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# EFFECT OF SALINITY AND NITROGEN BIO-FERTILIZATION ON SOME SUDAN GRASS (*SORGHUM SUDANENSE* (L.) MOENCH) VARIETIES AT RAS SUDR

[50]

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## ABSTRACT

This study was carried out at Ras Sudr Experimental Station, South Sinai during 2001 and 2002 seasons. Four sudan grass varieties (Giza2, Piper, Hybrid102 and Is3214) were tested under five nitrogen fertilizer (Mineral and biofertilizer) treatments under two levels of irrigation water salinity (3700 and 9200 ppm). Growth characters i.e. plant height, number of tillers/plant, stem diameter, number of leaves/plant, leaf area, leaves/stem ratio, and forage yield (fresh and dry weight of stem+sheaths and fresh and dry weight of forage yield) were recorded. In addition, carbohydrates, protein, fibers and ash percentages (in leaves and stems) and proline in leaves were determined. Results demonstrate that the Piper variety had the highest value of forage yield compared with the other varieties. The recommended dose of mineral nitrogen fertilizer gave the highest values followed by mixture of biofertilizers (*Azospirillum* plus *Azotobacter*) under the two salinity levels of irrigation water at both cuts (the first one was harvested after 65 days from sowing date and the second was obtained at the same time interval). Moreover there was a significant decrease in all growth characteristics and the yield of four sudan grass varieties by increasing the level of irrigation water salinity from 3700 to 9200 ppm except proline in leaves which significantly increased by increasing the level of salinity


**Key words:** Sorghum, (*Sorghum sudanense*), Salinity of irrigation water, Biofertilizers.

## INTRODUCTION

Forage sudan grass (*Sorghum sudanense* (L.) Moench) is considered as one of the most important fodder crops in many countries of the world due to its high fodder yielding potential and good better quality. Sudan grass has excellent growing habit, quick growing regrowth after first cut and better palatability, digestibility, ratoonability and various forms of its utilization like green chop, silage and hay (**Karwasra *et al* 1996 and Dahiya *et al* 1997**). In Egypt there is a

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great shortage in green forage in summer that considered being one of the main problems for feeding animals. Sudan grass is among the moderate crops to salinity tolerance therefore, it is important to develop new varieties, which are capable to grow under elevated salt levels in the soil and/or irrigation water (**Francois *et al* 1984**). Teosinte, Maize and Sudan grass are important forage crops which are grown extensively in salt affected semi-arid regions. Moreover sudan grass was comparatively more salt tolerant than Maize and Teosinte as far as various morpho-physiological characteristics are concerned (**Kumar *et al* 1991 and Datta *et al* 1996**).

The soil and ground water salinity generally co-exist and have become a colossal agro-ecological problem associated with declining crop yield as reported by **Hassan (1994) and Nassar *et al* (2000)**. Nitrogen fertilizers play an important role in increasing forage production of sudan grass with better nutritive value (**Patel & Rajagopal 2003 and Ramesh & Sammi 2004**). The cost of nitrogenous fertilizers is very high; hence, it becomes imperative to substitute nitrogen by some other cheaper sources, such as *Azospirillum* and/or *Azotobacter* which promote root growth and nitrogen fixation in soil, which may partially meet the nitrogen requirement of the crop (**Patel *et al* 1992; Desale *et al* 1999 and Patidar & Mali 2004**). **Subba Rao *et al* (1979)** demonstrated that application of *Azospirillum* and/or *Azotobacter* promoted root growth and more nitrogen fixation in soil, which help in increasing, fodder yield.

The main objective of the present investigation was to study the effect of nitrogen fertilizer (mineral and biofertilizer) treatments on yield and growth of sudan grass under high salinity conditions.

