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Effects of salt stress on some growth parameters and chemical contents of two forage sorghum lines

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ABSTRACT-Soil salinity has been recognized as the most serious problem for agriculture in arid and semi-arid areas of the world. To evaluate the changes in some growth parameters and chemical composition of two forage sorghum (*Sorghum bicolor* var. *sudanense*) lines (KFS1, KFS2) under salinity stress [0 (control), 3, 6, 9, 12 dS/m of sodium chloride], a pot experiment was carried out at College of Agriculture, Shiraz University, Shiraz, Iran in 2012. The experiment was conducted as a factorial one arranged in a completely randomized design with three replications. Results showed that increasing salinity levels decreased accumulation of K^+, emergence percentage and other growth parameters, and increased Na^+, proline and total proteins contents in shoot and leaves. Stepwise regression and correlation analyses showed that root density is the most important factor for plant productivity. KFS1 line generally had higher growth and emergence rate and it can be a favorite for selecting and crossing programs with KFS2 to obtain higher salinity tolerance.

INTRODUCTION

Saline soils are estimated to cover about 5–10% of the world's arable land, and the area affected by salinity is increasing steadily, in part due largely to mismanaged irrigation (Krishnamurthy et al., 2007). Soil salinity drastically reduces the productivity of most crops although to a varying extent across species (Munns et al., 2002). Several attempts have been made to overcome tile effects of salinity on germination and seedling development of different species such as wheat (*Triricum aestivum* L.), sorghum (*Sorghum bicolor* L.), barley (*Hordeum vulgare* L.), oat (*Avena sativa*), carrot (*Daucus carota* subsp. *sativus*), and tomato (*Solanum lycopersicum)* (Munns et al., 2002).

Sorghum, as an important failsafe crop in the global agro-ecosystem, is the fifth most important grain crop grown worldwide, which is unusually tolerant of low input levels, an essential trait for arid, semiarid, temperate and tropical regions. This hardy crop is now grown on some 42 million hectares in the world and 40000 hectares in Iran (ICRISAT, 2013). Also, sorghum is a major grain and forage crop and was previously characterized as moderately tolerant to salinity (Igartua et al., 1995). It is considered relatively more salt tolerant than maize (*Zea mays* L.), a cereal crop ranking first in productivity globally (Maas, 1985), and it has the potential as a crop for salt affected areas (Igartua et al., 1994). The presence of large genotypic variation for tolerance to salinity has been reported in sorghum (Maiti et al., 1994) which offers a good scope for integrating tolerance characteristics into appropriate breeding programs to improve crop productivity on saline soils (Krishnamurthy et al., 2007).

Sorghum is a moderately salt tolerant crop (Munns et al., 2002). Efforts to enhance crop yields under salinity stress have had a limited success because available knowledge of the mechanisms of salt tolerance has not been turned into useful selection criteria to evaluate a wide range of genotypes within and across species (Krishnamurthy et al., 2007). Attempts have been made to evaluate salt tolerance at germination and emergence stages in grain sorghum (Igartua et al., 1994), and large genotypic differences were reported, but this early evaluation appears to have little relation with overall performance under saline conditions. Though Na^+ exclusion and grain K^+/Na^+ ratios have been suggested to be reliable traits for selecting salt tolerant crops (Munns et al., 2002; Munns and James, 2003), the value of that trait has not been used in a large scale in sorghum (Poustini and Siosemardeh, 2004). The aim of this study was to determine the effect of salinity on some growth parameters and chemical composition of two forage sorghum lines.

MATERIALS AND METHODS

The surface layer of soil (0-30 cm) was collected from Bajgah, Shiraz, Iran [(29°43′ N and 52°35′ W, altitude 1,810 m as l], 12 km north of Shiraz, Iran during 2012. The physicochemical properties of the pot soil are presented in Table 1.

Experimental Procedures

The experiment was conducted as a factorial one arranged in a completely randomized design with two factors and three replications. The first factor was two forage sorghum lines (KFS1 and KFS2). Uniform and healthy seeds of the plants were received from Seed and Plant Improvement Institute Karaj, Iran. The second factor was four salinity levels of sodium chloride [0 (control), 3, 6, 9 and 12 dS/m]. Before starting the experiment, solutions were made by dissolving sodium chloride in distilled water and leaving it for 48 h, the EC of the water was monitored daily and adjusted when necessary using NaCl (Ashraf and O'Leary, 1996).

