

## Effect of salinity on the germination, growth and development of two varieties of onion (*Allium cepa* L.)

M. A. Rahim, R. Sultana<sup>1</sup> and N. Kabir

Department of Horticulture, Bangladesh Agricultural University, Mymensingh-2202, <sup>1</sup>Lal Teer Seed Company, Dhaka

**Abstract:** An experiment was conducted at the Post Graduate Laboratory of the Department of Horticulture, Bangladesh Agricultural University (BAU), Mymensingh 2202, Bangladesh during September to December 2014 to observe the effect of salinity in growth and development of onion. The experiment consisted of two varieties of onion viz. Taherpuri and Ishurdi and 11 levels of NaCl conducted by Randomized Complete Block Design with three replications. Taherpuri tolerate salinity upto 8ds/m whereas Ishurdi variety tolerate upto 10 ds/m. Percent germination, shoot length, root length, both root and shoot dry and fresh weight decreased as the level of salinity increased from 0 to 10ds/m. After 10ds/m no germination occurred in all varieties. The highest germination (84%) was noticed from Taherpuri variety under control (0ds/m). Shoot and root length; dry and fresh weight of shoots decreased as the concentration of salinity increased in all varieties.

**Key words:** Onion, *Allium cepa*, salinity, germination, variety.

### Introduction

Onion (*Allium cepa* L.) belongs to family Alliaceae and is one of the most important spice crops. In Bangladesh, onion is cultivated mainly as winter crop (Rahim and Siddique, 1990; Rahim, 1992). The main edible portion is the bulb, which is modified organ consisting of thickened fleshy scale leaves and the stem-plate (Jones and Mann, 1963). The leading onion producing countries are China, India, United States of America, Turkey, Russia, Pakistan, Japan, Brazil, Spain, Korea, Netherlands, Morocco, Egypt, Nigeria and Italy (FAO, 2013).

Onion is grown in all parts of Bangladesh. But commercial cultivation is found mostly in the greater districts of Faridpur, Barisal, Chandpur, Pabna, Rajshahi, Comilla, Dhaka, Tangail, Meherpur, Mymensingh, Manikgonj, Bogra, Rangpur, and Jessore (BBS, 2013). During the year 2011-2012, onion occupied an area of 1, 36,318 hectares of land in Bangladesh with a total production of 11, 51,000 metric tons (BBS, 2013). But this production of onion is not sufficient to meet up the demand of our huge population (Rahim and Siddique, 1991; Rahim, 1992). Due to limitation of land in Bangladesh, it is very hard to expand the cultivable land area under onion cultivation. The yield of onion in Bangladesh depends on various factors such as irrigation and soil management are vital factors in increasing the bulb and seed production of onion (Rahim *et al.*, 1982). Salinity is a major environmental constraint to crop productivity throughout the arid and Semi-arid regions of the world (Foolad and Lin, 1997). Bangladesh is a deltaic country with total area of 174,570 km<sup>2</sup>. The major part (80%) of the country consists of alluvial sediments deposited by the rivers Padma, Brahmaputra, Tista, Jamuna, Meghna and their tributaries. All these rivers are either directly or indirectly connected with the Bay of Bengal. In the recent years, the sea level of our country is gradually increasing and thus, salinity is being increased in the soil of southern part of our country. A one meter sea level rise will affect the vast coastal area and flood plain zone of Bangladesh (Sarwar, 2005). If the rising of the sea level is continued, some districts of our country like Rajbari, Faridpur, Madaripur, Jessore, Khulna, Barisal etc which are the major onion producing areas may also be affected by salinity and in that condition the production of spices especially onion will be hampered.

Salinity of soil and irrigation water is a continuing threat to economic crop production especially in arid and semiarid

regions of the world (Kayani *et al.*, 1990). About 20% of the net cultivable land of Bangladesh coastal region is affected by different degrees of salinity (Karim *et al.*, 1990). The ability of seed to germinate in saline environments, the cotyledons to break through a soil crust, emerging and seedlings to survive in saline conditions are crucial for crop production in saline soils (Maranon and Grieve, 1989).

