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Evaluation of Different Rice Genotypes in Response to Salinity Stress in Seedling Stage

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ABSTRACT: In order to assess the response of rice genotypes to salinity stress at seedling stage a factorial experiment with three replications in a completely randomized design in the biotechnology lab of Sari University of Agricultural Sciences and Natural Resources was carried out. In this experiment, the numbers of 17 rice genotypes in 4 salinity levels (0, 40, 80 and 120 mM) were studied. In this study biomass, root and shoot length, root and shoot fresh and dry weight traits was measured. Analysis of variance showed that significant effect of salinity on the traits of rice genotypes. According to the results of mean comparison of traits, by increasing the salinity of control level to 40, 80 and 120 mM levels, significantly reduced all characters. Shoot dry weight had the most reduction percent and root length had the lowest reduction percent in salinity. Simple correlation coefficients between traits showed a significant positive correlation between biomass and root dry weight (r = 0.998). The results of principal components analysis showed that in the first component, biomass (0.956) had the highest rates in the positive direction. According to the analysis done in terms of tolerance genotypes, Shastak Mohammadi and Line 21 in different levels of salinity were superior to other genotypes and can be used in continuing its reform programs.

Keywords: Correlation, Principal components, Rice, Salinity, Seedling.

INTRODUCTION

Research about the trend of population increase shows that between years 1950-2015, the population of earth has increased from 2.6 billion to 6 billion, therefore, the earth population is going to reach 11 billion by 2050. Food is one of the basic human rights. To provide food security, the production of food most be doubled. These days, producing rice has gained importance and after wheat, it is considered the second main food of people. Rice is the food of 2.4 billion people and provides 20% calorie of body. In comparison to large Asian countries such as china and India, Iran doesn't have considerable rice lands, but 600 hectares of rice fields have determining roles in providing food security and increasing or national income. Some of the limiting factors and an alarm in producing this strategic product include damage causes, the high cost of producing and misusing the rice fields (Sakina *et al,* 2016). Environmental stresses are the most important factors to decrease agricultural products in the world. If environmental stresses don't happen, the real yield must be equal to plant potential yield. While in most of the agricultural plants, the average yield of plants is 10 to 20 percent of potential yield. Iran is one of the countries where, in most of the parts, the important on alive stresses such as salinity, drought, temperature, wind and alive stresses such as fungal, bacteria, viruses, insects have decrease the yield and caused soil fertility and in some cases, inability to continue agriculture (Ologundudu *et al*, 2014). Any factor which prevents the full expression of genetic potential of one or some characters in a plant is called stress. According to biology, stress is defined as any type of change in environmental condition which leads to decrease or undesirable change of one action. In other words any change in environmental condition which cause to undesirable reaction of plant is called stress. This definition shows that stress doesn't mean the lack of one factor, but according to rules, the limiting factor, lack of one ecological factor or it's decrease to lower than the critical point or it's increase to the maximum of creature's tolerance, plays a limiting role. Too much increase of an environmental factor which a plant can't tolerate is called stress (Shereen *et al,* 2005). Non alive stresses including some of environmental factors such as salinity, drought, cold, and etc can cause decrease in yield by several mechanisms, stress of water, salt and dryness are the most important factors of arid and semi-arid areas. By estimation, only 10 percent of cultivable of the world are classified as land free of salt, 20% of lands are influenced by mineral stress, 26% by drought and 15% by freeze stress (Livett, 1991).

