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The Effect of NaCl Priming on Salt Tolerance in Sunflower Seeding Grown Under Saline Conditions

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Abstract

The experiment six sunflower cultivars were studied, the experiment ten seeds of each cultivar (Mehran-1, Mehran-2, Mehran-3, Mehran-4, record and HO-1) were placed on blotting paper and moisture with non-priming control, priming with taped water, 50 mM, NaCl, 100 mM NaCl, 150 mM NaCl and 200 mM NaCl). It was observed that germination percentage of seed affected significantly by the treatments, cultivars, intervals, H x T and T X V, while non-significant for H X V and H X T X V. Further root length was not affected by salinity treatment. Among the cultivars record showed greater root length (52.44mm) while fresh weight and dry weight of root affected significantly by treatments and cultivars. The priming control was not displayed maximum fresh weight of root (0.83g), while it was decreased as NaCl increased. The variety Mehran-I recorded higher fresh weight of root 0.70g, dry weight of root was 0.081g. During the pot experiment two cultivars were evaluated against five treatments indicated that germination of seed differed significantly between treatments, cultivar, and T X C, while non-significant among T X I, C X I and T X C X I. The seed germination reduced significantly as NaCl levels increased, the record showed significantly greater seed germination than Mehran-I increased NaCl significantly reduced number of green leaves and increased number of dry leaves plant^{-1} in both cultivars. The green leaves were recorded in Mehran-I recorded high root length was (47.24 mm), the fresh weight of root was recorded (0.70g) and dry weight of root was (0.81g).

Keywords

Sunflower, Nacl, Mehran, Priming, Treatment, Germination, mM

1. Introduction

Sunflower (*Helianthus annuus*) is one of the most imperative oilseed crop cultivated in the world. The total cost area under sunflower recorded during the year 2004 was 297300 hectares with a production of 485900 tons. Among while the provinces of Pakistan, Punjab and Sindh has equal and largest area under sunflower 141600 hectares, while production differed Punjab 245000 tons and Sindh 224000 tons [1]. Sunflower is a supporter of the composites family [2]. It is the cultivated all over the

world and performs well in most temperate regions of the world. The Europe is leading producer of sunflower seed accounting for about 60% of the world's total production. The other leading countries are China, USA, Turkey, India, Australia and South Africa Pakistan Statistical Year Book [3]. Sunflower oil is considered a finest to the most other vegetable oils because of its light color, bland flavor, high smoke points, high level of linoleic acid and absence of linoleic acid. It is indispensable fatty acid which must be supplied by diet and high level of tocopherol, a forum of vitamin E [4]. It was introduced to Europe in the 16th Century and imported in to Pakistan from Holland. In Pakistan, sunflower was first time introduced as an oilseed crop in the year 1960's [5]. Extensive research work on different aspects of this crop has continued since 1964 [6]. The area under sunflower cultivation in Pakistan was 65112 hectares with the production of 76419 tons in the year 2001-2002 [7]. Sunflower seed contains about over 40%. Fatty acid, 20.1% but Linoleic acid 67.5% and Linolenic acid 0.1. Growth is satisfactory when temperatures do not fall below 10°C, but the plant can resist far lower temperatures without damage. It is not even injured by early frost in autumn, which kill maize and soybean crops [8].

Origin of their every well-developed root system, sunflowers are fairly drought resistant and can produce a sensible crop with a winter rainfall of almost 300 mm. Sunflower can thrive on most of the soils, including sandy soils. The crop is far more tolerant of low soil fertility [9]. An estimated 90% of the sunflower seed produced is crushed for oil extraction. Newly germinated seedlings exhibited a decrease in size with increase in salt concentration [10]. Plant growth of sunflower adversely affected by salinity leaf area was most affected, root length and root volume were also affected by salinity [11]. Keeping in view the above facts, the experiments were conducted to see the effect of NaCl priming on salt tolerance in sunflower seeding grown under saline conditions.

2. Materials and Methods

Two sets of experiments were carried out to determine the effect of NaCl priming on salt tolerance in sunflower seeding grown under saline conditions. First experiment was laid out in the Department of Plant Physiology and Biochemistry and 2nd experiment in the Department of Soil Science, Faculty of Crop Production, Sindh Agriculture University, Tandojam during the year 2004.