The pots with 23 cm diameters and 20 cm heights were filled with 3 kg washed and sieved soil. Seeds were treated with 98% ethanol for approximately 20 seconds and then washed three times with distilled water prior to planting. Ten seeds of each cultivar were sown in each pot with equal distance from each other. Pots were weighed daily and water was added to reach field capacity (22.2%, w/w) based on decreasing the amount of water in pots. To reach FC, water was withheld from the plants and the pots were weighed daily until the desired level was reached. Sufficient water was then added to maintain this value on a daily basis (Munns et al., 2002).

Plant Analysis

Emergence percentage was obtained based on the emerged seeds per pot after complete germination. Remained plants were counted and the number of plants that emerged per pot was calculated at three growth stages (30, 60 and 90 days after sowing). Plant growth parameters including plant height, leaf area, shoot and root weight and total dry weight were measured at the end of the experiment. The leaf area was measured using a leaf area meter (Delta-T Devices). Shoots and roots were sampled from each pot separately, thoroughly washed with distilled water, weighed, and dried in a forced-air oven at 70 °C to constant mass (Igartua et al., 1995).

Free proline was extracted from fresh leaves according to Bates et al. (1973). Leaves samples (0.5 g) were homogenized in 10 ml of 3% (w/v) aqueous sulphosalicylic acid. The homogenate was filtered through What man No. 2 filter paper. Two ml of filtrate was then mixed in a test tube with 2 ml acid ninhydrin and 2 ml glacial acetic acid, and incubated at 100 °C water bath for 1 h. The reaction was terminated by placing the mixture in an ice bath. It was then extracted with 4 ml toluene. The absorbance was recorded at 520 nm and the proline concentration was determined as µg g^{-1} FW using a standard curve. The protein content of plant was estimated according to the method of Bradford (1976), using bovine serum albumin (BSA) as a standard and observance of 595 nm. A hundred and fifty mg of finely ground shoot sample was digested in 4 ml of concentrated sulfuric acid with 0.5% selenium powder at 360°C for 75 min on a block digester and the digest was diluted to 75 ml. Exchangeable Na^+ and k^+ were estimated (Sahrawat et al., 2002) using an atomic absorption spectrophotometer (Varion model 1200, Australia).

Statistical Analysis

Analysis of variance (ANOVA) was performed using the statistical software SAS Program version 9.1.3 (2003) (SAS Institute Inc., Cary, NC, USA). Means were separated by Duncan's Multiple Range Tests at $p \leq 0.05$. Correlation coefficients were calculated by software MINITAB version 16.

RESULTS AN DISCUSSION

Effects of Treatments on Growth Parameters of Forage Sorghum Lines

Generally, increasing salt levels decreased total leaves number per plant from the first (30 days after sowing) to the second measurement (60 days after sowing). KFS1 line had higher leaves number per plant than KFS2 at both times with no significant difference between them. Salinity decreased leaves number per plant at both times and the highest and lowest leaves numbers were obtained at 0 (control) and 9 dS/m salinity levels, respectively. There was a significant difference between 6 and 9 dS/m salinity levels at the first measurement (Table 2).

KFS1 line had a higher plant height than KFS2 (17.54% and 13.119% at the first and the second measurements, respectively). Control plants showed the highest height (24.75 and 29.64 cm, respectively) and 9 dS/m stressed plants showed the lowest height (9.5 cm and 10.92 cm, respectively). The difference between 6 and 9 dS/m salinity levels was not significant at the first measurement (Table 2).

There was no significant difference between forage sorghum lines for total tiller numbers per plant, but salinity levels showed significant differences. Control and 9 dS/m salinity stressed plants had the highest and lowest total tillers number per plant, respectively (Table 2).