## MATERIAL AND METHODS

This study was carried out at Ras Sudr Experimental Station, South Sinai during 2001 and 2002 seasons. Four sudan grass varieties namely; Giza2, Piper, Hybrid102 and Is3214 were chosen for the present study. Grains of the four varieties were provided by the Forage Research Division, Field Crops Research Institute of Agricultural Research Center, Ministry of Agriculture and Land Reclamation, Egypt. Efficient strains of *Azotobacter chroococcum* (AC), and *Azospirillum brasilense* (AB) were supplied by Microbiology unit, Desert Research Center, Egypt. The preceding winter crop was wheat. Sudan grass grains were sown on May 5$^{th}$ at the two seasons. Experimental plot was four ridges, 3 meters long and 50cm width. The size of each plot was 6m$^2$; the distance between hills was 15cm on one side of the ridges. Split-split plot design with five replications was used. Irrigation water levels of salinity (3700 and 9200 ppm) occupied the main plots and nitrogen fertilizer the sub-plots, whereas, the four sudan grass varieties occupied the sub-sub plots. Mineral nitrogen fertilizer treatments were applied as:

a- Recommended rate; 60 kg N/fed. as ammonium nitrate 33.5 % N added in two equal doses. The first one was applied after 20 and 50 days (half-and-half) and the second was applied after the first cut.

b- Without (control).

c- *Azotobacter chrococcum* (AC), rate of application five liters/fed.
d- *Azospirillum brasilense* (AB), rate of application five liters/fed.
e- Mixture of (AC) and (AB), rate of application five liters/fed.

Two cuts were taken every season, the first one was harvested after 65 days from sowing date and the second was obtained at the same time interval. Phosphorus fertilizer as calcium super-phosphate (15.5%) was added at a rate of 100 kg/fed. as a basal application during soil preparation and the other cultural practices were applied as recommended for growing sorghum in the area.

Mechanical and chemical properties of the soil are shown in Table (1) and chemical analysis of irrigation water at the two seasons is shown in Table (2).

Table 1. Mechanical and chemical properties of experimental soil at Ras Sudr in 2001 and 2002 growing seasons.

| Season | Physical analysis | | | |
|---|---|---|---|---|
| | Particle size distribution % | | | Class texture |
| | Sand | Silt | Clay | |
| 2001 | 58.41 | 20.23 | 21.36 | Sandy loam |
| 2002 | 62.34 | 17.15 | 20.51 | Sandy loam |

| Season | Chemical analysis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cations (mg/L) | | | | Anions (mg/L) | | | | |
| | Ph | Ec (ppm) | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $K^{+}$ | $CO3^{-}$ | $Hco3^{-}$ | $Cl^{-}$ | $SO4^{-}$ | $CaCO3^{-}$ |
| 2001 | 7.84 | 5510 | 19.01 | 47.31 | 18.32 | 0.67 | - | 6.51 | 51.03 | 27.47 | 49.37 |
| 2002 | 7.72 | 5700 | 21.13 | 48.92 | 20.19 | 0.69 | - | 8.04 | 49.5 | 31.19 | 52.94 |

Table 2. Chemical analysis of irrigation water at Ras Sudr in 2001 and 2002 growing seasons

| Season | Cations (mg/l) | | | | | | Anions (mg/l) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ph | Ec (ppm) | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $K^{+}$ | $CO3^{-}$ | $Hco3^{-}$ | $Cl^{-}$ | $SO4^{-}$ |
| 2001 | 8.56 | 3700 | 40 | 75 | 33 | 0.28 | - | 8.0 | 65.51 | 74.01 |
| 2002 | 8.35 | 9.200 | 35 | 70 | 37.4 | 0.31 | - | 9.5 | 62.02 | 71.21 |

Free proline in the leaves were determined according to the method described by **Bates *et al* (1973)**. Total carbohydrate were determined in leaves and stems at first and second cuts according to the method described by **Smith *et al* (1964)**. Total nitrogen was determined in leaves and stems as dry matter by using the modified mico-kieldahl method as described by **Peach and Tracey (1956)**. Protein content was calculated by multiplying the total nitrogen by 6.25. Crude fibers and ash contents were determined in leaves and stems according to the method described by **(A.O.A.C. 1990)**. At cut, ten guarded plants were taken randomly from each plot of the five replicates to determine the growth characteristics at the two cutting stages. Combined analysis of the two growing seasons data was carried out according to procedure outlined by **Steel and Torrie (1980)**. Duncan's multiple range test, **(Duncan, 1955)** was used to verify the significance of mean performance for all traits recorded.