1. Experiment

In this experiment, 10 seeds of six sunflower varieties namely Mehran-1, Mehran-2, Mehran-3, Mehran-4, Record, and HO-I were germinated in Petri dishes with 2 layers of filter papers at 25°^{C} in an incubator with priming treatments (24 h) of different NaCl concentrations i.e. T_1= Non-priming, T_2= Priming with (Tape water), T_3= 50 mM NaCl, T_4= 100 mM NaCl, T_5= 150 mM NaCl and T_6= 200 mM, NaCl. Watering was given up to paper saturation. The experiment was carried with three replications of each treatment. Observations were recorded on following parameters.

1. Daily Germination: Germination of seeds were recorded after every 24 hours up to 6 days.
2. Total germination%: The total germination as percentage was recorded on mean values of seed germination after six days.
3. Root length (mm): Root length (mm) was recorded after sixth day of sowing from each treatment.

II. Experiment

Two varieties of sunflower namely Mehran-I and Record were selected from the 1st experiment based on their tolerance. Five seeds of each variety were germinated (with above mentioned priming treatments) in pots filled with soil. After germination of seed salinity treatments were applied. Observations were recorded on following characters.

1. Seed germination. 5 seeds were germinated in each pot after few days only one healthy plant was left for further analysis.
2. Number of leaves/plant^{-1}: Leaves appeared in each plant were recorded at early stage of flowering.
3. Fresh and dry weight (g): Fresh weight of plants were recorded from each treatment and each replication. Then plants were dried in an oven for 72 hours at 70°C.
4. Na^+ and K^+ ion contents: The Na^+ and K^+ ion contents from flag leaf of each plant of each treatment were determined by sap method (Gorham *et al.,* 1999). Fresh leaves were collected washed and frozen. The sap was extracted in and samples were centrifuged then diluted and analyzed in flame photometer.

3. Results

About 10 seeds of six sunflower cultivars were placed on blotting paper in a Petri dish and treated with various concentration of NaCl. The results of germination percentage recorded under various time intervals.

1. Effect of different salinity (NaCl) levels

It was observed that germination% increased from 14.43% after 24 hours of sowing and reaches to 84.78% at 144 hours of sowing. The results further revealed that seed germination reduced significantly as concentration of NaCl increased during each interval in all six cultivars. Mehran-1 showed susceptibility against NaCl as compared to other cultivars after 144 hours of sowing. The results revealed that seed germination varied significantly among cultivars, treatment intervals and the interaction between intervals x treatments, and treatments x varieties, while no significant difference between the interaction of intervals x cultivars and intervals x treatment x cultivars statistically.

Table 1. *Effect of different salinity (NaCl) levels on the germination% of different varieties of sunflower.*