Table 1. Physicochemical properties of the pot soil used in this study

Organic carbon (%)	pH	Sand (%)	Silt (%)	Clay (%)	Soil texture	Electrical conductivity (dSm^{-1})	P (mg kg^{-1})	K (mg kg^{-1})	Total N (%)
1.03	7.07	7.0	66.3	26.2	Silty loam	0.4	21.5	476	0.05

Table 2. Effect of forage sorghum lines, salinity levels and their interactions on total leaves and tillers number per plant and plant height at two different times

	Plant height (cm) (second)	Total leaves number per plant (2^{nd})	Total tillers number per plant	Plant height (cm)(first)	Total leaves number per plant (1^{st})
Lines					
KFS1 (V_1)	3.56a	12.20a	1.57a	3.50a	14.19a
KFS2 (V2)	3.46a	10.23b	1.50a	3.23a	12.42b
Salinity level (dS/m)					
0 (S_1)	6.73a	23.75a	3.50a	6.50a	29.643a
3 (S_2)	5.07b	15.08b	2.17c	5.17b	17.717b
6 (S_3)	3.90c	11.75c	1.50c	3.00c	13.252c
9 (S_4)	2.73d	9.50c	1.0d	2.67c	10.925d
12 (S_5)	0.00e	0.00d	0.00e	0.00d	0.00e
Interaction					
V_1S_1	6.57a	24.0a	3.67a	6.33ab	29.330a
V_1S_2	5.23b	13.5b	2.00bc	5.33ab	15.593c
V_1S_3	4.23bc	9.50c	1.33cd	2.67c	11.607d
V_1S_4	3.00d	9.17c	1.00d	2.33c	10.570d
V_1S_5	0.00e	0.00d	0.00e	0.00d	0.000e
V_2S_1	7.00a	25.50a	3.33a	6.67a	29.957a
V_2S_2	5.00b	16.67b	2.33b	5.00b	19.840b
V_2S_3	3.67cd	14.00b	1.67b-d	3.33c	14.897c
V_2S_4	2.67d	9.83c	1.00d	3.00c	11.280d
V_2S_5	0.00e	0.00d	0.00e	0.00d	0.000e
Analysis of variance (P-values)					
Line (V)	0.129	0.034	0.078	0.091	0.026
Salinity level (S)	<0.0001	<0.0001	<0.0001	0.092	0.190
Line × salinity level	0.069	0.341	0.088	0.231	0.087

Means with similar letters within a column are not significantly different (Duncan 5%).
Line (V) ,Salinity levels (S)

There was no significant difference between lines for shoot and root weight and shoot/root ratio. Increased salinity level decreased shoot and root weight and the highest shoot (3.19 g) and root (2.29 g) weight were obtained in control, while the lowest ones were found at 9 dS/m salinity stressed plants.

The lowest shoot/root ratio was obtained at 9 dS/m with no significant difference with 3 dS/m salinity level. The highest shoot/root ratio was obtained in control plants. There was no significant difference between control, 3 and 6 salinity levels for shoot/root ratio (Table 3).

Forage sorghum lines showed no significant difference for leaf area at the first measuring time, but the difference was significant at the second time and KFS2 showed higher leaf area (13.5%) than KSF1. Leaf area decreased with increasing salinity levels and during measurements. The highest and lowest leaf areas were obtained at control and 9 dS/m salinity stressed plants, respectively. Regression lines were separately fitted for KFS1 and KFS2 lines and could account for the most of the variations of the first (KFS1; r^2=0.86 and KFS2; r^2=0.83) and also the second (KFS1; r^2=0.85 and KFS2; r^2=0.96) measuring times (Table 5).

KFS1 (First): $y=0.34 – 1.2X$

KFS2 (First): $y = 0.67 – 0.9X$

KFS1 (Second): $0.57 – 0.8X$

KFS2 (Second): $0.44 – 1.1X$

Effect of Treatments on Chemical Composition of Forage Sorghum Lines

There was no significant difference between lines and salinity × line interaction for proline content (Pr), but it was significant for salinity levels (Table 4). The highest and lowest proline contents were obtained at 9 and 0 (control) dS/m salinity levels, respectively. The difference between 3 and 6 dS/m salinity levels was not significant.

Protein content of KFS1 line (8.17%) was significantly lower than that of KFS2 line (9.13%). Salinity enhanced protein content of plants with no significant difference between control and 3 dS/m level (Table 4). On the other hand, protein content of control KFS1 line was higher than 3 dS/m salinity stressed plants.