Rice is approximately sensitive to salt and this stress causes that root grow less than usual and the metabolic process of plants have delay. Since in arid and semi-arid areas and lands by sea, it's difficult and expensive to deal with salty water and land. Therefore, the best way to increase the areas under cultivation is to identify and use of genotypes which have tolerance to salt to plant in these area. This problem is identified in Mazandaran which is the main area for planting rice by 200 thousands hectare. Although, the main water sources are river, spring and local pit in some places dams. Most of these lands benefit from good water and soil, but some areas don't benefit from good water and soil due to being close to sea and suffer from salty water and soil. These areas extended to 30 thousands hectare cover 14% of the whole rice lands of this province (Mirdar Mansoori *et al,* 2011). Ologundudu *et al* (2014) investigated the reaction of genotypes to salt stress in seedling stage in hydroponic plant and found out that characters such as height, leaf surface, root length, shoot length, dry weight of root, dry weight of shoot and dry weight of leaf and total biomass have shown significant difference in reaction to salt and the correlation ration of all the characters in seedling stage is positive and meaningful. Among all the characters, total biomass, showed the difference between genotypes and also salt treatment more than the other characters. Majeed *et al* (2013) investigated salt stress on growth criteria and physiological of different types of rice in seedling stage and stated that if salt increases 8 deci siemens in root length, shoot length, dry weight of root and shoot, leaf surface and chlorophyll decreases. Ghomi *et al* (2013) investigated the effect of salt on characters of rice seedling stage and identified the criteria for choosing appropriate genotype in seedling stage in salty condition. To do so, they investigated 150 family from F4 population produced by combination of Sepiderood and Qarib randomly and in effect of 12 deci Siemens on mater seedling stage in a controlled condition. They found out that dry weight of root and shoot to produce more biomass in seedling stage in rice in salt stress has the most importance. Mirdar Mansouri *et al* (2011) investigated 40 cultivars and the modified cultivar of rice in growth stage to evaluate salt tolerance of genotype of Iranian rice in hydroponic area and stated that there has been a significant difference among characters. Also, in seedling stage, cultivars such as Hasani, Shashtak Mohamadi, Talorm Milad and line 109 showed desirable tolerance to salt stress. This study aimed to investigate the seedling stage of rice growth and quantity cultivars of different genotypes of rice according to their tolerance to salt stress which can lead to choose the most tolerant genotype to this stress and by planting these types in salty areas, the yield will increase.

MATERIALS AND METHODS

To investigate the effects of salt stress in seedling stage of rice in 4 salinity levels including control, 40, 80, and 120 (mM). Sodium chloride has been investigated in the biotechnology lab of Sari University of Agricultural Sciences and Natural Resources. To provide salty mixtures, 40, 80,120 (mM) of salt has been combined to amount of sodium chloride 2.34 g, 6.68 g and 7.02 g by one liter of distilled water. This research has been done in hydroponic environment. In this study ,17 types of genotype including 7 Mutant lines of Tarom Mahaliin generation 7^{th} (M_7) and Tarom Jolodar, Shastak Mohamadi, Tarom Mahali, 5 Promising Lines, produced by classic modified of F12 generation, and controlled sensitive cultivars (IR29) and tolerant controlled cultivar (NONA BOKRA) has been administered in factorial test in 3 repetitions randomly. To plant, Styrofoam pages with 100 holes 10*10 and containers with 4 liters were used. First, each of these genotypes was provided according to the need of each seed. Seeds were put in a dish with paper after it has been cleaned by mixture of 10 percent of hypo chloride sodium and vita vax 1 per of 1000. They were sent to germinator system for growing seed. The temperature of germinator must be 27 Centigrade. They were sent to each hole and plastic system (a plastic surface with small holes that roots can move from it). In each hole one was planted and distilled water was used to transfer it for 7 days. Then, nutritional solution called Yoshida was added to dishes. pH of the solution was controlled every day and was kept fixed in 5. The nutrition solution was changed every day.

The average environmental temperature was 30 Centigrade during the day and 20 Centigrade at nights. After administering salt stress, the condition of seeding stage was investigated every day and their reactions were recorded. After 3 weeks, seedling stage rice was collected and their characters such as the length of root and shoot and the weight of root and shoot were evaluated to evaluate the dry weight of root and shoot, they were put in oven with 70 Centigrade temperature for 48 hours to fix their weight. Then they were measured by digital scale with sensitive to 0.001 gram, to measure their dry weight of root and shoot. Then the analysis was performed with SPSS software version 24. The process of data was done by (EXCEL).

RESULTS AND DISCUSSION

The results showed significant effect of salt stress on characters under study about genotype. So the effect of salt stresses on all the studied characters such as length of shoot and root and the fresh and dry weight of shoot and root and total biomass on 1% probability levels were significant. The results express the existence of genetic variety among rice genotypes under study in seedling stage and under salt stress (Table 1).

The comparison of average of characters showed that all the characters had significant decrease by increase in the amount of salt from controlled levels to 40, 80 and 120 mM (Table 2). Also, cultivars and genotypes under the study showed the most amounts of all characters such as root length, shoot length, fresh weight of shoot and root and dry weight of shoot and root and biomass of all in the controlled levels and without salt and they also showed the least amount in 120 mM of NaCl. Therefore, the length of shoot with the most amount in the controlled group without salt (18.32 cm) and least amount in level of 120 Mm (11.97 cm) and the percent of decrease in this feature in comparison to controlled is 34/7%.

