International Journal of Agriculture Innovations and Research
Volume 4, Issue 6, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 22/12/2015 | Accepted on : 31/12/2015 | Published : 08/06/2016

Response of Selected Barley Genotypes at Seedling Stage to Different Levels of Irrigation Water Salinity

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Abstract – **Salinity is considered as one of the major constraints on world barley production. Exploitation of natural variation of salinity tolerance in existing germplasm and the development of salinity tolerant cultivars are potential approaches for minimizing yield losses. In this study, four genotypes of barley viz. J-51, J-54, J-58 and J-98 which were chosen based on the their long-term superiority for forage yield under normal irrigation water conditions were investigated for their response to six levels of irrigation water salinity viz. control (1 dSm^{-1}), 2 dSm^{-1}, 4 dSm^{-1}, 6 dSm^{-1} , 8 dSm^{-1} and 10 dSm^{-1} along with international check, Beecher for two years at seedling stage up to 30 days during winter seasons of 2008 and 2009 (December) under simulated hydroponic conditions in shade-house at Agriculture Research Station, Rumais. The results showed that only main effect of salinity significant ($p<0.05$) to highly significant ($p<0.01$) for shoot length (cm), number of leaves, green and dry matter weights (g/seedling) whereas the main effect of cultivars and interaction effect of cultivars and salinity were highly significant ($p<0.01$) in respect of number of leaves, green and dry matter weights (g/seedling). Adverse effect of salinity was observed in all the genotypes for all the characters. Salinity tolerance of barley genotypes at seedling stage was assessed applying the concept higher mean values over the salinity treatments with respect to each character for selecting the most tolerant genotypes. Among all the genotypes examined, the salinity tolerance of J-98 was of higher order and consistency in both the years as it ranked first in terms of highest mean values across salinity environments (levels) for all the characters except dry mater %. All other genotypes, however, responded differentially to different levels of salinity for different characters without any consistency in performance in over the years.**

Keywords – **Salinity, Irrigation Water, Salinity Tolerance, Seedling Growth, Barley.**

I. Introduction

Arid and semi-arid areas of the world have been suffering from soil salinity because of improper irrigation practices or by water salinity all along their coasts owing to sea water intrusion. These conditions have adversely affected both the food and forage production in salinity affected areas of the world [1-2] because of their sensitivity to salinity. Hence, there is need of research to identify salt tolerant varieties of crops grown in the region which can be subsequently used in crop improvement for high yield and quality through breeding [2-4] as opposed to use of soil reclamation methods that work uneconomic. Both physiologists and plant breeders are now engaged in developing salt tolerant varieties in different salt sensitive crops [2-4].

Barley (*Hordeum vulgare L.*) is one of the annual forage crops invariably grown in Arabian Peninsula in particular and in the world in general as alternate fodder to their livestock because of its tolerance to abiotic stresses. Abiotic stresses like salinity and drought adversely affect growth and development via growth attributes like plant height, number of tillers/ plant, leaf length and leaf width etc. Many researchers have indicated the effect of salinity on different agronomic and yield characters at different stages of growth including seedling stage [5-8]. The information on seedling tolerance of varieties of barley would assist breeders in screening large number of germplasm or breeding lines available with them in a short time. The present investigation was conducted to study the effects of different levels of irrigation water salinity on agronomic traits, dry matter % and dry matter weight of six barley genotypes/ varieties at seedling stage under simulated hydroponic conditions in shade-house at Agriculture Research Station, Rumais.

II. Materials and Methods

The trial was laid in two consecutive winter seasons of 2007-2008 and 2008-2009 under drips in modified two-factor RCBD with three replications for 30 days in November and December using five genotypes of barley viz. J-51, J-54, J-58, J-98 and Beecher under six levels of irrigation water salinity viz. Control (1 dSm^{-1}), 2, 4, 6, 8 and 10 dSm^{-1} in shade-house under simulated hydroponic condition with perlite as a growth medium at Agriculture Research Station, Rumais. Simulated hydroponic condition had automated irrigation system. The chemical characteristics of the irrigation water treatments determined during two cropping seasons are presented in Tables 1 and 2, respectively.

Available ground water of electrical conductivity 36.5 $\pm$ 2 dSm^{-1} was used as a source of salinity as it incorporates several salt compositions commonly encountered in saline soils, namely high concentrations of sodium, chloride, sulphate and boron and low calcium to magnesium ratio. The salinity treatments were prepared in separate water tanks by diluting the available ground water by control water (1 $\pm$ 0.20dS m^{-1}) for supply of irrigation water of desired level of salinity to four lines of test barley cultivars grown under 15 cm diameter pots.

