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Effect of Salinity Stress on Growth and Yield of Forage Genotypes

Pijush Kanti Ghosh*, Md. Shafiqul Islam, Sarder Safiqul Islam

Agrotechnology Discipline, Khulna University, Khulna, Bangladesh
Email: *pijushpayari@gmail.com

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Abstract

Salinity is the major limiting factor for forage productivity in southwestern coastal region of Bangladesh. Some introduced forage cultivars have been shown promising adaptability in saline conditions. The objective of this study was to assess the productivity and measure the agronomic characteristics of several introduced grass species with different created soil salinity levels. This study was conducted at the net house of Dr. Purnendu Gain Field Laboratory, Agrotechnology Discipline, and Khulna University during the period from December 2017 to February 2018. The experiment was laid out in a factorial randomized complete block design with seven replications. The experiment consisted of two factor viz. soil salinity levels ($S_1 = 0.48$, $S_2 = 5.8$, $S_3 = 7.9$, $S_4 = 9.4$, $S_5 = 15$ d·Sm^{-1}) and thirteen forage genotypes. Salinity levels and forage genotypes significantly ($p < 0.05$) influence all the growth parameters and biomass yield. The growth parameters and yield gradually decreased with the advance of soil salinity level. The tallest plant height (109.85 cm) was found in S_1 at 90 DAS while the shortest plant (24.53 cm) was obtained in S_5 at 90 DAS. Soil salinity had a significant difference ($p < 0.001$) on plant height at 90 DAS. The highest numbers of tillers (3.36) were found in S_1, whereas the lowest (0.48) was in S_5 at 75 DAS. Soil salinity had a significant difference ($p < 0.001$) on Number of tillers at 75 DAS. The highest biomass wt. (29.14 g) was found in S_1, while the lowest biomass wt. (3.52 g) was obtained in S_5 at 60 DAS. Soil salinity had a significant difference ($p < 0.001$) on biomass wt. at 60 DAS. The highest dry matter% (DM%) (21.24%) was found in S_4, while the lowest DM (18.74%) was obtained in S_1 at 60 DAS. Soil salinity had a significant difference ($p < 0.001$) on dry matter% (DM%) wt. at 90 DAS. The tallest plant height (81.93 cm) was found in Pakchong, while the shortest plant (20.13 cm) was obtained in Endropogan at 60DAS. Soil salinity had a significant difference ($p < 0.001$) on plant height at 60 DAS. The highest numbers of tillers (3.07) were also found in Napier-3, whereas the lowest (0.80) was in H. Jaumbo at 75 DAS ($S_1 + S_2 + S_3 + S_4 + S_5$). Soil salinity had a significant difference ($p < 0.001$) on Number of tillers at 75 DAS. The highest biomass wt. (38.60 g) was found in Pakchong, while the lowest biomass wt. (4.49 g) was obtained in Oats at 60 DAS. Soil salinity had a significant difference ($p < 0.001$) on biomass wt. at 60 DAS ($S_1 + S_2 + S_3 + S_4 + S_5$). The highest (DM%) was found in Endropogan (24.68%), while the lowest DM (18.37%) was obtained Spelindida. Soil salinity had a significant difference ($p < 0.001$) on DM at 90 DAS. It can be concluded that Pakchong appears to be highly salt tolerant.

Keywords

Effect, Salinity Stress, Growth, Yield of Forage Genotypes

1. Introduction

Soil degradation caused by salinization and sodification is of universal concern. Salinity is a major constraint limiting agricultural productivity worldwide, and occurs in more than 100 countries of the world [1]. Nearly one billion hectares of land around the world were having some degree of salinization and sodification problem [2]. About 2.78 million hectares of land is classified as not suitable for agricultural cultivation due to salinization and sodification problems.

Soil salinity reduces forage yield [3] and alters mineral composition of forage [4]. Forage species vary in salinity tolerance and field testing under local edaphic conditions has identified appropriate forage species [4] [5] [6]. Out of 2.85 million hectares of the coastal and offshore areas of Bangladesh about 0.83 million hectares are arable lands. The low land use in saline area is mainly due to unfavorable soil salinity in dry season and unavailability of quality irrigation water [7] [8]. About 20% of the cultivable land of Bangladesh coastal region is affected by different degrees of salinity [9] [10] found that about 53% of the coastal area is affected by salinity. Rice-Maize cropping systems are of great importance for food security in south Asia and are fundamental to employment, income and livelihoods of millions of rural poor [10] [11]. Farmers have a poor idea about salt tolerant forage cultivars. Now it is dire need to identify the local/exotic forage cultivars which will solve the crucial forage shortage problem.