Table 1: Variance analysis of the effect of salt stress and genotypes about the study of root and shoot length, the fresh weight and dry weight of root and shoot and total biomass.

Sources of variation	Degrees of freedom	Mean Squares						
		Length of shoot (cm)	Length of root (cm)	Fresh weight of shoot (mgr)	Fresh weight of root (mgr)	Dry weight of shoot (mgr)	Dry weight of root (mgr)	Biomass (mgr)
Salinity	3	459.876**	28.737**	0.472**	0.713**	2.354**	0.004**	2.501**
Genotype	15	278.171**	17.795**	0.049**	0.055**	0.047**	0.0001**	0.050**
Genotype × Salinity	45	49.599**	2.123**	0.035**	0.053**	0.032**	0.0001**	0.034**
Error	128	1.916	0.503	0.006	0.001	0.002	0.0001	0.002
CV%		9.18	12.4	17.54	22.91	20.42	13.45	18.44

**: significant at 1% probability levels, respectively.

Table 2. The mean comparison of root and shoot, fresh weight and dry weight of root and shoot and total biomass in different levels of salt in rice genotypes with the percent of decrease in characters.

Characters Salinity levels (mM)	Length of shoot (cm)	Length of root (cm)	Fresh weight of shoot (mgr)	Fresh weight of root (mgr)	Dry weight of shoot (mgr)	Dry weight of root (mgr)	Biomass (mgr)
Control	18.32ᵃ	6.23ᵃ	393.00ᵃ	315.00ᵃ	470.00ᵃ	30.00ᵃ	500.00ᵃ
40	16.85ᵇ	6.03ᵃ	307.00ᵇ	91.00ᵇ	324.00ᵇ	28.00ᵃ	353.00ᵇ
Decrease (%)	9.5	3.21	21.88	71.11	31.06	6.67	29.4
80	13.14ᶜ	6.01ᵃ	261.00ᶜ	84.00ᵇ	52.00ᶜ	24.00ᵇ	76.00ᶜ
Decrease (%)	28.27	3.53	59	73.33	88.94	20	84.8
120	11.97ᵈ	4.63ᵇ	162.00ᵈ	63.00ᶜ	29.00ᵈ	11.00ᵈ	40.00ᵈ
Decrease (%)	34.66	25.68	58.78	80	93.83	63.33	92

Means followed by the same letters are not significantly different by the Duncan's test at 5% probability level.

The root length was the most in controlled level without salt (6.23 cm) and the least amount was in 120 mM salt (4.63cm) and the percent of decrease in this character in comparison to controlled is 25.68%. Also the fresh weight of shoot was the most in controlled level without salt (393.00 cm) and the least amount was in 120 mM salt (162.00cm) and the percent of decrease in this character in comparison to controlled is 58.78%. Besides, in fresh weight of root, the most amounts were in the controlled level without salt (315.00 mgr) and the least amount in level of 120 mM salt (63.000 mgr). The decrease ratio in comparison to control is 80%. The dry weight of shoot showed the most amount in controlled level without salt (47.00 mgr) and the most amount in level of 120 mM salt and the decrease ratio in comparison to controlled was 93/83%. The dry weight of root showed the most in controlled level without salt (30.00 mgr) and the most amount in surface of 120 mM (11.00 mgr) and the decrease ratio in comparison to controlled level was 63.34%. The biomass was the most amount in controlled level without salt (50.00 mgr) and the least amount in level of 120 mM (40.00 mgr) and the most decrease ratio was for dry weight of shoot and the least decrease ratio was for root length in salinity stress.

Sakina *et al* (2016), Grigorio *et al* (1997) and Zeng and Shannon (2000), have found the similar results to this research and stated that salt increase reduces seedling characters in rice. They claimed that salt causes decrease of water attraction by plant, therefore dry and fresh weight of plant decreases. Salt stress causes not having balance between the attracted water from root and removed water from shoot. So the stoma gets closed and it leads to decrease of sweating, photosynthesis and plant growth.