In each pot, two seeds were planted. The pots were fertilized with 100 kg N/ha, 90 kg P_2O_5/ha and 60 kg K_2O/ha in the form of urea (200 kg/ha), triple super

phosphate (180 kg/ha) and potassium sulphate (120 kg/ha). 1/3 of nitrogen and all of phosphate and potash were applied before planting and 1/3 of nitrogen after two weeks of planting (after germination) as per national recommendations [9]. The crops were irrigated through drips very gently till germination and later for 15-20 minutes each day. Barley genotypes attained 3-7 leaf stage after 30 days of planting when observations were recorded and plants in a pot were harvested for biomass.

Recording of observations on growth parameters was made after 30 days of planting. The observations were recorded on shoot and root lengths (cm), number of leaves/ seedling, green and dry matter weights per pot (g). Plant samples of all replications were taken to the laboratory for estimating dry matter percent for each genotype. Dry matter weights/ha were computed using dry matter % [10]. The data were subjected to statistical analyses considering salinity and genotypes as factors adapting ANOVA having only one error component according to the methods of Gomez and Gomez [11] using MSTAT-C.

III. Results and Discussion

Tables 1 to 6 present the means of characters of five barley genotypes recorded during winter seasons of 2007-2008 and 2008-2009, respectively. The results showed that only main effect of salinity significant ($p<0.05$) to highly significant ($p<0.01$) for shoot length (cm), number of leaves, green and dry matter weights (g/seedling) whereas the main effect of cultivars and interaction effect of cultivars and salinity were highly significant ($p<0.01$) in respect of number of leaves, green and dry matter weights (g/seedling). Adverse effect of salinity was evident in all the genotypes for all characters, due to which mean values were found to vary for each character among the genotypes with different levels of salinity in both years.

Shoot and Root Length (cm):

In respect of shoot length, in both years, there was significant decrease in mean shoot length with increased level of salinity ($p<0.05$) (Table 1). However, decrease in shoot length from control to 2 dS m^{-1} was not significant ($p>0.05$) while it was significant between other subsequent levels of salinity. In general decrease in adjacent salinity levels were found insignificant. The mean decrease over all the genotypes and years was found to be 1.92 % from control to 2 dS m^{-1} whereas it was 5% up to either 4 or 6 dS m^{-1}. In contrast, this decrease was very significant and up to 24.11% from control to 10 dS m^{-1}. Similar observations were made independently in different years either in respect of mean performance of genotypes or their independent response. In respect of mean response over two years, J-98 had numerically longest shoot length (35.33 cm) followed by J-51 (34.44 cm) and J-58 (34.30 cm). In general there was decrease in root length from control to subsequent levels of salinity up to 10 dS m^{-1} not only in both years but also in mean response of genotypes over two years. The effects of factors either independently or in interaction with others were not significant ($p>0.05$) (Table 2). However, in respect of mean response over two years, J-98 had numerically longest root length (13.22 cm) followed by J-58 (12.78 cm) and J-51 (12.29 cm). Similar observations were made by Bakth et al. [7] in respect of other varieties of barley tested at seedling stage.

Number of Leaves/ Plant (seedling)

In general, number of leaves/ plant was found decreased gradually and significantly from control to subsequent levels of salinity in both years ($p<0.05$) as evident in the mean response of genotypes over the years in respect of their leaf number as 6.78, 5.87, 5.23, 4.83, 4.7 and 3.67 in control, 2, 4, 6, 8 and 10 dS m^{-1}, respectively (Table 3). The reduction was drastic at salinity levels of 8 (30.67%) and 10 (45.87%) J 98 (5.7 and 5.79), J 54 (5.45 and 5.35) and J 51 (5.39 and 5.22) recorded higher number of leaves in both years (2008 and 2009) as compared to other genotypes (Table 3). No authors so far assessed the response considering this character.

Green and Dry Matter Weights / plant (g)

Both green and dry matter weights also showed progressive and significant ($p < 0.05$) decrease in trend at higher salinity levels in both years (Tables 4 and 5). The reduction was found significant in either both the years or in their mean response at every subsequent salinity levels ($p<0.01$). The decrease in green matter weight was to the extent 50 % in 2008, 45.45 % in 2009 and 47.94 % in mean performance whereas this decrease in dry matter weight was just around 60% either in 2008 and 2009 or in their mean performance. Among the genotypes, J 98 was found superior respectively in both green and dry matter weights not only both the years (2008- 2.06 and 0.82 g and 2009- 1.98 and 0.77 g) but also in their mean performance (2.02 and 0.79 g). Either J-58, J-51 and J-54 were next superiors in both green and dry matter weights (Tables 4 and 5). Similar observations were made by Bakth et al. (2007) in respect of other varieties of barley tested at seedling stage.

