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Annals of Biological Research, 2013, 4 (5):256-261
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0976-1233
CODEN (USA): ABRNBW

The impact of spraying silamol on the resistance of some agronomical parameters of *Lolium Perenne* L. to salinity

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ABSTRACT

In most parts of Iran, the salinity of water and soil is regarded as one of the effective factors in reducing the growth of plants. Silicon is one of the beneficial elements in increasing the resistance of plants against environmental tensions like salinity. In order to assess the effect of Silicon (Si) and salinity on some parameters of this lown, an experiment was conducted in the spring season of 1391(2012) in factorial which was based on a fully randomized plan with six salinity levels (0, 2, 4, 6, 8, 10 DS/m) and three Silicon levels (0, 0.3, 0.6 Ml/L Silamol) with three replications. The growth indexes (length of stem; the length of tiller; number of leafs in stem; number of leafs in tiller; and the number of tillers in the bush were analyzed. The results showed that salinity has a significant reducer effect on all of the measured indexes. The consumption of Silamol was solely meaningful in all of the evaluated factors except for the length of stem, and the number of leaves in the stem.

Key words: salinity, Silicon, lown, resistance to salinity, indexes of tiller, soluble spraying.

INTRODUCTION

Lown as one of the most important covering plants has a fundamental role in making green landscapes. On the one side, the salinity of soil and water is one of the deterrent factors in the growth of plants in dry and semi-dried regions and for this reason the use of salinity-resistant lowns or the use of an agent that can increase the resistance of lowns against salinity is regarded as one of the solutions in making the city landscapes in these regions. Nowadays, the per capita for landscapes in the world varies between 5 to 50 square meters, while the defined standard for Iran is 30 square meters [1]. Sometimes the application of salty water especially in the primary stages of germination will destroy all the efforts that have been made to make a suitable landscape. In a country like Iran, despite the recent talks in some circles based on removal of lown in landscapes, regarding this issue that Iran is the birthplace of lown [1], this method could be used widely. Optimized nutrition with different elements is one of the balancing factors of the salinity effects.

Silicon is regarded as one of the important elements in regulating the salinity tension. This element is the second affluent element on the crust of the earth (%31) after Oxygen (%49) [2]. Although Silicon is not regarded as a necessary mineral element for plants, it is a necessary element in some plants [3]. Several studies have shown that this element has positive effects on the growth of the plant [10,11,12]. Many plants have the ability to absorb Silicon and depending on different types, the accumulated Silicon content in the biomass can range from 10 to more than 100 Grams in Kilogram [5,6]. Not much information is available regarding the role of Silicon in the biology of the plant [5,19]. Silicon treatment can increase the tolerance of the plant against the toxicity of the Manganese, Iron, Aluminum, and the heavy metals [2,7]. Silicon decreases the availability of the abovementioned toxic elements to the roots of plants including rice and cane and increases the resistance of rice and barley to the salinity tension [8,16,17].

MATERIALS AND METHODS

This research was conducted in the spring of 2012 in the greenhouse of the flora clinic of the 21st district municipality of Tehran which is located in southwest of the capital of Iran. The resistance to salinity and growth indexes of *Lolium Perenne* L. under spraying Silamol was studied in factorial and was based on a fully randomized plan with three times replications and 18 treatments. The conducted treatments included the treatment of NaCl solutions with control concentrations (distilled water) S1=0, S2=2, S3=4, S4=6, S5=8, S6=10 dS/m and treatment of Silamol solutions with control concentrations (distilled water) C1=0, C2=0.3, C3=0.6 milliliter per liter (ml/l). The bed soil was a combination with proportion of one third of sand, one third of animal muck which was totally rotten and one third of soil. At first, this bed soil was disinfected by 2/1000 Benomil anti-mucus and after passage of 10 days, the prepared 12×12 cm plastic vases were filled with sand and mineral pumices to make 3 cm drainpipe and then the vases were filled with disinfected soil. The seed of *Lolium Perenne* L. was made with purity level of %97 and viability of %85. According to the brochure of the producing company, 10 to 15 seeds are needed in each square inch. The surface area of each vase was 23 square inches. With 10 seeds in each square inch, 230 seeds were needed to be spread monotonously in each vase. Since the purity and viability levels were not %100, 40 more seeds were considered as *over seeds*. Totally, 270 seeds were spread on the vase surface and then 0.5 cm of rotten muck was added to it. The *Lolium Perenne* L. used in this experience named *Express II* was in dark green and had a relative growth with a good density and had an extraordinary power of germination. Experts use this variation in the southern hot regions for overseeding and apart from that, it could be used as a perennial and permanent lown. The Silamol spraying was done every 14 days (according to the brochure of the producing company) after all the seeds were green and homogenous (19 days after plantation). The second stage of Silamol spraying was done 33 days after the plantation and before the application of salinity tension; the third stage was done 47 days after plantation and before the application of the salinity tension; and the fourth stage was done 61 days after the plantation and one week before the application of the salinity tension. The application of salinity tensions with the mentioned concentrations was done 54 days after the plantation and during 17 days. The sample's harvest time was done after the application of the salinity tension and 71 days after the plantation. The irrigation of all vases was carried out monotonously with distilled water (50 M/L in each session) due to the need of the plant. The laboratory salt (NaCl) with the purity level of %96 used in this research was made of German *Merck* Company. After 4 stages of renovating the lown from 5 cm top that was done to the complete pitching of the plant and the generation of tiller, on the fifth stage of renovating (71 days after plantation and 17 days after the application of salinity tension), 10 samples from each vase was selected for the assessment of the different parameters.