The length of shoot and root:

Comparison of genotypes shows that the highest length of shoot belongs to NONA BOKRA (21.75 cm) and the lowest belongs to IR29 (3.01 cm). Besides, the highest length of root (7.17 cm) belongs to M618 and the lowest amount (1.93 cm) belongs to IR29, (Table 3). Length of root and shoot will decrease in several cultivars when salinity stresses increased. So the highest length of root in 120 mM (20.00 cm) belongs to NONA BOKRA and the lowest amount (2.22 cm) belongs to IR29. Also, the highest length of shoot (6.31 cm) in this level belongs to Line 59 and the lowest (2.66 cm) belongs to IR29 (Table 4). The results are in agreement with Ologundudu *et al* (2014). They stated that the length of root of plants decreased when salinity stress increases. They claimed that plant's growth decreases dramatically due to decrease in water potential around root by salt. When the water potential of environment is low, it may goes to cut with salt solution that decreases water potential. This activity allows the water to continue it's bio processes and it's duties even in low potential. Also, decrease of root length in different cultivars of rice with increase in salt stress may decrease Ca^{+2} ions and increase Na^{+} in the parameters. Shoot length is influenced by root length, since plants tolerating salinity, attract water with their long roots in salt stress (Sakina *et al,* 2016). Genotypes such as M182, M184, Line 59, Line 113, M185, M618, M181, Shashtak Mohamadi which has longer root length in comparison to controlled level, are most tolerant. In the hierarchy after NONABOKRA, genotypes such as M181, M182 had the highest length (Table 3). The study shows that most of tolerant and half tolerant cultivars were tall cultivars, like Shashtak Mohamadi, Line 21, and IR29 which were very sensitive to salinity in dwarf cultivars. It's likely that dwarf cultivars tolerate decrease in plant growth in salt stress. This character has superiority over the other physiological activities of tolerating salinity. Therefore, shoot length is considered important in studying rice genotypes. Genotypes which have less height in salt stress in comparison to controlled level shows more salt stress (Shereen *et al,* 2005).

Table 3. The mean comparison of root and shoot, fresh weight and dry weight of root and shoot and total biomass in rice genotypes.

Characters / Genotypes	Length of shoot (cm)	Length of root (cm)	Fresh weight of shoot (mgr)	Fresh weight of root (mgr)	Dry weight of shoot (mgr)	Dry weight of root (mgr)	Biomass (mgr)
Shastak Mohamadi	15.202^{d}	5.75^{d-h}	324.00^{b-e}	234.75^{b}	248.833^{bc}	24.667^{cdf}	273.5^{bc}
Tarem Jelodar	13.00^{e}	5.37^{fgh}	195.25^{h}	63.83^{h}	194.667^{de}	26.000^{bc}	220.66^{d}
Tarem Mahali	18.63^{c}	5.80d-g	286.75^{d-g}	230.42^{b}	220.250^{cd}	20.05^{fg}	240.750^{cd}
Line 21	15.74^{d}	5.26^{ghi}	247.08^{fgh}	106.92^{def}	198.417^{de}	22.3^{def}	220.750^{d}
Line 59	13.15^{e}	6.62^{abc}	206.67^{h}	72.58^{gh}	165.083^{ef}	17.500^{bc}	182.583^{e}
Line 99	10.72^{f}	6.85^{ab}	377.33^{ab}	92.50^{efg}	252.250^{fg}	19.667^{fg}	271.917^{e}
Line 33	15.27^{d}	6.34^{bcd}	339.00^{a-d}	86.25^{fgh}	223.833^{cd}	25.417^{bcd}	249.250^{cd}
Line 113	9.69^{f}	6.03^{cde}	191.33^{h}	63.08^{h}	207.083^{d}	23.833^{cde}	230.917^{d}
M614	18.31^{c}	5.189^{ghi}	252.08^{fgh}	179.58^{c}	146.417^{g}	20.250^{fg}	166.667^{e}
M618	12.82^{e}	7.17^{a}	244.17^{fgh}	234.08^{b}	164.083^{ef}	22.833^{def}	186.917^{e}
M181	19.91^{b}	4.67^{i}	306.17^{c-f}	125.67^{d}	227.250^{cd}	22.417^{def}	249.667^{cd}
M182	20.63^{ab}	5.51^{e-h}	370.92^{abc}	116.92^{de}	327.917^{d}	26.833^{bc}	354.750^{d}
M184	20.78^{ab}	5.98^{def}	306.67^{c-f}	95.67^{efg}	283.750^{e}	21.833^{ef}	305.583^{de}
M185	15.48^{d}	6.70^{ab}	263.00^{e-h}	266.17^{a}	255.250^{fg}	20.250^{bfg}	275.500^{e}
M436	12.08^{e}	5.11^{hi}	254.50^{e-h}	93.83^{efg}	245.667^{c}	28.417^{b}	274.083^{bc}
IR29	3.01^{g}	1.93^{g}	220.00^{gh}	112.50^{def}	65.000^{h}	20.000^{g}	85.000^{f}
NONA BOKRA	21.75^{a}	6.97^{ab}	395.00^{a}	177.50^{c}	297.000^{ab}	37.133^{a}	334.133^{a}