Seed germination is an important and vulnerable stage in the life cycle of terrestrial angiosperms and determines seedling establishment and plant growth (Grattan *et al.*, 2001). Despite the importance of seed germination under salt stress, the mechanism (s) of salt tolerance in seeds is relatively poorly understood, especially when compared with the amount of information currently available about salt tolerance physiology and biochemistry in vegetative stage of plants. Several investigations of seed germination under salinity stress indicated that seeds of most species attain their maximum germination in distilled water and are very sensitive to elevated salinity at the germination and seedling phases of development (Ghoulam and Fares, 2002). Plant responses to salinity also depend on anion associated with sodium. The detrimental effect of salinity occurs because of osmotic stress and specific ion toxicity. The interaction of specific ion and osmotic effects induce a reduction in the number of seeds germinated and retardation in the rate of germination. The present investigation was conducted to know the effect of different concentrations of NaCl on germination, growth and development.

### Materials and Methods

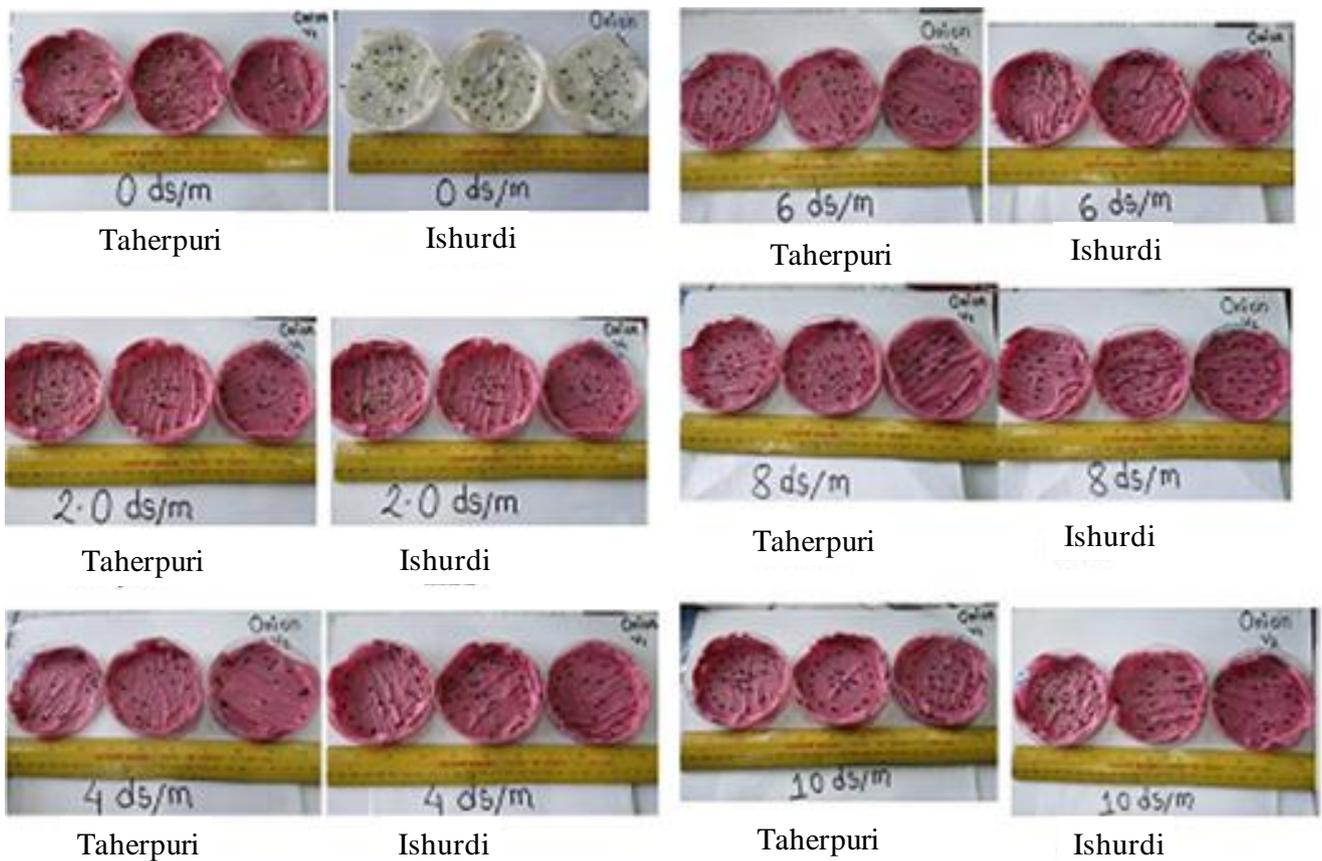
The present research work was conducted at the Post Graduate Laboratory of the Department of Horticulture, Bangladesh Agricultural University (BAU), Mymensingh during the period from September, 2014 to December, 2014. The treatments of the experiment consisted of two onion varieties and eleven concentrations of NaCl. Factor A: Onion varieties: (i)Taherpuri and (ii) Ishurdi; Factor B: Concentrations of Sodium Chloride (NaCl), (i) S0=0%(control), Distilled water, (ii) S2= 2ds/m, (iii) S4= 4 ds/m, (iv) S6= 6ds/m, (v) S8= 8ds/m, (vi) S10=10ds/m, (vii) S12= 12ds/m, (viii) S14=14ds/m, (ix) S16= 16ds/m, (x) S18=18ds/m, and (xi) S20=20ds/m. The present experiment was conducted following Randomized Complete Block Design (RCBD with three replications. Sodium chloride (NaCl) solutions of 0, 2,4,6, 8,10,12,14,16,18 and 20ds/m were prepared. Distilled

