differences were not seen in the traits between cultivars of dry split peas (Table 2). The characteristics mean in lower levels of salinity decreased in the interaction of cultivar × salinity on dry weight of cotyledons significantly. It was observed that the dry weight of cotyledon was lowest in figure Gachsaran with salinity levels at zero and 3 dS /m, while it was highest in figure Kabralyaaynta with the salinity level at 12 dS/ m (Figure 4). The fact that low concentrations of the salt medium increased root growth, with regard to water absorption and seed germination, showed that the reserved food is required more than the harvested food within the cotyledon. It was observed in this experiment that low levels of salinity (3 and 6 dS/m) with root growth and stem dry weight of cotyledons decreased, and it was believed that after water absorption, the number of series of hormones and enzymes within the seeds of important lipase, protease and amylase was simultaneously secreted (Niu et al., 1995). The secretion of this enzyme caused a reservation of food in the analysis of starch and is soluble in water and energy. For a way out, the development of root and stem should be provided. It seems that the top seed in the mechanism of action is altered and this process will be disrupted. Consequently, it will reduce or stop the growth of food transfer to seedling cotyledon dry weight, and even increase due to absorption of the soluble material within the bed; as such, no consumption of the cotyledons' dry weight can be seen.

Speed germination

The effect of salinity on germination traits was highly significant. With the increase in salinity levels from the control (zero) to 12 dS/ m, the germination rate decreased by 90% (Table 3). Among cultivars, cultivar Gachsaran has the highest mean germination rate, while cultivar Kabralyaaynta and two other cultivars have the lowest rate of germination (Table 2). The interaction of cultivar × salinity on germination was significant. As the highest germination rate was achieved by Gachsaran control (zero) salinity and the lowest by cultivar Kabralyaaynta, Philip 97 - IL in salinity of 12 dS/m was obtained. Germination as salinity Gachsaran cultivar 6 does not reveal a significant reduction (Figure 5).

Reduction in germination of other plants such as salt concentration of grain has been reported. To perform critical activities and subsequent seed germination, the water absorbed by the seed should be enough (Donovan and Day, 1989). If the water absorption is impaired or slow to occur, the slow activities of the seeds carried out during the process of growth of the root increase the expression of germination decrease (Sharif et al., 1998). Therefore, the less germination observed in cultivars Kabralyaaynta, ILL6199 and Philipp 97-1L, can be as a result of the less amount of water absorbed in their thick skin because of their seeds.

Conclusion

Salinity speed and percent germination of all cultivars decreased, while stem and root length with increasing salinity and high salt concentration decreased the environment. However, cotyledon dry weight in the low salinity levels (Control to 6 dS/ m) decreased, while high levels of salinity increased. Among the cultivars studied, often in terms of cultivar Gachsaran parameters, other cultivars were affected by salinity, while cultivars Kabralyaaynta and Philipp 97-1L have the highest sensitivity to salt stress in areas faced with soil salinity problems.

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