Time intervals	Varieties	Treatments NaCl Mm							
		Non-priming control D/water	Priming Tape water	50mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	Mean	
24 hours	Mehran-I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mehran-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Mehran-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Mehran-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Record	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	HO-I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Mean	0.00	0.00	0.00	0.00	0.00	0.00	--	
48 hours	Mehran-1	20.00	26.66	20.00	13.33	10.00	10.00	16.66	15.91
	Mehran-2	30.00	33.33	26.66	23.33	16.66	10.00	23.33	
	Mehran-3	10.00	13.00	10.00	6.66	6.66	6.66	8.83	
	Mehran-4	20.00	23.33	16.66	13.33	13.33	3.33	14.99	
	Record	23.33	23.33	20.00	16.66	13.33	10.00	17.77	
	HO-I	16.66	20.00	16.66	13.33	10.00	6.66	13.88	
	Mean	19.99	23.27	18.33	14.44	9.44	7.77	--	
72 hours	Mehran-1	40.00	43.33	30.00	30.00	26.66	23.00	32.16	28.58
	Mehran-2	40.00	43.33	36.66	33.33	23.33	16.66	32.21	
	Mehran-3	23.00	26.66	20.00	20.00	16.66	13.33	19.94	
	Mehran-4	33.33	40.00	30.00	23.33	23.00	16.66	27.77	
	Record	36.66	50.00	36.66	26.66	23.33	20.00	32.21	
	HO-I	26.66	40.00	33.33	26.66	20.00	16.66	27.21	
	Mean	33.27	40.55	31.10	26.66	22.16	17.71	--	
96 hours	Mehran-1	53.33	60.00	46.66	46.66	40.00	36.66	47.21	9.88
	Mehran-2	53.33	56.66	53.33	50.00	36.66	33.33	47.21	
	Mehran-3	26.66	40.00	23.33	23.33	20.00	16.66	24.99	
	Mehran-4	46.66	56.66	40.00	33.33	26.66	23.33	37.77	
	Record	46.66	63.33	43.33	40.00	33.33	26.66	42.21	
	HO-I	43.33	53.33	43.00	36.66	33.33	30.00	39.94	
	Mean	44.99	54.99	41.60	38.33	31.66	27.77	--	
120 hours	Mehran-1	70.00	73.33	63.33	60.00	46.66	43.33	59.44	3.95
	Mehran-2	66.66	66.66	63.33	60.00	50.00	46.66	58.88	
	Mehran-3	43.33	60.00	40.00	26.66	23.00	20.00	35.49	
	Mehran-4	60.00	70.00	50.00	50.00	43.33	36.66	51.66	
	Record	63.00	70.00	56.66	50.00	50.00	43.33	55.49	
	HO-I	60.00	63.33	53.33	50.00	46.66	43.33	62.77	
	Mean	60.49	56.66	54.44	49.43	43.27	38.88	--	
144 hours	Mehran-1	80.00	83.33	73.66	66.66	63.33	50.00	69.49	65.53
	Mehran-2	73.33	80.00	70.00	63.33	60.00	56.66	78.80	
	Mehran-3	66.66	76.66	53.33	46.66	46.66	30.00	53.32	
	Mehran-4	70.00	80.00	60.00	60.00	53.33	50.00	62.22	
	Record	73.33	83.00	70.00	56.66	56.66	46.66	64.38	
	HO-I	70.00	76.66	66.66	63.33	60.00	53.33	64.99	
	Mean	72.22	79.94	65.60	59.44	56.66	47.77	--	

2. Root length (mm)

The results on root length of six sunflower cultivars against different concentrations of NaCl under laboratory condition are presented in Table-2. Maximum root length was occurred in variety Record (52.48 mm) while minimum root length was recorded by variety Mehran-3 (35.34mm). The results demonstrated that only Mehran-3 reduced root length significantly, while other cultivars were resistant against NaCl.

The results revealed that root length differed significantly between the cultivars, while no significant difference between concentration of NaCl and their interaction.

Table 2. *Effect of different salinity (NaCl) levels on the root length (mm) of different varieties of sunflower.*

Varieties	Treatments						Mean
	Non-priming control D/water	Priming Tape water	50 mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	
Mehran-1	55.05	63.14	51.96	48.46	32.72	32.16	47.24
Mehran-2	50.67	59.56	47.54	40.28	34.76	31.53	44.05
Mehran-3	44.67	56.00	36.50	29.27	25.37	20.25	35.34
Mehran-4	50.20	60.17	36.50	35.47	31.07	24.67	39.68
Record	52.50	83.33	51.97	49.76	34.59	32.75	52.48
HO-I	54.51	60.30	46.73	35.95	29.50	23.71	41.78
Mean	52.93	66.25	45.20	39.86	31.33	27.51	--

3. Root Fresh weight (g)

The results of root fresh weight (g) of sunflower cultivars treated against different concentration of NaCl obtained are shown in Table-3. The results indicated that fresh weight of root varied significantly by the concentration of NaCl and cultivars, while their interaction was non-significant.