water was used as control. Hundred seeds of each of onion was germinated in two folds of Whatman no.1 filter paper placed in petri dishes (9 cm diameter). Each dish was moistened with 5 ml of distilled water or one of the salt concentrations 2,4,6, 8,10,12,14,16,18 and 20ds/m of NaCl. The level of water and salt solution were assessed daily and applied time to time as per requirement. Germination percentage, root length, shoot length, fresh root weight, fresh shoot weight, dry root weight and dry shoot weight were recorded at 3 days interval for 10 days. Germination was determined under constant room temperature  $27 \pm 2^\circ\text{C}$ . Data collection on germination percentage (%), radicle length, shoot length, fresh radicle weight, fresh shoot weight, dry radicle weight, dry shoot weight were taken. Data were analysed following MSTAT Statistical Package Program and level of significance and with least significance difference (LSD).

### Results and Discussion

The present study was conducted to investigate the effects of different levels of NaCl on germination and seedling growth of two varieties of onion. The results on seed germination percentage, radicle length, shoot length, fresh weight of radicle, fresh shoot weight, dry radicle weight, and dry shoot weight were significantly affected by 10 concentrations of NaCl.

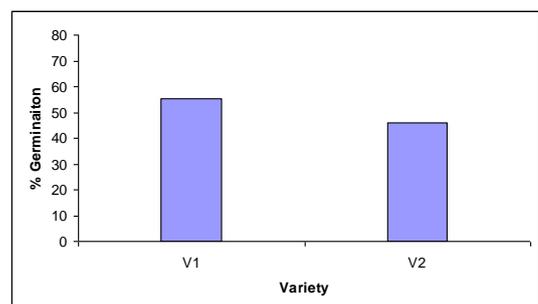
**Main effect of variety:** The percentage of seed germination was significantly influenced by the different varieties of onion (Plates 1). As the salinity increases the rate germination and growth of the seedlings also decreases. Similar results also noticed by Grattan and Grieve (2001).