## RESULTS AND DISCUSSION

### 1. Effect of irrigation water salinity and nitrogen fertilizers on some growth characters and forage yield

Results given in Table (3) show that generally increasing salinity level of irrigation water from 3700 to 9200 ppm significantly decreased all of the growth characters of the four sudan grass varieties at the two cuts. Reduced growth levels under salinity conditions may be due to the water deficit as a result of water and osmotic potentials in the growth medium or to water and ionic disequilibrium in the aerial parts of the plant. Moreover, high concentration of salts may reduce the absorption capacity of roots. In this respect **Kramer (1969)** demonstrated that high concentration of salt cause a decrease in the permeability of roots to water, and hence a decrease in the rate of its entry into the plant. **Kaoud and El-Fieshawy (1990)** indicated that the N, P, $Ca^{++}$ and $K^{+}$ concentrations were decreased while $Na^{+}$ and $Mg^{++}$ increased with increasing salt levels.

The interaction effect among salinity of irrigation water and nitrogen fertilizers on some growth characteristics of the four sudan grass varieties indicated that adding the recommended dose of mineral nitrogen fertilizer increased significantly plant height, fresh and dry weight of stem+sheaths/plant and leaves/stem ratio of Piper variety at the two cuts under 3700ppm. On the other hand, the lowest mean values of plant height, was for Is3214 followed by Hybrid102 under treatment without nitrogen fertilization when irrigated with saline water 9200ppm. Such trends were cited by **Hassan (1994) and Karwasra and Dahiya (1997)**. Regarding, number of tillers per plant, Is3214 variety showed the highest mean values at the recommended dose of mineral nitrogen fertilizer followed by the mixture of biofertilizers with salinity of irrigation water 3700ppm at first and second cut. Meantime, there were no significant differences between the four sudan grass varieties at recommended dose of mineral nitrogen fertilizer with saline water 9200ppm. These results could be attributed to the effect of high concentration of salts which caused an osmotic pressure that inhibited soluble nitrogen absorption and consequently prevent the stimulating effect of nitrogen on plant growth. Similar results were obtained by **Ramamurthy (2002); Patel & Rajagopal (2003) and Ramesh & Sammi (2004)**. Concerning, stem diameter, results in Table (3) indicate that the highest mean values were obtained for Is3214 at the recommended dose of mineral nitrogen fertilizer followed by *Azospirillum* and mixture of biofertilizers at 3700ppm of irrigated water. On the other hand, Piper and Giza2 varieties had the higher stem diameter values at the recommended dose of mineral nitrogen fertilizer at salinity of irrigation water 9200ppm. Data presented in Table (3) show also that, *Azospirillum brasilense* (AB) strain was more effective and suitable strain for inoculation to the four sudan grass varieties as compared with *Azotobacter chroococcum* (AC) strain. Similar trends were obtained by **Hassan (1994); Rawat & Hazra (1998); Nassar *et al* (2000); Ramamurthy (2002) and Patidar and Mali (2004).**

Regarding number of leaves/plant, (Table 3) results show that Piper variety had the highest values of number of leaves at the recommended dose of mineral nitrogen fertilizer and mixture of biofertilizers with salinity of irrigation water 3700ppm at the two cuts. While, Hybrid102 variety recorded the highest values of number of leaves with applying the recommended nitrogen fertilizer at the first cut without significant differences. The lowest values were detected for Giza2 variety with salinity of irrigation water 3700ppm at the nitrogen control treatment at the two cuts. Piper variety took the same trend with adding recommended dose of mineral nitrogen fertilizer and mixture of biofertilizers under salinity of irrigation water 9200 ppm at the two cuts. Similar results were obtained by **Hassan (1994); Karwasra & Dahiya (1997) and Nassar *et al* (2000).**