As salinity level increases with the progress of dry period, plant extracts less water from soil, aggravating water stress conditions. High soil salinity causes nutrient imbalances resulting from the accumulation of toxic elements in plants. Salinity affects growth and development of plants through osmotic and ionic stresses. Because of accumulated salts in soil under salt stress condition plant wilts apparently while soil salts such as Na^+ and Cl^- disrupt normal growth and development of plant [12] [13]. Because of accumulated salts in soil under salt stress condition plant wilts apparently while soil salts such as Na^+ and Cl^- disrupt normal growth and development of plant.

South-west coastal belt of Bangladesh is affected by different degrees of salinity. Bangladesh is a densely populated country with limited land resources where livestock gets very small places for grazing. It is important to serve green grass for getting increased productivity from livestock. The availability of green fodder and concentrate are 51.16 and 5.19 million tons DM against the requirements of 73.8 and 26.61 million tons [14]. The availability of green grass is mostly seasonal, only in monsoon, when plant growth is high. The roughage and concentrate available for feeding livestock could only meet 50% and 10% of the DM requirements, respectively. However, there is huge gap between the demand and availability of forages for animal production on commercial scale. Several studies in the past clearly indicated animal feeds and nutrient shortage in Bangladesh. Acute shortage of feeds and fodder is one of the single most important obstacles to livestock development in Bangladesh. A range of plants grow in saline soils and have been used as animal feed.

In South-East Asia as well as in Bangladesh very few researches on saline tolerant forage cultivars have been conducted yet. Moreover, very scanty database is available regarding forage productivity in saline prone area of south-west coastal belt of Bangladesh. Considering the issues the present research was conducted to evaluate the performance of forage cultivars in the south-western coastal saline soil.

2. Methodology

Experimental site: This experimental study was conducted in the net house of Dr. Purnendu Gain Field Laboratory, Agrotechnology Discipline, and Khulna University during the period from December 2017 to February 2018.

Experimental design: The experiment was laid out in randomized complete block design with five salinity levels having seven replications. Soil salinity levels were $S_1 = 0.48$ d·Sm^{-1}; $S_2 = 5.8$ d·Sm^{-1}; $S_3 = 7.9$ d·Sm^{-1}; $S_4 = 9.4$ d·Sm^{-1} and $S_5 = 15$ d·Sm^{-1} using different NaCl concentrations. The forage cultivars e.g. Pakchong (G_1), German (G_2), Dal (G_3), Para (G_4), Splindida (G_5), Hybrid jumbo (G_6), Guinea hard (G_7), Oats (G_8), Napier-2 (G_9), Napier-3 (G_{10}), Napier-4 (G_{11}), Ruzi (G_{12}) and Endropogan (G_{13}) were evaluated for their salt tolerance in pot culture. Pots were filled with five kg saline soil. The cuttings/seed were planted/sowing on 1st December 2017. Pots were watered at two days interval to minimize transplant shock; plants were watered for the duration of entire experiment time. Each pot was fertilized with N (5 g), P (7 g) and K (3 g) before transplant and then 5 g of N applied thirty days after planting. Electrical Conductivity Meter (EC meter) was used to measure the salinity of the soil solution. Soil salinity was measured at fifteen days interval. The study period from December 2017 to February 2018. Variables were 1) Plant height (cm); 2) Tiller number; 3) Leaf length (cm); 4) Leaf wide (cm); 5) Biomass (gm); 6) Dry Matter.

Data collection: Data were collected at 60th, 75th and 90th days after sowing/planting.

Plant height (cm): Plant height was measured with the help of a meter scale from the ground level to the tip of the uppermost leaf.

Tiller number: Tiller number was counted manually. All the tillers in each plant were considered as counting.

Biomass determination: Root was separated from the plant and then the stem with leafs weight (g/pot) with an electric balance.

Dry Matter: Dry matter was determined according to AOAC, 2000.