Table 3. *Effect of different salinity (NaCl) levels on the root fresh weight (g) of different varieties of sunflower.*

Varieties	Treatments						Mean
	Non-priming control D/water)	Priming Tape water	50mM NaCl	100mM NaCl	150 mM NaCl	200mM NaCl	
Mehran-1	0.933	1.667	0.703	0.350	0.293	0.247	0.70
Mehran-2	0.730	1.283	0.603	0.400	0.267	0267	0.59
Mehran-3	0.770	1.327	0.670	0.333	0.293	0.180	0.60
Mehran-4	1.160	1.430	0.743	0.577	0.250	0.197	0.73
Record	1.133	1.963	0.773	0.607	0.303	0.240	0.83
HO-I	0.820	1.110	0.603	0.370	0.233	0.217	0.56
Mean	0.92	1.46	0.68	0.44	0.28	0.22	---

4. Dry weight of root (g)

The results regarding dry weight of root (g) of sunflower cultivars tried for six different salinity treatments obtained are summarized in the Table-4. The results indicated that salinity treatments and cultivars had significant impact on the dry weight of root, whereas their interaction was non-significant. Increasing concentration of NaCl significantly increased in the dry weight of root i.e. (0.099g), while priming with tape water resulted in highest dry weight of root. The results further revealed that cultivar Record displayed maximum root dry weight mean (0.099g). However, Mehran-2 recorded minimum root dry weight means (0.062 g).

Table 4. *Effect of different salinity (NaCl) levels on the dry weight root (g) of different varieties of sunflower.*

Varieties	Treatments						Mean
	Non-priming control D/water	Priming Tap water	50 mM NaCl	100mM NaCl	150mM NaCl	200mM NaCl	
Mehran-1	0.095	0.103	0.090	0.077	0.073	0.053	0.081
Mehran-2	0.087	0.107	0.067	0.050	0.040	0.023	0.062
Mehran-3	0.090	0.107	0.078	0.060	0.047	0.030	0.068
Mehran-4	0.100	0.103	0.087	0.070	0.050	0.033	0.073
Record	0.133	0.147	0.110	0.087	0.067	0.050	0.099
HO-I	0.100	0.160	0.087	0.077	0.073	0.037	0.089
Mean	0.100	0.121	0.086	0.070	0.058	0.037	---

Experiment number 2

A pot experiment was laid out to see the influence of various concentration of NaCl on two cultivars of sunflower.

5. Germination%

The results on germination% of seeds of two cultivars of sunflower sown under different concentrations of NaCl obtained are presented in the Table-5. The results indicated that the germination% of seed differed significantly between NaCl treatments, cultivars, intervals and the interaction of treatments x cultivars, while no significant differences in the germination% was recorded between the interaction of cultivars x intervals, treatment x interval and treatments x cultivars x intervals respectively. There was zero germination after Ist day of sowing. The germination of seed was more in treatment priming with tape water, while low in pots started with NaCl. In case of variety Mehran-I germination% increased from 20.00% in the 2nd day to 90.00% in the 10th days of treatment. In case of Record, although the germination was comparatively high, it started during 2nd days of treatment (40.00%) and reaches up to 90.00% in the 10th day of treatment priming with tape was give greater seed germination than the NaCl treatment.

Table 5. *Mean germination (%) of sunflower variety Mehran-I at different intervals as affected by concentration of NaCl.*

Intervals	Treatments					Mean
	Priming with tape water	50 mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	
1ST day	0.00	0.00	0.00	0.00	0.00	0.00
2nd day	20.00	10.66	10.00	00.00	0.00	8.00
3rd day	23.00	20.00	10.20	8.00	9.66	14.132
4th day	30.20	25.01	15.02	13.20	12.00	19.086
5th day	34.88	30.00	20.00	18.04	16.04	23.792
6th day	46.02	36.02	28.40	20.88	18.69	30.002
7th day	58.78	42.28	36.41	28.66	20.21	37.268
8th day	70.20	56.33	43.66	35.67	27.00	46.572
9th day	80.00	78.28	53.00	42.00	35.00	57.656
10th day	90.00	80.82	60.00	55.00	43.21	65.806
Mean	45.308	37.94	27.669	22.145	18.181	

6. Shoot length (mm)

The results on shoot length of two sunflower cultivars of sunflower planted under five salinity treatments recorded are presented in Table-6. The results depicted that shoot length affected significantly by the concentration of NaCl, cultivars and the interaction of NaCl x cultivars, while no significant effect of the interactions of treatments x intervals, cultivars x intervals and treatment x cultivars x intervals were observed. Shoot length decreased significantly as concentration of NaCl increased up to 150 mM and 200 mM respectively. It was observed that in case of variety Mehran-I shoot in the Ist week of sowing was 15.59 mm and it increased progressively and was 32.00 mm during the 7th week of germination. The shoot length was more at 50 mM NaCl while further increased in the level of NaCl reduced shoot length. However, in case of variety Record a similar trend was observed in the shoot length in case of variety Record shoot in the Ist week of sowing was 18.78 mm and it increased progressively and was 41.30 mm during the 7th week of germination. The shoot length was reduced growth due to different concentrations of NaCl increase the time.