Table 3. Effect of forage sorghum lines, salinity levels and their interactions on shoot, root weight and Shoot/Root ratio

	Root weight(g)	Shoot weight (g)	Shoot/Root
Lines			
KFS1 (V_1)	0.69a	1.05a	1.12a
KFS2 (V2)	0.63a	0.94a	1.13a
Salinity level (dS/m)			
0 (S_1)	2.2883a	3.1917a	1.37504a
3 (S_2)	1.0567b	1.2783b	1.2232ab
6 (S_3)	0.3683bc	0.4750c	1.30678a
9 (S_4)	0.1133c	0.1233d	1.08712b
12 (S_5)	0.0000c	0.0000d	0.00000c
Interaction			
V_1S_1	2.3333a	3.1967a	1.3132ab
V_1S_2	0.9133bc	1.0567c	1.2261abc
V_1S_3	0.3300bc	0.4567d	1.3359ab
V_1S_4	0.1000c	0.1167d	1.1576bc
V_1S_5	0.0000c	0.0000f	0.0000d
V_2S_1	2.2433a	3.1867a	1.4369ab
V_2S_2	1.2000b	1.5000b	1.2206abc
V_2S_3	0.4067bc	0.4933d	1.2777ab
V_2S_4	0.1267c	0.1300d	1.0167bc
V_2S_5	0.0000c	0.0000f	0.0000d
Analysis of Variance			
Line (V)	0.097	0.078	0.124
Salinity level (S)	<0.0001	<0.0001	<0.0001
Line × salinity leve	0.210	0.087	0.089

Means with similar letters within a column are not significantly different (Duncan 5%).Line (V) , Salinity levels (S)

Effects of line and salinity levels were significant for both Na^+ and K^+, but salinity levels showed a significant difference for K/Na ratio. The only significant interaction between line and salinity levels was obtained for Na^+. KFS1 line had higher Na^+ (7.35%), K+ (5.2%) and K/Na (8.47) ratio compared to KFS2 line.

Increasing salinity levels decreased K^+ content and K/Na ratio, but increased Na^+ content. The highest Na^+ (210.17 mm/kg) and K^+ (502.09 mm/kg) contents and K/Na ratio (5.01) were obtained at 9 dS/m and control plants, respectively, and the lowest ones were achieved at 0 (control), 6 and 9 dS/m salinity levels, respectively (Table 4).

Proline is an osmoregulate and has a key role in osmotic adjustment. Salinity is usually accompanied with declining water absorption in root. This situation causes loss of water and turgecense in plant cells that induces osmotic stress. Salinity increased free proline content in stressed-plants leaves; particularly at level of 9 dS/m. Accumulation of proline in plant cells induces higher osmotic adjustment and inhibiting water loss on cells. Proline can further detoxify some kind of reactive oxygen species (ROS) such as singlet oxygen. Thus, proline is an important component for stress protection in plants (Nasir Khan et al., 2007). Salinity enhanced proline content of plants with no significant difference between two lines.

Free proline was reported to be increased in wheat, tobacco *(Nicotiana tabacum* L.) (Vladimir et al., 2006) and arabidopsis (*Arabidopsis thaliana*) (Nanjo, 1999) under saline conditions.

Salinity increased protein content of plants and KFS2 line had a higher protein content than KFS1. Plants respond to salinity by expression or over-expression of some stress related genes and since the final product of most of these genes are different proteins, higher accumulation of protein can cause higher protection of plants. Higher protein content could be an appropriate indicator for higher tolerance of plants to salinity and since KFS2 line had higher protein content, it can be eligible for breeding programs for higher tolerance to salinity (Nasir Khan et al., 2007).

Stressedplants had higher accumulation of Na^+ indicating higher uptake of Na^+. On the other hand, salinity decreased K^+ content in plants implying that higher levels of salinity and Na^+ have a negative effect on absorption and accumulation of K^+. Both K^+ and Na^+ have an important effect on osmotic adjustment. Higher accumulation of Na^+ has a positive effect on osmotic adjustment, but extra amount of this ion can be very dangerous to plant cells and therefore, one of the important negative effects of salinity in plants is the accumulation of this ion (Munns et al., 2002). Also, K^+ has an osmoregulating role and decreasing content of this ion under salinity stress has negative effects on plants cells (Munns et al., 2002). Salinity reduced K/Na ratio implying the negative effect of salinity on K^+ and its positive effects on Na^+ uptakes (Nasir Khan et al., 2007). KFS2 line showed higher K^+ and lower Na^+ contents in its leaves that might be due to the higher control of ion uptake. Tahir et al. (2010) reported higher and lower accumulation of Na^+ and K^+ under saline conditions, respectively.