Statistical analysis: The data were analyzed by using SAS, (1994) software. SPSS

3. Result & Discussion

3.1. Plant Height

It is shown in **Table 1** that salinity level had a significant effect ($p < 0.001$) on plant height at 60 DAS. At 60 DAS the tallest plant height (69.77 cm) was obtained at S_1 which was statistically similar to S_2 (69.51 cm). The shortest plant height was found at S_5 (23.29 cm). In case of 75 DAS there was significant differences ($p < 0.001$) in plant height among five salinity levels. The highest plant was 91.90 cm in S_1 which was statistically similar to S_2 (87.36 cm). The lowest plant height was found at S_5 (24.00 cm). Similar significant effect ($p < 0.001$) on forage plant height was also found in case of 90 DAS. The tallest plant height (109.85 cm) was obtained from S_1 and incase of S_2 and S_3 it was 100.64 cm and 93.23 cm, respectively, while the lowest plant height was found 24.53 cm in S_5. Similar results were obtained in the findings of Alam *et al.*, (2017) who reported that on the basis of different morphological and nutritional parameters, tolerance level of Napier grass to salinity stress can be rated as, BLRI Napier-4 > BLRI Napier-3 > BLRI Napier-2 > BLRI Napier-1. They also revealed that the plant height, number of tillers, leaf numbers, shoot presence or absence per cutting and leaf condition among all the forage cultivars were decreased with the increased of salinity levels. These results are consistent with the findings of the present study.

Table 1. Effect of salinity on Plant height.

Salinity level	Plant height (cm) (Mean ± SE)		
	60 DAS	**75 DAS**	**90 DAS**
S_1	$69.77^a \pm 3.45$	$91.90^a \pm 4.56$	$109.85^a \pm 5.06$
S_2	$69.51^a \pm 3.06$	$87.36^a \pm 3.85$	$100.64^b \pm 4.05$
S_3	$56.18^b \pm 2.87$	$74.03^b \pm 3.22$	$93.32^b \pm 3.66$
S_4	$50.64^c \pm 3.49$	$61.89^c \pm 2.93$	$76.26^c \pm 4.88$
S_5	$23.29^d \pm 5.15$	$24.00^d \pm 6.31$	$24.53^d \pm 6.7$
p value	<0.001	<0.001	<0.001

S_1 = 0.48 d·Sm^{-1}; S_2 = 5.8 d·Sm^{-1}; S_3 = 7.9 d·Sm^{-1}; S_4 = 9.4 d·Sm^{-1} and S_5 = 15 d·Sm^{-1}; DAS indicate days after sowing/planting; means with different superscripts in a column differ significantly; NS = non-significant, *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$.

It is reveled in Table 2 that genotypes had highly significant effect ($p < 0.001$) on plant height at 60 DAS. The highest plant height was obtained from Pakchong (81.93 cm) which was statistically similar to H. Jumbo (75.80 cm), German (75.60 cm) and Napier-4 (75.33 cm). The minimum plant height was found in Endropogan (20.13 cm). Similar trend was also found among the different genotypes at 75 DAS which had significant effect ($p < 0.001$) on plant height. The highest plant height was in German (115.00 cm) and 104 cm and 85.27 cm plant height was also found in Pakchong and Napier-4, respectively while the lowest plant height was in Endropogan (40.73 cm) at 75 DAS. Similar significant effect ($p < 0.001$) on plant height among the different genotypes was also found in case of 90 DAS. The highest plant height (120.20 cm) was obtained from German which is statistically similar to Pakchong (109.62 cm) and Napier-4 (107.93 cm), while the lowest plant height was found in Oats (56.26 cm).

3.2. Tiller Number

It is shown in Table 3 salinity levels had highly significant effect ($P < 0.001$) on tiller number at 60 DAS. The highest tiller number was 3.10 in S_1 while the lowest tiller number was found in S_5 (0.67). In the case of 75 DAS similar significant effect ($P < 0.001$) were found on tillar number forage plant. The highest tiller number was 3.36 in S_1. The lowest tiller number was found in S_5 (0.48). Similar

Table 2. Effect of salinity stress on plant height of forage genotypes.