Concerning leaf area, data presented in Table (3) show that the lowest values were detected for Hybrid102 variety under treatment without nitrogen fertilization with water salinity 9200ppm. On the other hand, the highest values were recorded by Is3214 variety with the recommended dose of mineral nitrogen fertilizer followed by mixture of biofertilizers at salinity of irrigation water 3700ppm in the two cuts. These results agree those obtained by **Saffa *et al* (1993) and Patidar & Mali (2004).** Hybrid102 and Is3214 varieties had the lowest values for fresh and dry weight of stem+sheaths under treatment without nitrogen fertilization when irrigated with saline water 3700ppm in the two cuts (Table 4). Meantime, the highest values were recorded by Piper variety with salinity of irrigation water 3700ppm at the recommended dose of mineral nitrogen fertilizer treatment followed by mixture of biofertilizers in the two cuts. On the other hand, the highest values were recorded by Piper variety when irrigated with saline water 9200ppm with adding recommended dose of mineral nitrogen fertilizer followed by fertilizing with mixture of biofertilizers at the two cuts for fresh weight of stem+sheaths characters. Regarding dry weight of stem+sheaths, (Table 4) Piper variety fertilized with the recommended dose of mineral nitrogen fertilizer followed by mixture of biofertilizers had the highest values under salinity of irrigation water 9200ppm at the two cuts. Similar results were found by **Karwasra & Dahiya (1997) and Nassar *et al* (2000).**

Mean-time Piper variety had the highest values of leaves/stem ratio under

Table 3. Effects of Salinity x N fertilizers x Varieties interaction on some growth characters of four Sudan grass varieties at Ras Sudr over two growing seasons (2001 and 2002).