Means followed by the same letters are not significantly different by the Duncan's test at 5% probability level.

Fresh weight of root and shoot: The comparison of genotypes shows that the most amount of fresh weight of shoot (395.00mgr) belongs to NONA BOKRA and the lowest amount (191.00mgr) belongs to Line 113. Also, the most fresh weight of root (266.1 mgr) belongs to M185 and the least amount belongs to Line 113 (63.08 mgr) (Table 3). The comparison of average interaction effects of salt and genotype for fresh weight of root and shoot showed that the intertwined effects of salt and cultivars had meaningful difference and the most amount of fresh weight of shoot (288.00 mgr) belongs to Line 21 and the least amount (72.00 mgr) belongs to M614 in 120 mM salt. Also, the freshest weight of shoot (150.00 mgr) belongs to NONA BOKRA and the least amount (30.00 mgr) belongs to IR29 in this level.

Shoot parameters are more sensitive to salinity. Decrease in shoot parameters maybe due to being closed and so decrease in hole moistures which cause limitations in photosynthesis capacity of plants (Zinnah *et al,* 2013). Genotypes such as M184, M182, M181 and Line 21 have more amount of fresh weight in comparison to tolerable controlled NONA BOKRA (Table 4). Also salinity limits water attraction by root and effects growing cells of plants dramatically. The increase of salt concentration can be poisonous (Sakina *et al,* 2016).

Table 4. **The mean comparison of inter relationship between genotypes and salt stress for length of root and shoot, fresh weight and dry weight of root and shoot and total biomass**.

Genotypes	Characters Salinity levels (mM)	Length of shoot (cm)	Length of root (cm)	Fresh weight of shoot (mgr)	Fresh weight of root (mgr)	Dry weight of shoot (mgr)	Dry weight of root (mgr)	Biomass (mgr)
Shastak Mohamadi	Control	22.65	6.42	648.67	370.00	615.00	27.00	642.00
Tarem Jelodar	Control	14.83	4.683	253.00	118.00	470.00	40.00	510.00
Tarem Mahali	Control	23.983	7.653	394.00	290.00	470.00	28.33	498.00
Line 21	Control	15.93	5.796	291.00	184.00	573.00	24.00	497.00
Line 59	Control	12.46	7.796	259.33	182.00	410.00	23.33	433.33
Line 99	Control	16.843	7.606	528.00	141.00	620.00	30.33	650.33
Line 33	Control	17.15	6.613	683.00	116.00	510.33	33.66	544.00
Line 113	Control	12.95	6.096	210.00	145.00	410.00	37.66	477.66
M614	Control	20.63	7.23	385.00	330.00	449.66	28.00	577.66
M618	Control	22.18	7.47	424.00	230.00	316.00	35.00	351.00
M181	Control	19.00	4.43	334.00	265.00	471.00	28.00	499.00
M182	Control	22.48	5.563	499.33	179.00	811.66	32.66	844.33
M184	Control	22.66	5.346	420.33	162.00	550.00	26.00	576.00
M185	Control	21.993	7.96	476.33	360.00	732.00	28.66	760.00
M436	Control	18.88	5.25	403.33	160.00	536.66	32.33	569.00
IR29	Control	15.80	5.58	300.00	260.00	430.00	20.00	520.00
NONA BOKRA	Control	23.00	7.5	560.00	360.00	760.00	35.00	585.00
Shastak Mohamadi	40	12.45	5.86	218.00	249.00	310.00	41.66	352.00
Tarem Jelodar	40	15.15	6.426	227.00	47.33	250.00	26.00	286.00
Tarem Mahali	40	23.05	6.26	321.00	91.33	350.00	22.66	373.00
Line 21	40	24.133	5.496	193.00	52.00	348.00	26.33	374.00
Line 59	40	19.60	6.2	178.00	44.00	187.00	21.00	208.00
Line 99	40	5.20	7.42	568.33	100.00	340.00	22.33	362.00
Line 33	40	18.633	7.236	295.00	106.33	323.00	29.33	353.00
Line 113	40	10.35	6.23	194.33	30.33	360.00	24.3	384.3
M614	40	26.15	4.796	327.33	81.00	280.03	23.00	303.00
M618	40	5.10	7.956	256.33	104.00	300.00	24.3	342.00
M181	40	26.00	4.74	380.33	97.00	358.00	22.00	380.00
M182	40	26.9	5.496	395.33	118.33	410.00	31.66	442.00
M184	40	26.383	6.306	283.00	81.33	310.00	31.33	341.00