Dry Matter %

Like other characters, dry matter % was found gradually and insignificantly decreased as the salinity levels increased. The mean dry matter % over the years was 49.90% at control while it was around 36 % at the highest salinity level (10 dS m^{-1}) of the experiment.

Salinity tolerance of barley genotypes was assessed using the concept of mean value over the salinity treatments with respect to each character and selected the most tolerant genotypes considering the information of all the characters under study. Among all the genotypes tested, the salinity tolerance of J-98 was of highest degree and more consistent as they scored highest mean values across salinity environments (levels) over the years for all the characters under study except dry matter % followed by J-51 and J-58. All other genotypes, however, responded differentially to different levels of salinity for different characters.

Several authors worked on either screening of barley varieties/ germplasm and discussed the response under different levels of salinity at seedling stage around couple of weeks [6-9] and found in general that all the genotypes tested showed decrease in their response at higher salinity levels increased either gradually or drastically in respect of the characters studied. Some authors are of the opinion that

the response of the genotypes at seedling stage would reflect the same in response as at adult stage under field conditions which need to be confirmed in terms of mechanisms that plants resort to resist stress conditions in two different stages of growth [3]. The results of experiments conducted by Tavakkoli et al. [3] observed differences in the responses to salinity between plants grown in hydroponic and soil systems on the basis different mechanisms of salt tolerance at adult stage in the field. However, the results of our experiments on response of same barley genotypes considered in the present experiment at adult stage under field conditions indicated same genotypes like J-98, J-51 and J-58 that were found to have higher degree of tolerance as compared to other genotypes [12]. The nature of response of genotypes in two stages could be also attributed to genetic mechanism prevailing at different developmental stages of plant.

IV. Acknowledgment

We wish to thank to the Director General of Agriculture & Livestock Research and the Directors of Soil and Water Research Center and Plant Production Research Center for their support in conducting the experiments. International Center for Biosaline Agriculture, Dubai, UAE is gratefully acknowledged.

References

[1] T.J. Flowers and A.R. Yeo. 1995. Breeding for salinity resistance in crop plants—where next? Australian Journal of Plant Physiology. 22: 875–*884*.

[2] V. Chinnusamy, A. Jagendorf and J.K. Zhu. 2005. Understanding and improving salt tolerance in plants. Crop Sci. 45: 437-448.

[3] E. Tavakkoli, P. Rengasamy and G.K. McDonald. 2010. The response of barley to salinity stress differs between hydroponic and soil systems. *Functional Plant Biol.*37: 621-633.

[4] M. A. Babu, D. Singh and K. M. Gothandam. 2012. The effect of salinity on growth, hormones and mineral elements in leaf and fruit of tomato cultivar pkm1. J. Animal and Plant Sci. 22:159-164.

[5] B. A. Rottella and V. Martinez. 1997. Effect of salinity on the growth and nitrogen uptake by wheat seedling. J. Plant Nutr. 20: 793-804.

[6] F. Taghipour and M. Salehi, 2008. The study of salt tolerance of Iranian barley (*Hordeum vulgare* L.) genotypes in seedling growth stages. Biological Diversity and Conservation. 1/2: 53-58.

[7] J. Bakht, M. Shafi, A.A.Khan, S. Hussain, M. Tariq, H. Akbar, A. Jan and M. Rehman. 2007. Growth performance of oat and barley at early seedling stage under saline environment. Sarhad J. Agric. 23: 565-569.

[8] J. Bakht, M. Shafi and Y. Jamal. 2011. Response of maize (Zea mays L.) to seed priming with NaCl and salinity stresses. Spanish J. Agric. Res. 9: 252-261.

[9] A.I. Goyal, S. Pradhan, and V. K. Bajaj. 2012. Screening of salt tolerance in different varieties of *Hordeum vulgare*. *World Applied Sci. J.* 16 (7): 926-932.

[10] H.D. Chapman and P.F. Pratt. 1961. Methods of analysis for soils, plants and waters. Univ. of California. USA.