| Salinity | N | Varieties | Plant height (cm) | | No. of tillers/plant | | Stem diameter (mm) | | No. of leaves/plant | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1st cut | 2nd cut | 1st cut | 1st cut | 2nd cut | 2nd cut | 1st cut | 2nd cut |
| Salinity of water irrigation 3700 ppm | Recommend 60 kg N/fed. | Giza2 | 145.50 b | 171.00 c | 6.73 g | 5.88 i | 11.10 ab | 11.91 ab | 11.21 c | 10.59 bc |
| | | Piper | 167.60 a | 184.50 a | 11.77 d | 10.78 cd | 10.25 bc | 10.62 ef | 13.66 a | 12.54 a |
| | | Hybrid 102 | 132.60 d | 129.40 h | 13.39 c | 12.34 b | 11.40 ab | 11.98 ab | 12.52 b | 11.56 ab |
| | | Is 3214 | 117.40 gh | 139.80 f | 16.58 a | 13.66 a | 11.77 a | 12.12 a | 11.42 c | 10.61 bc |
| | Control (zero N) | Giza2 | 33.74 u | 25.54 q | 2.20 mn | 1.83 lm | 4.68 hi | 4.41 pq | 5.97 lm | 5.78 lm |
| | | Piper | 32.04 u | 25.31 q | 2.18 mn | 1.47 lm | 4.45 ij | 3.88 rs | 6.52 jk | 6.39 jk |
| | | Hybrid 102 | 27.89 v | 25.99 q | 3.35 jk | 2.40 l | 4.89 hi | 4.35 qr | 6.40 jk | 6.33 kl |
| | | Is 3214 | 24.99vw | 23.00 r | 2.43 lm | 1.1 no | 5.35 hi | 5.44 no | 6.58 jk | 6.50 ij |
| | Azotobacter | Giza2 | 110.20 i | 128.10 h | 4.11 ij | 3.61 k | 9.42 de | 9.79 hi | 9.12 fg | 8.42 ef |
| | | Piper | 121.40 f | 134.90 g | 7.51 g | 6.82 h | 8.51 ef | 9.05 jk | 9.17 fg | 8.58 ef |
| | | Hybrid 102 | 105.50 j | 111.70 j | 8.72 f | 7.48 gh | 9.43 de | 9.87 gh | 9.95 de | 9.52 cd |
| | | Is 3214 | 101.30 k | 109.90 j | 9.74 e | 8.16 fg | 10.23 bc | 10.81 de | 9.01 fg | 8.46 ef |
| | Azospirillum | Giza2 | 126.00 e | 148.30 e | 4.77 i | 4.11 jk | 10.41 bc | 10.85 cd | 9.50 fg | 8.75 ef |
| | | Piper | 145.50 b | 149.00 e | 9.31 ef | 8.52 f | 9.34 de | 9.67 ij | 11.44 c | 10.63 bc |
| | | Hybrid 102 | 114.60 h | 124.90 i | 11.10 d | 10.07 de | 10.49 bc | 11.01 bc | 10.88 cd | 10.20 cd |
| | | Is 3214 | 107.40 ij | 122.00 i | 11.76 d | 10.29 de | 10.75 ab | 11.13 ab | 9.16 fg | 8.52 ef |
| | Mixture | Giza2 | 138.50 c | 166.00 d | 5.75 h | 4.91 j | 10.62 ab | 11.05 ab | 10.61 cd | 9.36 de |
| | | Piper | 164.40 a | 176.90 b | 10.77 d | 9.85 e | 9.68 cd | 10.02 fg | 13.56 a | 12.40 a |