Genotypes	Plant height (cm) (Mean ± SE)		
	60 DAS	75 DAS	90 DAS
Pakchong	$81.93^{a} \pm 1.99$	$104.00^{b} \pm 3.20$	$109.62^{a} \pm 11.16$
German	$75.60^{a} \pm 1.92$	$115.00^{a} \pm 3.15$	$120.20^{a} \pm 3.43$
Dal	$57.80^{b} \pm 8.49$	$72.93^{d} \pm 10.94$	$77.27^{b} \pm 13.14$
Para	$47.93^{c} \pm 6.50$	$73.13^{d} \pm 10.0$	$85.27^{b} \pm 9.67$
Spelindida	$36.53^{d} \pm 6.20$	$48.47^{gh} \pm 7.83$	$60.87^{d} \pm 9.88$
H. jumbo	$75.80^{a} \pm 2.16$	$62.20^{e} \pm 8.65$	$65.13^{cd} \pm 8.90$
Guinea hard	$37.67^{d} \pm 8.50$	$49.93^{g} \pm 11.13$	$59.20^{d} \pm 13.14$
Oats	$58.07^{b} \pm 2.87$	$52.27^{fg} \pm 7.36$	$56.27^{d} \pm 8.16$
Napier-2	$43.27^{c} \pm 7.07$	$61.87^{e} \pm 8.92$	$79.07^{bc} \pm 11.38$
Napier-3	$50.07^{c} \pm 7.17$	$60.40^{ef} \pm 8.75$	$82.87^{b} \pm 17.40$
Napier-4	$75.33^{a} \pm 2.14$	$85.27^{c} \pm 3.66$	$107.93^{a} \pm 3.46$
Ruzi	$48.33^{c} \pm 7.43$	$61.13^{e} \pm 9.21$	$86.60^{b} \pm 12.69$
Endropogan	$20.13^{e} \pm 3.95$	$40.73^{h} \pm 7.07$	$62.73^{cd} \pm 10.80$
p value	<0.0001	<0.0001	<0.0001

DAS indicate days after sowing/planting; means with different superscripts in a column differ significantly; NS = non-significant, *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$ (plant height S_1 + plant height S_2 + plant height S_3 + plant height S_4 + plant height S_5).

Table 3. Effect of salinity on tiller number.

Salinity level	Tiller number (Mean ± SE)		
	60 DAS	75 DAS	90 DAS
S_1	$3.10^a \pm 0.29$	$3.36^a \pm 0.33$	$4.08^a \pm 0.39$
S_2	$2.44^b \pm 0.38$	$2.54^b \pm 0.24$	$2.74^b \pm 029$
S_3	$1.90^c \pm 0.16$	$1.95^c \pm 0.15$	$2.13^c \pm 0.14$
S_4	$1.36^d \pm 0.14$	$1.74^c \pm 0.17$	$1.95^c \pm 0.19$
S_5	$0.67^e \pm 0.15$	$0.48^d \pm 9.13$	$0.54^c \pm 0.38$
p value	<0.001	<0.001	<0.001

$S_1 = 0.48$ d·Sm^{-1}; $S_2 = 5.8$ d Sm^{-1}; $S_3 = 7.9$ d·Sm^{-1}; $S_4 = 9.4$ d·Sm^{-1} and $S_5 = 15$ d·Sm^{-1}; DAS indicate days after sowing/planting; means with different superscripts in a column differ significantly; NS = non-significant, *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$.

trend of salinity effect on tiller number was obtained in 90 DAS. Alam *et al.*, (2017) reported that on the basis of different morphological and nutritional parameters, tolerance level of different cultivars of Napier grass to salinity stress can berated as: BLRI Napier-4 > BLRI Napier-3 > BLRI Napier-2 > BLRI Napier-1. They also revealed that the plant height, number of tillers, leaf numbers, leaf lengths, shoot presence or absence per cutting and leaf condition among all the cultivars were decreased with the increased of salinity levels, which agrees with the present findings. So the result obtained from this study is consistent with the findings of present study.

There was significant effect on tiller number (P < 0.001) among the different genotypes (Table 4) at 60 DAS. The maximum tiller number was obtained from Napier-4 (3.60) and the tiller number 2.27, 2.20, 2.93 and 2.80 were also found in German, Para, Oats, and Napier-3, respectively. The minimum tiller number was found in Endropogan (0.73). Forage genotype had highly significant effect on tiller number (P < 0.001) of forage plant (Table 4) at 75 DAS. The highest tiller number was in Napier-3 (3.07) while the lowest tiller number was found in H. Jumbo (0.80). The tiller number 2.71, 2.87 and 2.80 was found in German, Oats and Napier-4, respectively. Similar trend was also found in 90 DAS. Forage genotype had highly significant effect on tiller number (P < 0.001) of forage plant (Table 4) at 90 DAS. The highest tiller number (3.53) was obtained from Para while the lowest tiller number was found in H. Jumbo (0.80). The tiller number 2.40, 3.07, 3.27 and 3.13, was found in German, Oats, Napier-3 and Napier-4, respectively.