[11] M. Akthar and S.K. Nadaf. 2001. Scientific production of field crops in Oman. Ministry of Agriculture & Fisheries. Sultanate of Oman. 88 p.

[12] Rabeea, J., Nadaf, S.K., Al-Wahibi, H.S., Al-Habsi, S.S. and Al-Harthy, A.S. 2015. Response of selected barley genotypes to different levels of irrigation water salinity. *J. Agricultural and Crop Res.* 3:1-10.

International Journal of Agriculture Innovations and Research
Volume 4, Issue 6, ISSN (Online) 2319-1473

Table 1. Means of Shootlength (cm)of fivesalt tolerant genotypes under six levels of water salinity at seedling stage

Year	Genotype	Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	37.53	35.63	36.93	35.80	34.87	29.40	35.03
	J 54	34.80	35.03	35.47	37.20	31.63	28.03	33.69
	J 58	42.53	37.53	34.77	35.43	35.13	24.13	34.92
	J 98	38.40	37.00	36.87	35.33	34.43	31.53	35.59
	Beecher	36.73	38.23	33.60	33.63	32.90	21.50	32.77
2008	Mean	38.00	36.68	35.53	35.48	33.79	26.92	34.40
		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	34.93	36.13	33.07	32.67	33.47	32.80	33.85
	J 54	36.10	36.47	35.03	35.73	34.80	28.87	34.50
	J 58	36.07	37.23	37.97	34.37	31.87	24.53	33.67
	J 98	38.27	36.33	36.07	37.43	31.07	31.20	35.06
2009	**Beecher**	38.67	37.17	37.60	35.03	31.30	31.83	35.27
	Mean	36.81	36.67	35.95	35.05	32.50	29.85	34.47
		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	36.23	35.88	35.00	34.24	34.17	31.10	34.44
	J 54	35.45	35.75	35.25	36.47	33.22	28.45	34.10
	J 58	39.30	37.38	36.37	34.90	33.50	24.33	34.30
	J 98	38.34	36.67	36.47	36.38	32.75	31.37	35.33
Means over years	**Beecher**	37.70	37.70	35.60	34.33	32.10	26.67	34.02
	Mean	37.40	36.68	35.74	35.26	33.15	28.38	34.43

Statistical Parameters

	F-test	LSD (5%)
Years	NS	-
Salinity	*	1.59
Years x Salinity	Ns	-
Cultivars	NS	-
Cultivars x Years	NS	-
Cultivars x Salinity	NS	-
Years x Salinity x cultivars	NS	-
C.V.(%)	9.86	

* - Significant at 0.05 level of probability ; ** - Significant at 0.01 level of probability ; NS- Non-significant

International Journal of Agriculture Innovations and Research
Volume 4, Issue 6, ISSN (Online) 2319-1473

Table 2. Means of rootlength (cm) of fivesalt tolerant genotypes under six levels of water salinity at seedling stage

Year	Genotype	Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
2008	**J 51**	13.76	12.80	12.50	13.00	12.00	9.96	12.34
	J 54	12.43	12.66	12.40	14.33	10.83	6.90	11.59
	J 58	15.06	15.30	15.43	15.26	12.60	5.40	13.18
	J 98	13.63	12.26	13.63	13.26	14.93	7.36	12.51
	Beecher	13.03	12.46	11.36	12.86	13.76	8.90	12.06
	Mean	13.58	13.10	13.06	13.74	12.82	7.70	12.34
2009		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	13.73	12.73	12.40	12.83	11.90	9.86	12.24
	J 54	13.40	12.56	12.30	12.16	10.76	7.56	11.46
	J 58	15.86	14.13	13.30	13.10	12.53	5.43	12.39
	J 98	13.56	12.16	13.50	13.23	14.93	16.23	13.94
	Beecher	12.00	11.46	10.30	10.76	9.73	8.90	10.53
	Mean	13.71	12.61	12.36	12.42	11.97	9.60	12.11
Means over years		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	13.75	12.77	12.45	12.92	11.95	9.91	12.29
	J 54	12.92	12.61	12.35	13.25	10.80	7.23	11.52
	J 58	15.46	14.72	14.37	14.18	12.57	5.42	12.78
	J 98	13.60	12.21	13.57	13.25	14.93	11.80	13.22
	Beecher	12.52	11.96	10.83	11.81	11.75	8.90	11.29
	Mean	13.65	12.85	12.71	13.08	12.40	8.65	12.22