| | | Hybrid 102 | 121.00 f | 134.60 g | 12.89 c | 11.25 c | 11.14 ab | 11.49 ab | 11.64 bc | 10.65 bc |
| | | Is 3214 | 118.20 fg | 135.30 g | 14.43 b | 12.39 b | 11.39 ab | 11.87 ab | 11.15 c | 10.38 cd |
| Salinity of water irrigation 9200 ppm | Recommend 60 kg N/fed. | Giza2 | 65.52 m | 47.19 m | 3.36 jk | 1.86 lm | 6.53 g | 6.71 m | 8.32 gh | 7.55 gh |
| | | Piper | 81.85 l | 62.53 k | 2.57 kl | 1.95 lm | 8.46 ef | 8.93 kl | 9.61 ef | 8.94 e |
| | | Hybrid 102 | 59.29 n | 40.88 n | 3.21 jk | 2.24 lm | 5.34 hi | 5.56 no | 8.07 hi | 7.48 gh |
| | | Is 3214 | 43.70 qr | 36.73 o | 3.66 jk | 2.24 lm | 4.64 ij | 5.04 op | 7.81 i | 7.41 gh |
| | Control (zero N) | Giza2 | 23.34 w | 14.82 t | 1.43 qr | 1.12 no | 2.48 m | 2.27 t | 5.38 m | 5.34 no |
| | | Piper | 25.92 vw | 21.51 s | 1.29 r | 0.911 op | 3.69 kl | 3.67 s | 5.56 m | 5.47 no |
| | | Hybrid 102 | 16.51 x | 12.90 t | 1.43 qr | 0.988 no | 2.43 m | 2.29 t | 5.54 m | 5.46 no |
| | | Is 3214 | 14.11 x | 12.42 t | 1.31 r | 0.779 p | 2.39 m | 2.24 t | 5.41 m | 5.24 o |
| | Azotobacter | Giza2 | 45.63 pq | 34.93 o | 2.45 lm | 1.81 lm | 4.49 ij | 4.76 op | 7.14ij | 6.34 jk |
| | | Piper | 56.03 o | 42.59 n | 1.85 no | 1.10 no | 5.36 hi | 5.70 mn | 7.98 hi | 7.36 hi |
| | | Hybrid 102 | 39.88 st | 26.92 p | 1.68 op | 1.18 no | 3.13 lm | 3.54 s | 6.46 jk | 5.79 lm |
| | | Is 3214 | 33.78 u | 23.10 r | 1.52 po | 0.975 no | 2.97 lm | 3.45 s | 5.95 m | 5.53 mn |
| | Azospirillum | Giza2 | 53.78 o | 37.36 o | 2.77 kl | 1.90 lm | 5.34 hi | 5.83 mn | 7.24 ij | 6.67 ij |
| | | Piper | 64.70 m | 50.43 l | 2.06 no | 1.40 mn | 6.48 g | 6.40 mn | 8.34 gh | 7.65 fg |
| | | Hybrid 102 | 47.42 p | 35.88 o | 2.21 mn | 1.57 lm | 3.82 jk | 4.11 qr | 7.53 ij | 6.90 ij |
| | | Is 3214 | 37.29 t | 29.82 p | 1.84 no | 1.19 no | 3.64 kl | 4.11 qr | 6.32 kl | 5.82 lm |
| | Mixture | Giza2 | 62.52 mn | 43.18 n | 2.98 kl | 2.26 lm | 5.83 gh | 6.32 mn | 8.13 hi | 7.43 gh |
| | | Piper | 81.14 l | 61.79 k | 2.37 lm | 1.79 lm | 7.79 f | 8.24 l | 9.16 fg | 8.40 ef |
| | | Hybrid 102 | 53.06 o | 44.10 m | 2.65 kl | 1.86 lm | 4.75 hi | 5.09 op | 8.18 hi | 7.42 gh |
| | | Is 3214 | 41.17 rs | 34.53 o | 2.07 no | 1.68 lm | 4.58 ij | 4.94 op | 7.24 ij | 6.69 ij |