Table 6. *Average shoot length (mm) of sunflower variety Mehran-I at different intervals as affected by concentration of NaCl.*

Intervals	Treatments					Mean
	Priming with tape water	50 mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	
1ST week	22.00	19.17	18.84	18.50	15.04	15.59
2nd week	28.53	24.50	23.47	22.67	17.04	19.36
3rd week	33.67	30.04	27.00	26.04	19.10	22.64
4th week	39.39	38.67	29.33	28.25	21.38	26.17
5th week	42.38	42.00	34.17	32.33	22.12	29.00
6th week	45.25	43.33	38.00	35.17	23.25	30.00
7th week	46.30	44.17	42.22	37.00	25.00	32.00
Mean	36.78	34.55	30.43	28.56	20.41	--

7. Number of green leaves plant^{-1}

The results on analysis of variance mean for number of green leaves plant^{-1} of two cultivars of sunflower sown under different concentrations of NaCl obtained are shown in the Table-7. The results revealed that number of green leaves differed significantly between concentrations of NaCl cultivars, NaCl x cultivars intervals, NaCl x intervals, and cultivars and intervals, while no significant difference between the interaction of NaCl x cultivars x intervals. Increasing concentrations of NaCl significantly reduced number of green leaves. Among the cultivars, M1 recorded greater green leaves than the Record in each concentration of NaCl. Number of green leaves increased as crop age improved then it declined as crop reaches to maturity.

Table 7. *Average number of green leaves plant^{-1} of sunflower variety Mehran-I at different intervals as affected by concentrations of NaCl.*

Weeks	Treatments					Mean
	Priming with tape water	50 mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	
1ST week	5.00	5.00	5.00	4.33	3.60	3.82
2nd week	9.06	9.00	8.00	7.00	5.12	6.36
3rd week	12.33	12.00	11.00	9.33	7.12	9.40
4th week	13.67	13.00	11.10	9.67	9.00	8.63
5th week	13.90	13.10	12.15	10.15	9.45	9.97
6th week	14.00	13.50	13.08	11.25	10.45	10.36
7th week	15.02	14.65	14.08	12.23	11.10	11.18
Mean	11.85	11.46	10.63	9.13	7.97	--

8. Number of dry leaves plant^{-1}

About the data number of dry leaves of two cultivars of sunflower evaluated for various concentrations of NaCl recorded are presented in Table-8. The results indicated that NaCl treatments, cultivars, treatments x cultivars, intervals, treatments x intervals and cultivars x intervals had significant effect on number of dry leaves plant^{-1}, while the interaction of treatments x cultivars x intervals was non-significant. Sunflower treated with NaCl resulted in greater number of dry leaves. Increasing NaCl level increased number of dry leaves as compared to priming with tape water. Among the two cultivars tested cultivar record displayed maximum number of dry leaves as compared to variety M1.

Table 8. *Average number of dry leaves plant^{-1} of sunflower variety Mehran-I at different intervals as affected by concentration of NaCl.*

Weeks	Treatments					Mean
	Priming with tape water	50 mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	
1ST week	1.67	1.10	1.03	0.96	0.68	1.08
2nd week	1.67	1.33	1.04	1.00	0.90	1.22
3rd week	2.40	2.33	1.50	1.33	1.00	1.77
4th week	3.67	3.33	2.27	1.75	1.67	2.53
5th week	4.67	3.33	3.15	2.70	1.95	3.16
6th week	4.83	4.00	3.22	2.95	2.25	3.44
7th week	5.10	5.00	4.30	3.25	2.40	4.01
Mean	3.43	2.91	2.38	1.99	1.55	--