Statistical Parameters

	F-test	LSD (5%)
Years	NS	-
Salinity	NS	-
Years x Salinity	NS	-
Cultivars	NS	-
Cultivars x Years	NS	-
Cultivars x Salinity	NS	-
Years x Salinity x cultivars	NS	-
C.V.(%)	30.58	

* - Significant at 0.05 level of probability ; ** - Significant at 0.01 level of probability ; NS- Non-significant

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Volume 4, Issue 6, ISSN (Online) 2319-1473

Table 3. Means of number leaves/plant of fivesalt tolerant genotypes under six levels of water salinity at seedling stage

Year	Genotype	Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
2008	**J 51**	7.00	5.33	5.00	5.00	4.67	4.33	5.22
	J 54	7.00	6.00	5.33	5.67	5.00	3.67	5.45
	J 58	7.33	5.67	4.33	5.00	4.67	3.33	5.06
	J 98	6.89	7.01	6.33	4.33	5.33	4.33	5.70
	Beecher	5.33	5.11	4.67	4.33	4.33	3.67	4.57
	Mean	6.71	5.82	5.13	4.87	4.80	3.87	5.20
		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	7.33	5.67	5.33	5.33	4.33	4.33	5.39
	J 54	7.45	5.67	5.67	5.33	4.67	3.33	5.35
	J 58	7.00	5.86	4.67	4.67	4.33	3.67	5.03
	J 98	7.11	7.33	6.33	4.33	5.33	4.33	5.79
	Beecher	5.33	5.00	4.67	4.32	4.33	3.67	4.55
	Mean	6.84	5.91	5.33	4.80	4.60	3.87	5.22
		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	7.17	5.50	5.17	5.17	4.50	4.33	5.30
	J 54	7.23	5.84	5.50	5.50	4.84	3.67	5.40
	J 58	7.17	5.77	4.50	4.84	4.50	3.33	5.04
	J 98	7.00	7.17	6.33	4.33	5.33	4.33	5.75
	Beecher	5.33	5.06	4.67	4.33	4.33	3.67	4.56
	Mean	6.78	5.87	5.23	4.83	4.70	3.67	5.21

Statistical Parameters

	F-test	LSD (5%)
Years	NS	-
Salinity	**	0.45
Years x Salinity	NS	-
Cultivars	**	0.69
Cultivars x Years	NS	-
Cultivars x Salinity	*	0.58
Years x Salinity x cultivars	NS	-
C.V.(%)	19.20	

* - Significant at 0.05 level of probability ; ** - Significant at 0.01 level of probability ; NS- Non-significant

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Volume 4, Issue 6, ISSN (Online) 2319-1473

Table 4. Means of green matter weight (g) of fivesalt tolerant genotypes under six levels of water salinity at seedling stage

Year	Genotype	Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
2008	**J 51**	1.63	1.52	1.43	1.38	1.39	1.29	1.44
	J 54	1.77	1.67	1.52	1.53	1.29	0.82	1.43
	J 58	2.42	1.96	1.36	1.28	1.18	0.89	1.52
	J 98	2.53	2.37	2.15	2.01	1.97	1.33	2.06
	Beecher	1.73	1.66	1.49	1.39	1.15	0.72	1.36
	Mean	2.02	1.84	1.59	1.52	1.40	1.01	1.56
		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	1.51	1.51	1.44	1.39	1.40	1.28	1.42
2009	**J 54**	1.39	1.31	1.29	1.28	1.09	0.83	1.20
	J 58	2.39	1.95	1.37	1.33	1.20	0.90	1.52
	J 98	2.38	2.11	2.09	2.01	1.97	1.34	1.98
	Beecher	1.66	1.67	1.49	1.48	1.15	0.73	1.36
	Mean	1.87	1.71	1.54	1.50	1.36	1.02	1.50
		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	1.57	1.52	1.44	1.39	1.40	1.29	1.43
	J 54	1.58	1.49	1.41	1.41	1.19	0.83	1.32
	J 58	2.41	1.96	1.37	1.31	1.19	0.90	1.52
	J 98	2.46	2.24	2.12	2.01	1.97	1.34	2.02
	Beecher	1.70	1.67	1.49	1.44	1.15	0.73	1.36
	Mean	1.94	1.77	1.56	1.51	1.38	1.01	1.53

Statistical Parameters

	F-test	LSD (5%)
Years	NS	-
Salinity	**	0.02
Years x Salinity	NS	-
Cultivars	**	0.02
Cultivars x Years	NS	-
Cultivars x Salinity	**	0.02
Years x Salinity x cultivars	NS	-
C.V.(%)	2.28	