Table 3. Cont.

| Salinity | N | Varieties | Leaf area ($cm^2$) | | Stem + sheaths Fresh weight (g/plant) | | Stem + sheaths Dry weight (g/plant) | | Leaves / stem ratio | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1st cut | 2nd cut | 1st cut | 1st cut | 2nd cut | 2nd cut | 1st cut | 2nd cut |
| Salinity of water irrigation 3700 ppm | Recommend 60 kg N/fed. | Giza2 | 239.60 g | 259.30 f | 217.66 c | 227.00 c | 80.59 de | 96.15 b | 16.45 c | 18.57 c |
| | | Piper | 269.40 e | 276.60 e | 243.80 a | 256.80 a | 97.50 a | 108.6 a | 20.64 a | 23.51 a |
| | | Hybrid 102 | 343.20 c | 349.20 c | 204.40 d | 213.90 e | 89.57 b | 89.51 c | 11.69 ef | 13.52 f |
| | | Is 3214 | 449.30 a | 455.60 a | 186.50 g | 194.70 g | 81.46 de | 81.87 e | 10.65 fg | 11.54 g |
| | Control ( zero N) | Giza2 | 81.28 u | 75.38 r | 53.14 x | 48.33 t | 20.44 qr | 20.30 | 6.34 mn | 6.49 kl |
| | | Piper | 73.08 w | 63.38 u | 47.28 y | 42.47 u | 21.19 qr | 17.30 st | 6.55 lm | 6.55 kl |
| | | Hybrid 102 | 64.57 y | 60.15 v | 39.45 z | 34.83 v | 16.95 st | 13.98 tu | 6.42 mn | 5.60 no |
| | | Is 3214 | 75.32 v | 64.96 t | 39.26 z | 35.40 v | 17.78 st | 13.55 uv | 5.96 no | 5.71 mn |
| | Azotobacter | Giza2 | 170.6 l | 175.60 k | 166.30 j | 169.70 i | 61.84 i | 69.21 gh | 9.55 gh | 10.53 h |
| | | Piper | 190.60 k | 201.20 j | 176.00 i | 180.20 h | 74.21 gh | 76.76 f | 12.42 e | 14.63 e |
| | | Hybrid 102 | 220.80 i | 211.70 i | 146.30 l | 152.60 k | 64.97 i | 66.56 h | 7.72 jk | 8.64 j |
| | | Is 3214 | 249.70 f | 253.80 f | 131.90 m | 138.40 l | 56.45 j | 58.78 i | 6.59 lm | 6.70 k |
| | Azospirillum | Giza2 | 211.40 j | 220.10 h | 182.80 g | 192.60 g | 76.84 fg | 81.41 e | 11.52 ef | 13.64 f |
| | | Piper | 222.00 i | 227.10 h | 199.10 e | 223.10 d | 82.87 cd | 95.12 b | 14.70 d | 18.52 c |
| | | Hybrid 102 | 270.00 e | 275.80 e | 160.60 k | 168.90 i | 71.58 h | 71.63 g | 8.77 hi | 10.56 h |
| | | Is 3214 | 327.70 d | 331.90 d | 146.80 l | 160.50 j | 64.14 i | 67.35 h | 8.65 ij | 9.53 i |
| | Mixture | Giza2 | 232.90 h | 243.70 g | 205.20 d | 220.90 d | 82.35 cd | 90.73 c | 14.69 d | 17.51 d |
| | | Piper | 254.50 f | 253.20 f | 230.70 b | 250.10 b | 89.21 b | 95.6 b | 18.67 b | 22.54 b |
| | | Hybrid 102 | 327.20 d | 338.30 d | 194.30 f | 206.20 f | 85.63 c | 85.81 d | 11.60 ef | 13.49 f |
| | | Is 3214 | 428.20 b | 436.80 b | 180.50 h | 191.60 g | 77.63 ef | 79.67 ef | 9.88 gh | 11.52 g |
| Salinity of water irrigation 9200 ppm | Recommend 60 kg N/fed. | Giza2 | 122.70 p | 113.2 op | 101.20 p | 77.64 o | 42.18 l | 31.54 kl | 7.48 kl | 6.56 kl |
| | | Piper | 131.70 n | 130.7 lm | 127.10 n | 99.17 m | 54.49 jk | 40.81 j | 8.72 hi | 8.59 j |
| | | Hybrid 102 | 119.30 q | 105.4 p | 82.51 r | 67.05 p | 32.35 no | 28.59 lm | 6.72 lm | 6.42 kl |
| | | Is 3214 | 147.90 m | 138.0 l | 74.36 t | 57.96 r | 29.68 op | 25.00 op | 6.49 lm | 6.35 kl |
| | Control ( zero N) | Giza2 | 62.49 y | 59.04 vw | 36.72 z | 31.62 v | 15.53 t | 12.48 uv | 4.69 rs | 3.52 q |
| | | Piper | 72.25 x | 66.59 stu | 44.22 y | 33.18 v | 17.30 st | 13.73 tu | 4.55 rs | 3.59 q |
| | | Hybrid 102 | 54.46 z | 49.51 w | 32.99 z | 27.16 w | 11.59 u | 11.24 uv | 4.42 st | 3.08 qr |
| | | Is 3214 | 57.98 z | 52.31 w | 30.89 z | 24.39 w | 11.80 u | 10.63 v | 3.93 t | 2.63 r |
| | Azotobacter | Giza2 | 79.18 v | 71.84 rst | 70.66 u | 53.65 s | 30.48 no | 20.91 qr | 4.85 qr | 4.54 p |
| | | Piper | 86.03 u | 80.36 r | 91.15 q | 63.08 q | 32.62 no | 25.63 no | 5.51 op | 4.63 p |
| | | Hybrid 102 | 74.85 w | 69.00 stu | 48.57 y | 35.17 v | 19.68 qr | 14.84 tu | 4.63 rs | 3.72 q |
| | | Is 3214 | 101.30 t | 92.19 q | 44.49 y | 35.33 v | 18.55 rs | 14.71 tu | 4.50 st | 3.59 q |
| | Azospirillum | Giza2 | 100.40 t | 90.84 q | 79.66 r | 67.32 p | 34.42 mn | 27.70 mn | 5.80 no | 5.56 o |
| | | Piper | 111.00 s | 105.7 p | 103.10 p | 78.09 o | 43.42 l | 34.11 k | 6.54 lm | 6.18 kl |
| | | Hybrid 102 | 85.53 u | 77.46 rs | 61.03 w | 46.75 t | 22.56 qr | 19.91 rs | 5.35 pq | 4.70 p |
| | | Is 3214 | 116.70 r | 106.3 p | 55.21 x | 45.54 t | 23.41 q | 19.38 rs | 5.52 op | 4.54 p |
| | Mixture | Giza2 | 113.90 r | 108.2 p | 94.10 q | 74.30 o | 36.68 m | 30.80 kl | 6.99 lm | 6.60 k |
| | | Piper | 127.70 o | 119.8 no | 121.90 o | 92.03 n | 52.14 k | 38.22 j | 8.53 ij | 8.13 j |
| | | Hybrid 102 | 103.50 t | 94.16 q | 76.68 s | 62.84 q | 27.73 p | 22.22 pq | 6.64 lm | 5.74 lm |
| | | Is 3214 | 135.50 n | 127.3 mn | 68.43 v | 55.34 r | 29.38 op | 24.22 op | 6.35 mn | 5.61 no |