9. Fresh weight of leaves (g)

The data pertaining to fresh weight of leaves of two cultivars of sunflower planted under different concentration of NaCl recorded are shown in Table-9. It may be seen from the results that various NaCl treatments had significant effect on fresh weight of leaves, while no significant differences in the fresh weight of leaves was observed between cultivars and the interaction of NaCl and cultivars. Increasing concentration of NaCl significantly reduced fresh weight of leaves. This reduction was maximum at 200 mM NaCl (3.09), while it was maximum in case of priming with Tape water (26.58g). There were no significant differences among the two varieties tested. It was found that variety Record showed greater fresh weight of leaves (13.62 g, plant^{-1}), while Mehran-I recorded lowest weight (12.88 g plant^{-1}).

Table 9. *Effect of different salinity (NaCl) levels on the fresh weight of leaves (g) of two varieties of sunflower.*

Varieties	Treatments					Mean
	Priming with tape water	50 mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	
Mehran-1	24.54	18.86	14.20	3.65	3.14	12.88
Record	28.63	19.66	13.33	3.47	3.03	13.62
Mean	26.58	19.26	13.76	3.56	3.09	--

10. Dry weight of leaves (g)

The results of dry weight of leaves of two sunflower cultivars evaluated under different concentration of NaCl recorded are presented in Table-10. It was found that variety Record showed greater dry weight of leaves (4.54g plant^{-1}), while Mehran-I recorded lowest weight (4.15 g plant^{-1}). Increasing concentration of NaCl increased dry weight of leaves. The minimum was recorded at 200 mM (2.84g) and maximum in case of Tape water (6.17g). The results further showed that both the cultivars equally affected by concentrations of NaCl. The results indicated that the differences in the dry weight of leaves between the concentration levels of NaCl were highly significant, while no significant difference between the cultivars and the interaction of treatments x cultivars.

Table 10. *Effect of different salinity (NaCl) levels on the dry weight of leaves (g) of two varieties of sunflower.*

Varieties	Treatments					Mean
	Priming with tape water	50 mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	
Mehran-1	5.45	5.31	4.05	3.07	2.87	4.15
Record	6.89	5.07	5.80	3.13	2.81	4.54
Mean	6.17	5.19	4.42	3.19	2.84	--

11. Na^+ content of green leaves (%)

The data regarding Na^+ content of green leaves of two sunflower cultivars tried under different concentration of NaCl obtained are presented in the Table-11. The result revealed that Na^+ content of leaves increased as concentration of NaCl increases. The Na^+ content was recorded when NaCl was applied at 200 mM NaCl however, content of Na^+ was recorded in pots priming with tape water. The result further revealed that among the two-variety evaluated maximum content of Na^+ was recorded in case of variety M1 (62.13%), while cultivar Record displayed lowest Na^+ content of leaves (59.46%). The statistical analysis of data showed that there was no significant difference in the Na^+ content of leaves between concentration of cultivars and their interaction.

Table 11. *Na^+ content in green leaves of two sunflower varieties as affected different concentration of NaCl.*

Varieties	Treatments					Mean
	Priming with tape water	50 mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	
Mehran-1	42.667	55.667	59.333	71.00	82.00	62.133
Record	45.667	49.333	57.00	70.333	75.00	59.467
Mean	44.167	52.500	58.166	70.667	78.500	--

12. K^+ content of leaves (%)

The results on K^+ content of leaves of two sunflower cultivars treated with different concentrations of NaCl obtained are presented in the Table-12. The results indicated that K^+ content of leaves was in pots treated with 200 mM NaCl while pots priming with tape water resulted in K^+ content of leaves. The results further indicated that although the results were non-significant, however, variety M1 displayed maximum K^+ content of leaves (47.26%) as compared Record which recorded lowest K^+ content of leaves (41.33%).

Table 12. *K^+ content in the green leaves of two varieties of sunflower as affected at different concentrations of NaCl.*

Varieties	Treatments					Mean
	Priming with tape water	50 mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	
Mehran-1	32.333	44.333	48.000	50.00	61.667	47.267
Record	31.333	34.000	37.667	49.667	54.000	41.333
Mean	31.833	39.167	42.833	49.833	57.833	--

13. Na^+ content of plant

The results on Na^+ content of sunflower plant under different concentrations of NaCl recorded are shown in the Table-13. The results revealed that Na^+ content sunflower plant increased as NaCl increased. Application of 200 mM NaCl displayed highest Na^+ content of plant while sunflower priming with tape water resulted in lowest Na^+ content of plant. The results further indicated that cultivar M1 recorded comparatively maximum Na^+ content of plant (131.33%) when compared to Record (121.26%), although the results were statistically non-significant for treatments, cultivars, and their interactions.