All growth parameters decreased with enhancing salinity levels which was probably due to inhibiting effects of salinity on photosynthesis and also higher use of energy to control ion uptake in root and higher accumulation of proline (Nasir Khan et al., 2007). Salinity had lower effects on crop emergence percentage than other growth parameters. KFS1 line had a higher plant height, but the leaf area of KFS2 line was higher. On the other hand, the difference between lines for other growth parameters was not significant. Due to the importance of photosynthesis, leaf area is a more proper factor than height and therefore, KFS2 is more appropriate than KFS1 line under saline conditions.

Table 4. Effect of forage sorghum lines, salinity levels and their interactions on protein, proline, Na^+ and K^+ contents and K/Na .

	Protein content (%)	Proline content (μg/g)	Na^+ content (mg/kg)	K^+ content (mg/kg)	K/Na
Lines					
KFS1 (V_1)	7.17b	0.25a	119.38a	368.23a	2.59a
KFS2 (V2)	8.13a	0.14a	110.52b	350.62b	2.38b
Salinity level (dS/m)					
0 (S_1)	5.54c	0.125c	90.557d	502.097a	5.0123a
3 (S_2)	5.72c	0.198b	112.083c	482.937b	3.5771b
6 (S_3)	8.48b	0.221b	161.977b	433.297c	2.4313c
9 (S_4)	10.85a	0.285a	210.170a	374.815d	1.6206d
12 (S_5)	0.00	0.000d	0.0000e	0.0000e	0.0000e
Interaction					
V_1S_1	5.61d	0.130d	98.947e	495.23a	4.8878a
V_1S_2	4.85d	0.197c	134290d	466.29b	3.3643c
V_1S_3	8.00cd	0.21bc	173.303c	418.30c	2.2956d
V_1S_4	10.22b	0.270 a	235.407a	368.30d	1.4632e
V_1S_5	0.00e	0.000 e	0.0000f	0.0000e	0.0000f
V_2S_1	5.48d	0.120d	100.167e	507.96a	5.0468a
V_2S_2	6.58d	0.200c	127.877d	501.59a	3.7899b
V_2S_3	8.96c	0.233d	165.650c	448.29b	2.5669d
V_2S_4	11.49ab	0.300a	200.933b	381.33d	1.7780e
V_2S_5	0.00e	0.0000e	0.0000f	0.0000e	0.0000f
Analysis of variance (P-values)					
Line (V)	0.007	0.103	0.005	0.004	0.092
Salinity level (S)	0.002	<0.0001	0.003	<0.0001	0<0.0001
Line × salinity level	0.21	0.110	0.009	0.190	0.073

Means with similar letters within a column are not significantly different (Duncan 5%). Line (V) , Salinity levels (S)

Table 5. Stepwise selection for the most important variables affecting shoot weight

Step	Entered variable	Removed variable	Partial R^2	Model R^2	P-value
1	Root weight	-	0.8829	0.8829	<.0001
2	LA (2nd)	-	0.0048	0.9877	0.0032
3	Total tillers number per plant	-	0.0036	0.9913	0.003
4	Shoot/Root	-	0.0009	0.9922	0.0969
5	K^+ content	-	0.0043	0.9964	<.0001
6	Total leaves number per plant (1st)	-	0.0005	0.997	0.0602
7	Leaf area (1st)	-	0.0005	0.9974	0.0573

Multiple regressions analysis based on stepwise selection showed that the most important factor for shoot weight of sorghum under salinity conditions is root weight. As well as root weight, shoot root ratio entered in the model as an effective variable which significantly could change and affect shoot weight. Higher density of root under saline conditions can be helpful for higher tolerance of plants by increasing absorption surface of root (Nasir Khan et al., 2007).

Two stages of leaf area and the first stage of measuring leaf number were entered into the model implying the ability of plants to continue to produce higher shoot weight. After root weight, second leaf area (P=0.003), total tillers number per plant (P=0.003), shoot/root ratio (P=0.096), K^+ content (P<0.001), first leaf number (P=0.060) and first leaf area (P=0.057) entered in the model, respectively (Table 5).