RESULTS AND DISCUSSION

The Length of the Stem

According to the results of the analysis of the parameters variance, the length of the stem was under influence of the different levels of the salinity tension and became significant in the statistical level of one percent, but the consumption of the different levels of Silamol and the reciprocal effects of experimental tensions (salinity and Silamol) did not have a significant difference of the length of the stem (Table 1). Among the different levels of salinity tensions, the highest length of the stem with the average height of 5.84 cm belonged to the salinity tension level of 2 dS/m and lowest length with the average height of 4.35 cm belonged to the salinity tension level of 10 dS/m. In addition, in the different levels of Silamol consumption, the highest length of stem with the average of 5.43 cm belonged to the treatment of consumption of 0.6 ml/l of Silamol and the lowest with the average of 5.04 cm belonged to the controlling treatment (consumption of distilled water) (Table 2). Based on the results of comparison of the reciprocal effects, it has been observed that the highest length of stem with the average of 6.12 cm belonged to the salinity tension treatment of 2 dS/m and consumption of 0.6 ml/l, and the lowest length of the stem also belonged to the salinity tension treatment of 10 dS/m with the average distilled water consumption of 4.05 cm (Table 3). In the salinity tension, with the increase of the salt concentration in the nutrient solutions, the osmotic potential of the solution increases, while water absorbency decreases and subsequently the Turgor pressure of the cells decreases. The loss of water forbids the cells to grow [15]. The application of Silicon balances the effect of water tensions and increases the growth of the plant. The conducted experiment on the corn plant showed that under conditions of water tensions, the amount of Calcium, Potassium, the dry and wet weight, chlorophyll content and the level of photosynthesis decreases and the application of Silicon in these conditions increases these physiologic parameters, improving the growth of plant and increases the amount of production [9].

The length of the Tiller

The results of the variance analysis showed that the length of the tiller under the influence of different levels of salinity tension and the consumption of different doses of Silamol became significant in statistical level of one percent, but the reciprocal effect of experimental treatments did not show a significant statistical difference on the length of the tiller (Table 1). The characteristics of tiller's length kept under the influence of the different levels of salinity tension in a way that the increase in salinity tension extremity led to the decrease in the length of the tiller. Its highest level with the average of 3.39 cm belonged to the distilled water treatment and the lowest with the average of 2.45 cm belonged to the salinity tension treatment of 10 dS/m (Table 2).

Among the different levels of Silamol consumption, the results showed that with the increase in the consumption of Silamol, the length of the tiller increases. In this experience, the maximum length of the tiller with the average of 3.29 cm belonged to the treatment of consumption of 0.6 ml/l Silamol and the minimum length with the average of 2.41 cm belonged to the treatment of distilled water (Table 2). The maximum length of Silamol with the average of 3.78 cm was gained after the treatment of distilled water accompanied by the consumption of 0.6 ml/l of Silamol. The minimum length of tiller with the average of 1.91 cm belonged to the treatment of salinity tension of 10 dS/m and the distilled water treatment (Table 3). With the increase in the concentration of salinity, the tiller length of three kinds of lawns including *Lolium perenne* L., *Festuca arundinacea* and C*ynodon dactylon* decreased. The salinity along with the change in the water condition of the plant lead to the stoppage of growth and obstruction in distribution and lengthening of cells and cause the destruction of the cells [14].

Basically, plants encounter two main problems when facing the salinity. From the one hand, the potential of the water surrounding the root decreases because of the decline in the available water for the plant and on the other hand, some ions leave toxic effects on biological and biochemical processes of the plant. Both problems lead to disorder in nutrient elements taken by the root and ultimately lead to decrease in the growth of the plant [18]. One way to decrease the malignant effects of salinity tensions is the use of mineral nutrition methods including Silicon nutrition [12].