3.3. Salinity Effect on Biomass

The result shown in Table 5 that salinity levels had significant effect ($p < 0.001$) on total biomass weight per pot at 60 DAS. The highest biomass wt. per pot was 29.14 g, obtained in S_1 and 24.04 g in S_2 while the lowest biomass wt. was found at S_5 (3.52 g). In the case of 75 DAS salinity levels had highly significant effect (p

Table 4. Effect of salinity stress on tiller number of forage genotypes.

Genotypes	Tiller number (Mean ± SE)		
	60 DAS	75 DAS	90 DAS
Pakchong	$1.60^{efg} \pm 0.21$	$1.53^{d} \pm 0.22$	$1.93^{de} \pm 0.27$
German	$2.27^{cd} \pm 0.42$	$2.71^{ab} \pm 0.38$	$2.40^{cd} \pm 0.35$
Dal	$1.47^{fg} \pm 0.31$	$1.60^{cd} \pm 0.34$	$1.67^{de} \pm 0.39$
Para	$2.20^{cde} \pm 0.41$	$2.47^{ab} \pm 0.48$	$3.53^{a} \pm 0.63$
Spelindida	$1.07^{gh} \pm 0.25$	$1.33^{de} \pm 0.32$	$1.20^{ef} \pm 0.20$
H. jambu	$1.13^{gh} \pm 0.90$	$0.80^{e} \pm 0.11$	$0.80^{f} \pm 0.11$
Guinea hard	$1.13^{gh} \pm 0.20$	$1.20^{de} \pm 0.31$	$1.20^{ef} \pm 0.31$
Oats	$2.93^{b} \pm 0.51$	$2.87^{ab} \pm 0.62$	$3.07^{abc} \pm 0.63$
Napier-2	$1.67^{d\text{-}g} \pm 0.35$	$2.27^{bc} \pm 0.52$	$2.67^{bc} \pm 0.60$
Napier-3	$2.80^{bc} \pm 0.50$	$3.07^{a} \pm 0.48$	$3.27^{ab} \pm 0.56$
Napier-4	$3.60^{a} \pm 0.29$	$2.80^{ab} \pm 0.30$	$3.13^{ab} \pm 0.35$
Ruzi	$2.00^{def} \pm 0.45$	$2.47^{ab} \pm 0.46$	$3.47^{a} \pm 0.71$
Endropogan	$0.73^{h} \pm 0.12$	$1.07^{de} \pm 0.21$	$1.47^{ef} \pm 0.27$
p value	<0.0001	<0.0001	<0.0001

DAS indicate days after sowing/planting; means with different superscripts in a column differ significantly; NS = non-significant, *** = $p < 0.001$,** = $p < 0.01$, * = $p < 0.05$ (tiller number S_1 + tiller number S_2 + tiller number S_3 + tiller number S_4 + tiller number S_5).

Table 5. Effect of salinity on biomass.

Salinity level	Biomass wt./pot, g (Mean ± SE)		
	60 DAS	75 DAS	90 DAS
S_1	$29.14^{a} \pm 4.33$	$41.26^{a} \pm 5.72$	$68.72^{a} \pm 13.88$
S_2	$24.04^{b} \pm 4.01$	$39.50^{ab} \pm 18.7$	$52.21^{ab} \pm 15.06$
S_3	$13.05^{c} \pm 2.25$	$20.71^{bc} \pm 2.99$	$40.35^{bc} \pm 10.98$
S_4	$8.94^{d} \pm 1.88$	$12.78^{c} \pm 2.05$	$18.30^{c} \pm 2.28$
S_5	$3.52^{e} \pm 1.11$	$5.50^{c} \pm 1.85$	$10.06^{c} \pm 3.5$
p value	<0.001	<0.012	<0.002

$S_1 = 0.48$ d·Sm^{-1}; $S_2 = 5.8$ d·Sm^{-1}; $S_3 = 7.9$ d·Sm^{-1}; $S_4 = 9.4$ d·Sm^{-1} and $S_5 = 15$ d·Sm^{-1}; DAS indicate days after sowing/planting; means with different superscripts in a column differ significantly; NS = non-significant, *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$.