**Plate 1.** Effect of salinity on the germination and growth of two onion varieties

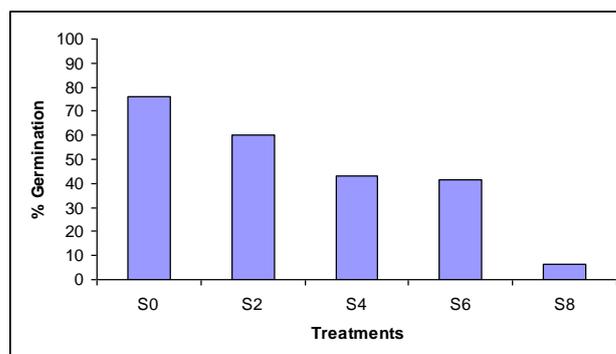
The maximum germination (55.40%) of seed was found in the variety Taherpuri and the minimum (40.45%) was observed in Ishurdi (Fig. 1). Salt tolerance also a genetical characters as reported by others ( Ghoulam and Fares, 1997; Kayani *et al.*, 1990).

Other parameters also higher in Taherpuri than Ishurdi (Table 1). Shoot length and root length was maximum in Ishurdi variety than in Taherpuri. Similarly, shoot fresh weight and dry weight also higher in Ishurdi variety than in Taherpuri variety. Similar results also reported by Karim *et al.*, 1900; Sarwar, 2005 and Rahim *et al.*, 1982.



**Fig. 1.** Effect of variety on the germination of onion. V1=Taherpuri; V2= Ishurdi

**Main effect of NaCl concentration:** The seed germination percentage was significantly influenced with the increasing levels of NaCl concentration. The maximum germination percentage of seed (58.17) was found with the control (0%) concentration and the minimum germination percentage (5.72) was noticed with 1.50% salt concentration (Fig. 2). As the concentration of NaCl increases the germination percentage also decreases. Shoot length, root length, shoot fresh and dry weight also highly significant among the different levels of NaCl (Table 2). Maximum shoot length was found from control (0ds/m) and the lowest from highest dose (8ds/m). Root fresh weight was found at 5% level of significant but other parameters are highly significant. There variations are due to level of NaCl as found in other crops (Sarwar, 2005; Karim *et al.*, 1900).



**Fig. 2.** Effect of different level of NaCl on germination of onion. S0= Control; S2= 2ds/m; S4=4ds/m; S6= 6ds/m; and S8= 8ds/m

**Table 1.** Mean effect of variety Germination, shoot length, Root length, shoot weight (fresh and dry), Root weight (fresh) on two varieties of onion

Treatment	% Germination	Shoot length (cm)	Root length (cm)	Shoot fresh wt. (g)	Shoot dry wt (g)	Root fresh wt (g)
V1	55.40	1.220	0.557	0.067	0.006	0.008
V2	46.13	1.733	0.760	0.078	0.006	0.017
LSD (0.05)	4.017	1.109	0.483	0.073	0.007	0.023
LSD(0.01)	5.499	1.517	0.661	0.100	0.010	0.032
Level of significance	**	**	**	NS	NS	NS

\*\* = Significant at 1% level of probability; NS= Not Significant

**Table 2.** Mean effect of NaCl on % Germination, shoot length, Root length, shoot weight (fresh and dry), Root weight (fresh) of Onion

Treatment name	% Germination	Shoot length (cm)	Root length (cm)	Shoot fresh wt. (g)	Shoot fresh wt (g)	Root fresh wt (g)
So	76.00	3.51	1.09	0.19	0.02	0.03
S2	60.00	1.43	0.73	0.07	0.01	0.02
S4	43.33	0.94	0.55	0.06	0.01	0.01
S6	41.50	0.87	0.52	0.04	0.00	0.01
S8	6.352	0.584	0.254	0.038	0.004	0.012
LSD (0.05)	8.695	0.800	0.348	0.053	0.005	0.017
LSD(0.01)	30.844	2.285	0.652	0.117	0.005	0.017
Level of significance	**	**	**	**	**	*

\*\* = Significant at 1% level of probability, \* = Significant at 5% level of probability