Number of Leaves in the Stem

According to the taken results from the table of variance analysis, it has been observed that the different levels of salinity tensions had a significant difference ($P<0.01$) on the number of leaves in the stem but the consumption of the different levels of Silamol and the reciprocal experimental treatments statistically did not put significant difference on the number of leaves in the stem (Table 1). With the increase in the levels of salinity tensions, the number of leaves in the stem decreased. The highest level with the average of 10.88 belonged to the controlling treatment (consumption of distilled water) and the lowest figure was gained with the average of 8.22 from the salinity tension treatment of 10 dS/m. Also, Silamol caused the increase in the number of leaves in the stem. The highest number of leaves in the stem with the average of 10.05 numbers belonged to the treatment of consumption of 0.6 ml/l Silamol and the lowest figure with the average of 9.22 numbers belonged to the treatment of distilled water consumption (Table 2).

The comparison result of the average of reciprocal effects showed that the highest number of leaves in the stem came after the application of distilled water treatment along with the consumption of 0.6 ml/l Silamol which equaled to 11.33. The lowest figure was gained with the average of 7.66 of the salinity tension treatment of 10 dS/m along with the consumption of distilled water (Table 3).

With the increase in efficiency of water consumption and content improvement of the relevant humidity of leaf in the salinity condition, Silicon consumption leads to the increase in the Turgor pressure and the increase in size of the leaf. The plant's photosynthesis, also, increases in the presence of Silicon. This leads to the increase in the number of the leaves and expansion of the surface size of the leaf [9]. The presence of Silicon in the nutrient solution and in the salinity condition increases the number and surface size of the leaf, significantly. The decrease in the surface size of the leaf that is caused by salinity is either because of decline in the numbers of leaves caused by lack of photosynthesis, or the decrease in the size caused by the decline of the Turgor pressure [15].

Number of Leaves in the Tiller
According to the results of the variance analysis, the parameters of the number of leaves in the tiller were significant under the influence of the different levels of salinity tensions in the statistical level of one percent and the consumption of different levels of Silamol in statistical level of 5 percent. However, the twofold reciprocal effects of experimental treatments showed significant difference on the number of leaves in the tiller (Table 1). The increase in intensity of salinity tension led to the decrease in number of leaves in the tiller in a way that the maximum number of leaves in the tiller with the average of 11.77 numbers was gained from the control treatment (distilled water consumption) and the minimum with the average of 8.27 numbers was gained from the salinity treatment level of 10 dS/m (Table 2).

Among the different levels of Silamol consumption, the maximum number of leaves in the tiller with the average of 11.07 belonged to the treatment of consumption of 0.6 ml/l of Silamol, and the minimum with the average of 9.67 belonged to the distilled water treatment (Table 2).

Among the reciprocal effects of parameters, the maximum number of leaves in the tiller was gained from the distilled water treatment with consumption of 0.6 ml/l of Silamol which equaled 13.13. The minimum length was gained from the salinity tension treatment of 10 dS/m along with consumption of distilled water with the average of 7.80 (Table 3).

The Number of Tillers in the Bush
The results of the variance analysis showed that the number of tillers in the bush was significant under the influence of the different levels of salinity tensions and consumption of Silamol in statistical level of one percent, but the reciprocal effects of the experimental treatments did not statistically put a significance difference on the number of the tillers in the bush (Table 1).

According to the results of the comparison of the main effects average of Parameters, it has been observed that the maximum number of tillers in the bush with the average of 5.66 belonged to the controlling treatment (consumption of distilled water) and the lowest with the average of 3.33 belonged to the salinity treatment level of 10 dS/m (Table 2). Among the different levels of Silamol consumption, the highest number of tillers in the bush with the average of 5.05 was gained from the treatment of consumption of 0.6 ml/l and the lowest with the average of 4.33 gained from the treatment of distilled water consumption (Table 2). The twofold reciprocal effects of Parameters influenced the number of tillers in the bush, in a way that the highest number of the tillers in the bush gained from the treatment of the distilled water consumption along with consumption of 0.6 ml/l Silamol which equaled 6.33. The lowest number of tillers in the bush with the average of 3.00 belonged to the salinity treatment level of 10 dS/m along with consumption of distilled water (Table 3). Silicon causes the increase in the growth of the plant by increasing the number of the tillers, surfaces of the leaf and photosynthetic activity of the lower leaves, while the shortage of water causes leaning of the rice leaves and appearance of stained-leaves in cane. Silicon causes the leaves of the rice to stand vertically with good stability [6]. Ma & Takahashi [11] reported that Silicon increases the growth of the plant through increasing the number of tillers, expanding the surface of the leaf and also intensifying the synthetic activities of the lower leaves and also increases the number of Rachillae in the bunch in one hundred ripe seeds and the weight of one thousand seeds in the plant rice.