< 0.012) on biomass weight per pot. The highest biomass wt./pot was 41.26 g in S_1 and 39.50 g in S_2. The lowest biomass wt./pot was obtained in S_5 (5.50 g). Similar trend was also found in 90 DAS. The highest biomass wt. per pot was 68.72 g in S_1 and 52.21 g in S_2. The lowest biomass wt./pot. was 10.06 g in S_5. Biomass production of forage genotypes was gradually decreased with the increased of salinity level. The finding of the present study was consistent with that of Alam *et al.* 2017.

The result shown in Table 6 that forage genotypes had significant effect ($p < 0.001$) on total biomass weight per pot at 60 DAS. It reveals that maximum biomass wt./pot was 38.60 g obtained from the genotype Pakchong which was statistically similar to Napier-4 (38.16 g) at 60 DAS. In this experiment the biomass wt./pot was also 31.28 g and 27.70 g found in Napier-3 and Napier-2, respectively. The minimum biomass wt./pot was 4.49 g in Oats. Forage genotype had highly significant effect ($p < 0.023$) on biomass wt. at 75 DAS. The maximum biomass wt./pot was obtained from Pakchong (84.12 g), while 46.94 g and 38.74 g was found in Napier-4 and Napier-3 respectively; minimum biomass wt./pot. was also obtained in Oats (8.00 g). There was significant difference ($p < 0.001$) in biomass wt./pot among the different forage genotypes at 90 (DAS). The maximum biomass wt. /pot. (138.49 g) was obtained from Pakchong while the minimum biomass wt./pot was found in Oats (8.77 g) and 62.73 g and 61.03 g was found in Napier-4 and Napier-3, respectively.

3.4. Effect of Salinity on Dry Matter (DM)

In Table 7, it reveals that salinity level had significant effect ($p < 0.001$) on dry matter at 60 DAS. The highest DM% was 21.24 obtained from S_4 and the lowest DM% was found 18.74 from S_1. In case of 90 DAS, similar trend of salinity effect ($p < 0.001$) on the DM% of the forage plant was observed. The highest DM% was

Table 6. Effect of salinity stress on biomassof forage genotypes.

Genotypes	Biomass wt.(g)/pot (Mean ± SE)		
	60 DAS	75 DAS	90 DAS
Pakchong	$38.60^{a} \pm 7.07$	$84.12^{a} \pm 44.58$	$138.49^{a} \pm 57.04$
German	$11.84^{e} \pm 2.36$	$26.30^{b} \pm 5.68$	$49.96^{bcd} \pm 4.34$
Dal	$8.93^{fg} \pm 2.84$	$19.79^{b} \pm 10.20$	$29.32^{bcd} \pm 8.29$
Para	$7.62^{fg} \pm 2.63$	$9.90^{b} \pm 2.18$	$18.02^{bcd} \pm 3.98$
Spelindida	$10.07^{ef} \pm 2.08$	$9.94^{b} \pm 2.33$	$13.38^{d} \pm 2.46$
H. Jumbo	$8.07^{fg} \pm 3.59$	$9.41^{b} \pm 1.81$	$16.04^{cd} \pm 2.90$
Guinea hard	$6.85^{gh} \pm 1.92$	$9.34^{b} \pm 2.51$	$13.13^{d} \pm 3.53$
Oats	$4.49^{h} \pm 1.16$	$8.00^{b} \pm 1.78$	$8.77^{d} \pm 1.79$
Napier-2	$27.70^{c} \pm 7.8$	$27.29^{b} \pm 6.8$	$38.56^{bcd} \pm 7.39$
Napier-3	$31.28^{b} \pm 8.84$	$38.74^{b} \pm 11.11$	$61.03^{bc} \pm 13.60$
Napier-4	$38.16^{a} \pm 5.60$	$46.94^{ab} \pm 6.37$	$62.73^{b} \pm 6.35$
Ruzi	$21.36^{d} \pm 5.67$	$31.89^{b} \pm 9.86$	$36.01^{bcd} \pm 7.34$
Endropogan	$4.62^{h} \pm 1.51$	$8.31^{b} \pm 3.18$	$14.12^{cd} \pm 3.75$
p value	<0.001	<0.023	<0.001

DAS indicate days after sowing/planting; means with different superscripts in a column differ significantly; NS = non-significant, *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$ (biomass wt. S_1 + biomass wt. S_2 + biomass wt. S_3 + biomass wt. S_4 + biomass wt. S_5).