Genotypes	Characters Salinity levels (mM)	Length of shoot (cm)	Length of root (cm)	Fresh weight of shoot (mgr)	Fresh weight of root (mgr)	Dry weight of shoot (mgr)	Dry weight of root (mgr)	Biomass (mgr)
M185	40	11.9	7.05	269.33	101.33	236.6	27.33	264.00
M436	40	6.75	5.73	218.33	97.00	370.00	30.00	400.00
IR29	40	3.8	1.25	230.00	200.00	90.00	10.00	100.00
NONA BOKRA	40	25.00	8.00	352.00	300.00	350.00	63.5	363.00
Shastak Mohamadi	80	16.36	5.65	339.33	45.33	40.33	20.00	60.33
Tarem Jelodar	80	10.73	6.43	167.00	46.00	36.66	29.00	65.66
Tarem Mahali	80	17.9	6.26	227.00	67.33	37.00	25.00	62.00
Line 21	80	10.21	5.5	216.33	152.33	34.33	24.00	58.33
Line 59	80	9.75	6.2	141.33	31.00	23.00	13.33	36.33
Line 99	80	14.18	7.42	294.00	54.00	33.00	15.00	48.00
Line 33	80	14.51	7.24	231.00	56.33	39.00	28.66	67.66
Line 113	80	10.11	6.23	247.00	28.00	40.00	20.66	60.66
M614	80	9.38	4.8	224.00	61.33	30.00	24.00	53.66
M618	80	13.83	7.96	211.33	56.00	27.33	23.00	50.33
M181	80	15.97	4.74	245.33	84.33	34.00	25.66	59.66
M182	80	14.65	5.5	365.00	87.33	48.00	31.00	79.00
M184	80	16.24	6.31	307.33	57.33	23.00	21.00	251.00
M185	80	14.71	7.05	204.33	45.00	32.33	17.00	49.33
M436	80	13.69	5.73	272.33	58.33	48.00	28.00	76.00
IR29	80	2.22	1.25	200.00	60.00	50.00	30.00	80.00
NONA BOKRA	80	19.00	8.00	320.00	200.00	100.00	40.00	140.00
Shastak Mohamadi	120	9.35	5.087	90.00	74.67	21.00	10.00	31.00
Tarem Jelodar	120	11.27	3.96	134.00	44.00	23.00	9.00	32.00
Tarem Mahali	120	9.6	3.04	155.00	73.00	24.00	6.00	30.00
Line 21	120	12.72	4.27	228.00	39.33	39.00	15.00	54.00
Line 59	120	10.82	6.31	248.00	33.33	41.00	12.00	53.00
Line 99	120	6.66	3.97	119.00	75.00	16.00	9.00	25.00
Line 33	120	10.8	3.4	147.00	66.33	23.00	10.00	33.00
Line 113	120	5.36	5.58	114.00	49.00	17.00	12.00	29.00
M614	120	17.12	3.93	72.00	46.00	26.00	6.00	32.00
M618	120	10.18	5.31	85.00	46.33	13.00	9.00	22.00
M181	120	18.69	4.87	265.00	56.33	20.00	14.00	34.00
M182	120	18.5	5.52	224.00	83.00	22.00	12.00	34.00
M184	120	17.87	5.97	216.00	82.00	25.00	9.00	34.00
M185	120	13.35	4.78	102.00	58.33	20.00	8.00	28.00
M436	120	9.01	3.77	124.00	60.00	28.00	23.00	51.3
IR29	120	2.22	2.66	180.00	30.00	20.00	1.00	21.00
NONA BOKRA	120	20.00	4.41	200.00	150.00	38.00	10.00	48.00
LSD		2.2349	1.1456	123.1	52.5	64.8	5.7	63.9