Table1. Analysis Variance of agronomical characteristic

S.O.V	df	The length of the stem	The length of the tiller	The number of leaves in the tiller	The number of leaves in the stem	The number of tillers in the bush
Factor A	5	3.08 **	1.08 **	17.92**	10.61**	6.80 **
Factor B	2	0.68 n.s	3.76 **	9.30*	3.16 n.s	2.38 **
AB	10	0.02 n.s	0.01 n.s	0.56 n.s	0.21 n.s	0.18 n.s
Error	36	0.26	0.06	2.87	1.37	0.42
%c.v	-	9.73	8.94	16.47	12.17	13.98

ns,,**: Non- significant and significant at in 0.05 and 0.01 level of probability respectively.*

Table 2. Means comparison of agronomical characteristic

Treatment	length of the stem (cm)	Length of the tiller (cm)	Number of leaves in the Tiller	Number of leaves in the stem	Number of tillers in the bush
S1	5.79 a	3.39 a	11.77 a	10.88 a	5.66 a
S2	5.84 a	3.18 ab	11.58 ab	10.66 a	5.33 a
S3	5.47 ab	3.03 bc	11.02 ab	9.88 ab	5.11 a
S4	5.17 bc	2.82 cd	9.92 bc	9.44 bc	4.44 b
S5	4.79 cd	2.65 de	9.13 c	8.55 cd	4.11 b
S6	4.35 d	2.45 e	8.27 c	8.22 d	3.33 c
C1	5.04 b	2.41 c	9.67 b	9.22 b	4.33 b
C2	5.23 ab	3.06 b	10.11 ab	9.55 ab	4.61 b
C3	5.43 a	3.29 a	11.07 a	10.05 a	5.05 a

(S) Salinity: S1= distilled water (control), S2= 2 dS/m, S3= 4 dS/m, S4= 6 dS/m, S5= 8 dS/m, S6= 10 dS/m (C) Silamol: C1= distilled water (control), C2= 0.3 ml/l, C3= 0.6 ml/l

Table 3. Means comparison of agronomical parameters

Treatment	length of the stem (cm)	Length of the tiller (cm)	Number of leaves in the Tiller	Number of leaves in the stem	Number of tillers in the bush
S1 C1	5.62 a-e	2.95 d-g	11.16 a-c	10.33 a-c	5 b-d
S1 C2	5.81 a-c	3.43 a-c	11.03 a-d	11 ab	5.66 ab
S1 C3	5.96 ab	3.78 a	13.13 a	11.33 a	6.33 a
S2 C1	5.57 a-e	2.71 e-h	10.73 a-d	10.33 a-c	5 b-d
S2 C2	5.84 a-c	3.23 b-d	11.06 a-d	11 ab	5.33 a-c
S2 C3	6.12 a	3.59 ab	12.96 ab	10.66 ab	5.66 ab
S3 C1	5.31 a-f	2.46 g-i	10.46 a-d	9.66 a-e	4.66 b-e
S3 C2	5.40 a-f	3.27 b-d	10.96 a-d	9.66 a-e	5.33 a-c
S3 C3	5.69 a-d	3.37 a-c	11.63 a-c	10.33 a-c	5.33 a-c
S4 C1	5.02 b-f	2.30 h-j	9.40 cd	9 b-e	4.33 c-f
S4 C2	5.12 b-f	2.98 c-f	9.80 b-d	9.33 a-e	4.33 c-f
S4 C3	5.37 a-f	318 b-e	10.56 a-d	10 a-d	4.66 b-e
S5 C1	4.70 e-g	2.11 ij	8.46 cd	8.33 c-e	4 d-g
S5 C2	4.75 d-g	2.82 d-g	9.40 cd	8.33 c-e	3.66 e-g
S5 C3	4.92 c-g	3.01 c-f	9.40 cd	9 be	4.66 b-e
S6 C1	4.05 g	1.91 j	7.80 d	7.66 e	3 g
S6 C2	4.47 fg	2.61 f-h	8.40 cd	8 de	3.33 fg
S6 C3	4.54 fg	2.81 d-g	8.63 cd	9 b-e	3.66 e-g

(S) Salinity: S1= distilled water (control), S2= 2 dS/m, S3= 4 dS/m, S4= 6 dS/m, S5= 8 dS/m, S6= 10 dS/m (C) Silamol: C1= distilled water (control), C2= 0.3 ml/l, C3= 0.6 ml/l

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