Table 7. Effect of salinity on DM.

Salinity level	Percentage of dry matter (DM) (Mean ± SE)	
	60 DAS	90 DAS
S_1	$18.74^c \pm 1.06$	$25.02^a \pm 1.27$
S_2	$20.13^b \pm 1.04$	$24.83^a \pm 1.10$
S_3	$21.06^a \pm 1.33$	$24.82^a \pm 1.11$
S_4	$21.24^a \pm 1.87$	$25.91^a \pm 1.70$
S_5	$19.92^b \pm 2.06$	$22.67^b \pm 2.17$
p value	<0.0001	<0.0001

$S_1 = 0.48\ d \cdot Sm^{-1}$; $S_2 = 5.8\ d \cdot Sm^{-1}$; $S_3 = 7.9\ d \cdot Sm^{-1}$; $S_4 = 9.4\ d \cdot Sm^{-1}$ and $S_5 = 15\ d \cdot Sm^{-1}$; DAS indicate days after sowing/planting; means with different superscripts in a column differ significantly; NS = non-significant, *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$.

Table 8. Effect of salinity stress on DM of forage genotypes.

Genotypes	Percentage of dry matter (DM) (Mean ± SE)	
	60 DAS	90 DAS
Pakchong	$16.69^g \pm 1.21$	$21.03^d \pm 1.44$
German	$15.38^g \pm 0.70$	$24.13^a \pm 1.17$
Dal	$15.86^g \pm 2.18$	$22.20^c \pm 1.69$
Para	$15.92^g \pm 1.33$	$24.99^a \pm 1.33$
Spelindida	$17.56^f \pm 2.65$	$18.37^f \pm 1.20$
H. jambu	$17.42^f \pm 0.92$	$19.21^e \pm 1.30$
Guinea hard	$20.61^d \pm 3.36$	$23.49^b \pm 2.29$
Oats	$19.44^e \pm 1.37$	$24.88^a \pm 2.57$
Napier-2	$20.26^d \pm 3.16$	$22.02^c \pm 1.21$
Napier-3	$21.79^c \pm 2.94$	$22.40^c \pm 0.83$
Napier-4	$23.45^b \pm 1.08$	$24.18^c \pm 1.26$
Ruzi	$20.42^a \pm 3.87$	$21.81^d \pm 1.13$
Endropogan	$23.68^b \pm 4.85$	$24.68^d \pm 1.97$
p value	<0.0001	<0.0001

DAS indicate days after sowing/planting; means with different superscripts in a column differ significantly; NS = non-significant, *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$ (DM S_1 + DM S_2 + DM S_3 + DM S_4 + DM S_5).

25.91 obtained from S_4 while the lowest DM% was 22.67 found in S_5. Emama *et al.*, (2009) reported that dry weight of Bami cultivar per pot was significantly decreased with the increase of salinity level which is disagreed with the findings of the present study, because different forage genotypes might have different dry matter percentage.

The result shown in Table 8 that forage genotypes had significant effect ($p < 0.001$) on dry matter percent at 60 DAS. It reveals that maximum DM% was

23.68 obtained from the genotype Endropogan while the lowest DM% was found in German (15.38) at 60 DAS. Forage genotype had highly significant effect ($p < 0.001$) on DM% at 90 DAS. The highest DM% was 24.68 obtained in Endropogan, while the lowest DM was found in Splindida (18.37%). DM% was gradually decreased with the increased of salinity level.

3.5. Limiation of the Study

1) This experiment was conducted in net house so the sun light was not abundant for plant growth.

2) There were no nutrient competition between plants.

4. Conclusion

The highest biomass wt. (38.60 g) was found in Pakchong, while the lowest biomass wt. (4.49 g) was obtained in Oats at 60 DAS. Soil salinity had a significant difference ($p < 0.001$) on biomass wt. at 60 DAS. It can be concluded that Pakchong appears to be highly salt tolerant with high biomass production.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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