* - Significant at 0.05 level of probability ; ** - Significant at 0.01 level of probability ; NS- Non-significant

Table 5. Means of dry matter weight (g) of fivesalt tolerant genotypes under six levels of water salinity at seedling stage

Year	Genotype	Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
2008	**J 51**	0.82	0.73	0.59	0.56	0.60	0.52	0.64
	J 54	1.11	1.04	0.73	0.58	0.47	0.29	0.71
	J 58	0.83	0.75	0.61	0.45	0.45	0.31	0.57
	J 98	1.21	0.93	0.75	0.76	0.75	0.50	0.82
	Beecher	0.80	0.72	0.64	0.56	0.42	0.25	0.56
	Mean	0.96	0.84	0.67	0.58	0.54	0.38	0.66
2009		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	0.77	0.73	0.60	0.57	0.56	0.49	0.62
	J 54	0.88	0.80	0.62	0.48	0.40	0.28	0.58
	J 58	1.06	0.88	0.62	0.47	0.45	0.33	0.64
	J 98	1.15	0.84	0.73	0.73	0.69	0.47	0.77
	Beecher	0.77	0.72	0.63	0.60	0.45	0.26	0.57
	Mean	0.93	0.79	0.64	0.57	0.51	0.37	0.63
		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	0.80	0.73	0.60	0.56	0.58	0.50	0.63
	J 54	0.99	0.92	0.68	0.53	0.44	0.29	0.64
	J 58	0.95	0.82	0.62	0.46	0.45	0.32	0.60
	J 98	1.18	0.88	0.74	0.74	0.72	0.48	0.79
	Beecher	0.78	0.72	0.64	0.58	0.44	0.26	0.57
	Mean	0.94	0.81	0.65	0.58	0.52	0.37	0.65

Statistical Parameters

	F-test	LSD (5%)
Years	NS	-
Salinity	**	0.03
Years x Salinity	NS	-
Cultivars	**	0.05
Cultivars x Years	NS	-
Cultivars x Salinity	**	0.04
Years x Salinity x cultivars	NS	-
C.V.(%)	10.88	

* - Significant at 0.05 level of probability ; ** - Significant at 0.01 level of probability ; NS- Non-significant

International Journal of Agriculture Innovations and Research
Volume 4, Issue 6, ISSN (Online) 2319-1473

Table 6. Means of dry matter (%) of fivesalt tolerant genotypes under six levels of water salinity at seedling stage

Year	Genotype	Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	50.54	48.18	41.37	40.64	43.03	40.33	44.02
	J 54	62.91	62.41	48.30	38.02	36.66	35.33	47.27
	J 58	34.35	38.39	45.14	35.13	37.83	35.11	37.66
	J 98	47.93	39.39	35.06	37.89	37.93	37.53	39.29
	Beecher	45.98	43.21	43.13	40.04	36.56	35.22	40.69
2008	Mean	48.34	46.32	42.60	38.34	38.40	36.70	41.78
		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	51.12	48.16	41.65	40.75	40.11	38.17	43.33
	J 54	63.01	60.83	48.06	37.55	36.68	34.23	46.73
	J 58	44.35	45.24	45.54	35.35	37.59	37.21	40.88
	J 98	48.24	39.64	35.07	36.11	35.22	35.11	38.23
	Beecher	46.49	43.12	42.58	40.47	39.22	35.29	41.20
	Mean	50.64	47.40	42.58	38.05	37.76	36.00	42.07
		Control	2 ds/m	4 ds/m	6 ds/m	8 ds/m	10 ds/m	Mean
	J 51	50.83	48.17	41.51	40.70	41.57	39.25	43.67
	J 54	62.96	61.62	48.18	37.79	36.67	34.78	47.00
Mean	**J 58**	39.35	41.82	45.34	35.24	37.71	36.16	39.27
	J 98	48.09	39.52	35.07	37.00	36.58	36.32	38.76
	Beecher	46.24	43.17	42.86	40.26	37.89	35.26	40.94
	Mean	49.49	46.86	42.59	38.20	38.08	36.35	41.93

Statistical Parameters

	F-test	LSD (5%)
Years	NS	-
Salinity	NS	-
Years x Salinity	NS	-
Cultivars	NS	-
Cultivars x Years	NS	-
Cultivars x Salinity	NS	-
Years x Salinity x cultivars	NS	-
C.V.(%)	10.23	

NS- Not significant (p>0.05)