**Table 3.** Effect of various level of NaCl on variety of Taherpuri and Ishardi ( Onion)

Treatment name	% Germination	Shoot length (cm)	Root length (cm)	Shoot fresh wt. (g)	Shoot dry wt (g)	Root fresh wt (g)
V1So	84.00	2.53	0.68	0.16	0.02	0.02
V1S2	65.33	1.35	0.64	0.06	0.00	0.00
V1S4	46.67	0.84	0.57	0.08	0.01	0.01
V1S6	43.00	0.77	0.51	0.02	0.00	0.00
V1S8	38.00	0.61	0.38	0.01	0.00	0.00
V2So	68.00	4.49	1.51	0.22	0.02	0.03
V2S2	54.67	1.51	0.82	0.08	0.01	0.03
V2S4	40.00	1.05	0.52	0.03	0.00	0.01
V2S6	40.00	0.97	0.52	0.05	0.00	0.01
V2S8	28.00	0.65	0.44	0.01	0.00	0.01
LSD (0.05)	8.983	0.826	0.360	0.054	0.005	0.017
LSD(0.01)	12.296	1.131	0.493	0.074	0.007	0.023
Level of significance	**	**	**	**	**	**

\*\* = Significant at 1% level of probability

**Combined effect of variety and NaCl concentrations on onion:** The highest germination (84%) was noticed from Taherpuri variety under control (0ds/m) (Table 3). Shoot and root length; dry and fresh weight of shoots decreased

as the concentration of salinity increased in all varieties (Table 3). At 6ds/m concentration in Taherpuri variety root was found almost zero. Shoot developments were better than root developments in all treatments. Similar

results also reported by Karim *et al.*, 1900; Sarwar, 2005; Rahim *et al.*, 1982; Kayani *et al.*, 1990.

### References

- BBS. 2013. *Statistical Year Book of*. Bangladesh Bureau of Statistics. Statistics Division, Ministry of Planning. Govt. of the People's Republic of Bangladesh. 38.
- FAO. 2013. *Production Yearbook*. Food and Agriculture Organization of the United Nations, Rome, Italy. 58 153.
- Foolad, M .R. and Lin, K. R. 1997. Genetic analysis of salt tolerance during vegetative growth in tomato, *Lycopersicon esculentum* Mill. *Plant Breeding* 115: (4) 245-250.
- Ghoulam, C. and Fares, K. 2002. Effects of salt stress on growth, inorganic ions and proline accumulation in relation to osmotic adjustment in five sugar beet cultivars. *Environmental and Experimental Botany*, 47: 39-50.
- Gomez, K.A., Gomez., A.A. 1984. *Statistical Procedure for Agricultural Research*. 2<sup>nd</sup> (edn.). John Willey and Sons, New York. pp. 28-192
- Grattan, S.R. and Grieve, C.M. 2001. Salinity-mineral nutrient relations in horticultural crops. *Sci. Hort*, 78:127-157.
- Jones, H.A. and Mann, L.K. 1963. Onions and Their Allies. *World crop series*.
- Kayani, S.A., Naqvi, H.H. and Ting, I.P. 1990. Salinity effects on germination and mobilization of reserves in jojoba seed. *Crop Sci*, 30:704-708.
- Karim, M.A., Ungar, I.A., Showalter, A.M. 1900: Effects of sodium chloride treatments on growth and ion accumulation of the halophyte. *Seed Science and Technology* 31:2763 - 2774.
- Maranon. E.V. and Grieve, C.M. 1989: Spike and leaf development in salt stressed wheat. *Crop Sci*, 30: 1309-1313.
- Rahim, M.A., Husain, A. and Siddique, M.A. 1982. Seed production ability of three onion cultivars. *Bangladesh Horticulture*, 10 (1): 31-38.
- Rahim, M.A. and Siddique., M.A. 1990. Research on onion in Bangladesh. *Onion Newsletter for the Tropics*, NRI (UK), 2:5-10.
- Rahim, M.A. and Siddique, M.A. 1991. Onion seed production situation in Bangladesh-problems, prospects and research. *Onion Newsletter for the Tropics*, NRI, 3:39-41.
- Rahim, M.A. 1992. Research and development of cultivated Alliums in Bangladesh. Abstract in Ist Biennial Conference of CSSB, 18-20 Jan, 1992. p. 16.
- Sarwar, M. 2005: Effects of salinity and relative humidity on growth and ionic relations of plants. *New Phytol*, 113 : 13-20.