Table 13. *Na^+ content of two sunflower varieties plants as affected by different concentration of NaCl.*

Varieties	Treatments					Mean
	Priming with tape water	50 mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	
Mehran-1	120.00	120.667	133.333	136.000	146.667	131.333
Record	106.667	114.333	120.333	131.667	133.333	121.267
Mean	113.333	117.500	126.833	133.833	140.000	--

14. K^+ content of plant (%)

The data pertaining to K^+ content of sunflower plant treated with different concentrations of NaCl recorded are shown in the Table-14. It may be seen from the results that increasing NaCl corresponding increased K^+ content of plant. K^+ content of plant was observed when 200 mM NaCl was applied while sunflower priming with tape water resulted in K^+ content of plant. The results further indicated that among the two cultivars evaluated Mehran-1 recorded greater K^+ content of plant (221.87%) than did Record (200.20%). The statistical analysis of data showed no significant difference in the K^+ content of plant among treatments, cultivars, and their interactions.

Table 14. *K^+ content of two sunflower varieties plants as affected by different concentration of NaCl.*

Varieties	Treatments					Mean
	Priming with tape water	50 mM NaCl	100 mM NaCl	150 mM NaCl	200 mM NaCl	
Mehran-1	198.667	205.667	210.333	240.333	254.333	221.867
Record	178.667	184.333	193.333	221.333	223.333	200.200
Mean	188.667	195.00	201.833	230.833	238.833	--

4. Discussion

In the saline soils have problem because the salts prevent plant roots from making use of water in soil. Salts in the soil water inhibit plant growth for two reasons [12]. First, the occurrence of salt in the soil solution reduced the ability of the plant to take up water, and this leads to reductions in the growth rate. This is referred to as the osmotic or water deficit effect of salinity [13]. High salt content in the soil also causes nutrient deficiencies [14]. The present studies were, therefore, conducted to see the effects of NaCl priming on salt tolerance in sunflower seedling growth under saline conditions. The results of 1st experiment carried out in which the seeds of six cultivars of sunflower were placed on blotting paper and treated them with different concentrations of NaCl and compared with untreated control under laboratory conditions indicated that seed germination recorded after 24 hours up to 144 hours of sowing showed that salinity levels, cultivars, interval and their interaction had significant effect on seed germination, increasing NaCl level significantly decreased in the seed germination%, in all varieties, among cultivar Record showed some resistant against salinity [15-17]. Root length was not affected by NaCl while varied significantly among cultivars. Record produced greater root length (45.19mm) over rest of the cultivars evaluated [18]. Further fresh weight of root and dry weight of root affected by NaCl treatments cultivars and their interaction. Fresh and dry weight of root decreased significantly as NaCl level increases. Among cultivars, greater fresh and dry weight was observed in case of variety Mehran-1 [19-20]. It was further noted that Na^+ and K^+ content of both leaves and plant increased in both of cultivars as NaCl increased but this increment was more in case of cultivar Mehran-1. These results are also supported by the findings of [21], evaluated different salinity level in sunflower and found that salinity delayed seed germination, and emergence at high NaCl no germination was observed. The growth of all cultivars decreased with the increased in NaCl concentration. At 0.05% NaCl and high concentration, the growth in plant was more pronounced [22, 23]. While found that salt stress in sunflower caused marked injury to seeding growth, with the effect on leaf area being more significant than on plant height [24]. Found that in sunflower K supply did not significantly alter plant dry matter production, but increased leaf surface area with moderate salt concentration (50 mM NaCl) in the root environment [25]. identified important components of salt tolerance in sunflower low uptake it, high uptake of K^+ and Na^+ reported that seedling growth exhibited similar sensitivity to that of seed germination under high salt concentrations in sunflower [26-29].

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