Means of the morphological parameters and chemical contents were used for correlation coefficients analysis. Correlations between shoot weights and other variables, except Na^+ content were significantly positive, but correlation between shoot weight and Na^+ content was negative and insignificant (r=0.07). The highest correlation between parameters and shoot weight belonged to root weight. Na^+ showed a significant correlation just with proline contents (r=0.96), shoot root ratio (r=0.72) and K^+ (r=0.68). Overall, all correlation coefficients between parameters, except for Na^+ content with shoot and root weight, were positive (Table 6).

Table 6. Correlation coefficients between different growth parameters and chemical contents

	Leaf area	Total leaves number per plant	Plant height	Root weight	Shoot/Root	proline	K^+	Na^+	K^+/Na^+	Total tillers number per plant	Shoot weight
Leaf area	1										
Total leaves number per plant	0.73**	1									
plant height	0.81**	0.85*	1								
Root weight	0.91**	0.78**	0.82**	1							
Shoot/Root	0.60**	0.81**	0.78**	0.49**	1						
proline	0.14	0.5**	0.44*	0.074	0.80**	1					
K^+	0.62**	0.89**	0.85**	0.54**	0.95**	0.79**	1				
Na^+	0.02	0.33	0.3	-0.062	0.72**	0.96**	0.68**	1			
K^+/Na^+	0.87**	0.96**	0.96**	0.79**	0.81**	0.44**	0.88**	0.278	1		
Total tillers number per plant	0.89**	0.90**	0.93**	0.81**	0.72**	0.362	0.77**	0.21	0.91**	1	
Shoot weight	0.82**	0.75**	0.81**	0.99**	0.48**	0.05**	0.51**	-0.074	0.77**	0.69**	1

**, *: Significant at P<0.01 and 0.05, respectively

CONCLUSIONS

All growth parameters of forage sorghum lines decreased with enhancing salinity levels. Salinity increased protein content of plants and KFS2 had a higher protein content than KFS 1line. Increased salinity levels decreased shoot and root weight. Multiple regression, stepwise selection, root weight and shoot/root ratio, leaf area and total leaves and tillers number per plant, and K^+ content were selected as the most significant factors contributing to shoot weight. Effects of lines and salinity levels were significant for both Na^+ and K^+ contents, but just salinity showed a significant difference for K^+/Na^+ ratio. Stepwise selection and correlation coefficients showed that root weight was the most important factor in plant shoot production under salinity conditions and breeding programs must be carried out to screen lines with higher root density to increase tolerance to salt stress. Generally, KFS1 line had higher growth and emergence rates.

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دانشگاه شیراز

تأثیرتنش شوری بر برخی ویژگی‌های رشد و ترکیبات شیمیایی دو لاین سورگوم علوفه‌ای

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چکیده- شوری به عنوان یکی از جدی ترین و مهمترین تنش‌های محیطی در زمینه فعالیت‌های کشاورزی در مناطق خشک و نیمه‌خشک جهان شناخته می‌شود. به منظور بررسی تغییرات برخی پارامترهای رشدی و ترکیبات شیمیایی دو لاین(KFS1, KFS2) سورگوم علوفه‌ای (*Sorghum bicolor* var. sudanese) تحت شرایط تنش شوری [۰ (شاهد)، ۳، ۶، ۹ و ۱۲ دسی زیمنس بر متر کلریدسدیم]، آزمایشی گلخانه‌ای به صورت فاکتوریل بر اساس طرح کاملاً تصادفی با سه تکرار در دانشکده کشاورزی دانشگاه شیراز در سال ۱۳۹۰ انجام شد. نتایج نشان داد که شوری درصد سبز شدن و سایر پارامترهای رشد و هم چنین تجمع K^+ را کاهش می‌دهد ، ولی باعث افزایش میزان سدیم و پرولین و میزان پروتئین اندام‌های هوایی می‌گردد. نتایج رگرسیون گام به گام و ضرایب همبستگی بین صفات نشان داد که تراکم ریشه یکی از مهمترین عوامل مؤثر در توان تولیدی گیاه می باشد. جمع‌بندی نتایج نشان میدهدکه لاین KFS1 سورگوم علوفه‌ای دارای سرعت سبز شدن و قدرت رشد بیشتری می‌باشد و می‌تواند لاین مناسبی برای انتخاب و تلاقی با لاینKFS2 جهت انجام کارهای اصلاحی و افزایش برای تحمل به شوری باشد.