Dry weight of root and shoot: The comparison of genotypes shows that the most amount of dry weight of shoot (327.917 mgr) belongs to M182 and the least amount belongs to IR29 (65.00 mgr). Therefore the most amount of root dry weight (37.133) belongs to genotype NONA BOKRA and the least amount belongs to genotype IR29(10.00 mgr) (Table 3). The comparison of interaction average effect of salt and type on dry weight of root and shoot are meaningful. So the most amount of dry weight in 120 Mm level (39.00 mgr) belongs to Line 21 and the least amount (13.00 mgr) belongs to M618.

In the character such as dry weight of root, the most amount belongs to genotype M436 and the least amount (6.00 mgr) amount belongs to genotypes such as Shashtak Mohamadi, Tarom Mahali and M614 (Table 3). The results are in agreement with Zeng and Shannon (2000). The decrease in dry weight of rice in salt stress is due to decrease in water attraction by root, which is caused by decrease in potential around the root because of NaCl. By osmotic potential increase due to salinity stress, the cell length decreases and the amount reduces. By reducing root growth due to salinity or drought, the dry weight decreases. It can be said that the plants with stronger roots has less decrease in comparison to other plants. If a plant growth is compared in salt stress condition and salt free condition. It can be good criteria for salt tolerance. So the total dry material is a suitable criterion for assessing plant growth. (Majeed *et al,* 2013). Line 21 and Line 59 have more dry weight of shoot in comparison to controlled level. Also, genotypes such as Line 33, Line 21, Line 113, Line 59, M436, M182, M181, Shahtak Mohamadi are more tolerant since they have more dry weight of root.

Table 5: The correlation between characters such as length of root and shoot, fresh weight and dry weight of root and shoot and total biomass.

Characters	1.Length of shoot (cm)	2.Length of root (cm)	3.Fresh weight of shoot (mgr)	4.Fresh weight of root (mgr)	5.Dry weight of shoot (mgr)	6.Dry weight of root (mgr)	7.Biomass (mgr)
1	1						
2	0.417 ns	1					
3	0.551*	0.315 ns	1				
4	0.278 ns	0.233 ns	0.190 ns	1			
5	0.683**	0.537*	0.708**	0.076 ns	1		
6	0.348 ns	0.180 ns	0.441 ns	-0.013 ns	0.513*	1	
7	0.682**	0.529*	0.712**	0.073 ns	0.998**	0.564**	1

ns, * and **: No significant and significant at 5% and 1% probability levels, respectively.

Total biomass: By comparing genotypes, if can be found out that the most amount of total biomass belongs to IR29 (Table 3). Due to significant interaction effect of cultivar and salinity on character, the most amount of total biomas in 120 Mm level of NaCl (54.00 mgr) belongs to Line 21 and the least amount (22.00 mgr) belongs to M618 (Table 4). By increase in salt stress, active mechanism of the seeding tolerable cultivar will have less deformation. No need to mention that after attracting water and germinating and before their first leaves get in the exposure of sunlight and do photosynthesis, they use the food sources in endosperm to grow root and shoot. It has been reported that a lot of amino acid in seed has been used by increasing salinity stress, while this amount in non tolerant genotype cells is less. (Ologundudu *et al*, 2014). Base on studied by increase in salinity, the dry weight of biomass in most of the plants, especially rice decreases and it is likely that the negative effect of salt on plants, provoke osmotic potential in planting environment. So the root cells cannot receive the needed water from plants and transfer it to shoot. In plants attracting many types of mineral and nutrition material is limited through salinity. The growth of plants in salty area is inhibiting due to metabolic processes which lead to less production of dry weight of seedling stage. Biomass shows positive correlation to salinity tolerance and is used to choose tolerant genotypes to salinity (Sakina *et al,* 2016). Genotypes such as Shashtak Mohamadi and M436 had less biomass in comparison to controlled tolerant genotype (Table 3). Salt prevents cell division directly and indirectly and as a result leaf growth and plant cells stop. Salt causes Morphological changes such as decrease in root and shoot length, all of these factors decrease biomass (Zinnah *et al,* 2013). When the growth speed and as a result biomass is more, more cells are produced and there will be more vacuoles for collecting salt. Attracted salt by root produce poison in cytoplasm and stop cell growth and root growth by decreasing turgor (Hakim *et al,* 2010). M436, Line 21 and Line 59 are more tolerant since they have more general Biomass in comparison to controlled genotype.

The simple correlation between characters under study:

The correlation between characters under study showed that total biomass has positive and meaningful correlation with length of shoot (0.682**) and root (0.529**), the fresh weight of shoot (0.712**) and dry weight of shoot (0.998**) and root (0.564**). Therefore, it is concluded that all the mentioned characters have had effect in increase of biomass. The results show that long genotypes benefit from biomass in exposure to salinity stress. It is said that Shashtak Mohamadi, which has high dry weight, has more biomass.

Table 6. The Principle component analysis for length of root and shoot, fresh weight and dry weight of root and shoot and total biomass (componant transformation matrix).

Characters	Componant 1	Componant 2
Length of shoot	0.697	0.420
Length of root	0.480	0.513
Fresh weight of shoot	0.774	0.199
Fresh weight of root	-0.460	0.896
Dry weigh of shoot	0.941	0.163
Dry weight of root	0.710	0.216
Biomass	0.956	0.142
Variance(%)	51.739	19.638
Cumulative variance(%)	51.739	71.377

The most positive correlation and meaningful observed in 1% probability level belongs to total biomass with dry weight of root (0.998**). This shows that the most amount of biomass is related to dry weight of root and this feature has more importance in determining biomass character. The results are in agreement with Sakina *et al* (2016).

The principal component analysis for characters under study: Based on the result of principal component analysis, the first two components justified 71.38% of the total variations. In the first component, total Biomass (0.956) has shown more amounts in the positive way for itself and is more important. In the second component, fresh weight of root (0.896), showed the most amount in the positive way. In the first component, the characters such as shoot length, fresh weight of shoot, dry weight of root and total biomass had the most amounts in the positive way and this component justifies 51.74 percent of changes. In the second component, the length of root and fresh weight of root showed the most amount in the positive way. In general, the increase in both components improves plants reaction to stresses.

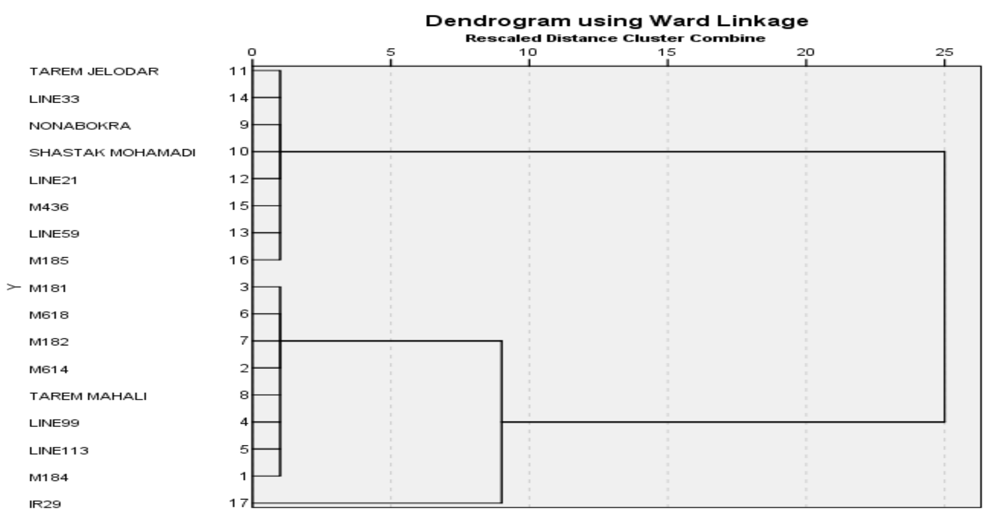

Fig. 1. The cluster analysis of genotypes based on shoot and root length, fresh and dry weight of shoot and root and total biomass under salinity stress.

Cluster analysis: According to danrogram results which were administered by ward method, genotypes are divided into 3groups. In first group include: genotypes such as M184, M614, M181, Line 99, Line 113, M618, and M182, Tarom Mahali. The second genotype include IR29, and the third contain genotypes NONA BOKRA, M185, M436, Line 21, Line 59, Line 33, Shashtak Mohamadi and Tarom Joladar according to the analysis the first group is half-tolerant to salinity, the second is sensitive and the third tolerant is to salinity.

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