Table 4. Effects of Salinity x N fertilizers x Varieties interaction on yield, carbohydrate percentage of four sudan grass varieties at Ras Sudr over 2001 and 2002 growing seasons.

| Salinity | N | Varieties | Fresh forage yield kg/fed. 1st cut | Fresh forage yield kg/fed. 2nd cut | Dry forage yield kg/fed. 1st cut | Dry forage yield kg/fed. 2nd cut | Carbohydrate in stems (%) 1st cut | Carbohydrate in stems (%) 2nd cut | Carbohydrate in leaves (%) 1st cut | Carbohydrate in leaves (%) 2nd cut |
|---|---|---|---|---|---|---|---|---|---|---|
| Salinity of water irrigation 3700 ppm | Recommend 60 kg N/fed. | Giza2 | 5367 b | 6053 b | 2003 b | 2056 b | 36.73 bc | 35.69 cd | 40.83 gh | 36.58 de |
| | | Piper | 5694 a | 6594 a | 2109 a | 2309 a | 41.01 a | 40.36 a | 46.75 a | 41.63 b |
| | | Hybrid 102 | 3380 d | 5060 c | 1340 e | 1654 c | 37.92 b | 37.31 bc | 47.52 a | 43.47 a |
| | | Is 3214 | 3303 d | 4373 d | 1181 fg | 1415 de | 36.44 bc | 35.10 de | 41.80 ef | 39.59 c |
| | Control (zero N) | Giza2 | 341.9 no | 291.1pq | 133.2 q | 110.2 kl | 28.75 pq | 27.63 st | 34.98 no | 31.45 kl |
| | | Piper | 525.3mn | 521.5mn | 200.4pq | 192.5 kl | 33.74 ef | 32.73 ij | 36.19 m | 32.41 jk |
| | | Hybrid 102 | 333.4 no | 423.4 no | 124.8 qr | 156.6 kl | 29.94 no | 28.90 qr | 33.46 pq | 28.49 no |
| | | Is 3214 | 326.1 no | 397.4 op | 115.8 qr | 132.7 kl | 28.80 pq | 27.70 rs | 37.50 l | 34.59 fg |
| | Azotobacter | Giza2 | 1244 hi | 2561 h | 422.2mn | 995.4gh | 31.98 ij | 31.17mn | 37.59 kl | 32.53 jk |
| | | Piper | 1557 fg | 2621 g | 571.0 jk | 1085 fg | 36.28 bc | 35.24 cd | 41.35 fg | 34.60 fg |
| | | Hybrid 102 | 1205 hi | 2354 hi | 465.8lm | 878.3 hi | 34.02 ef | 33.22 hi | 42.11 ef | 34.93 fg |
| | | Is 3214 | 1317 gh | 2533 hi | 495.5 kl | 923.7 hi | 33.24 fg | 32.40 jk | 38.38 jk | 33.41 hi |
| | Azospirillum | Giza2 | 3324 d | 3310 f | 1212 fg | 1218 ef | 33.88 ef | 32.95 ij | 39.05 ij | 33.79 gh |
| | | Piper | 3467 d | 4392 d | 1279 ef | 1495 de | 37.87 b | 36.85 cd | 43.11 cd | 35.53 ef |
| | | Hybrid 102 | 2170 e | 3408 f | 796.9 h | 1214 ef | 36.71 bc | 36.12 cd | 43.85 c | 37.26 d |
| | | Is 3214 | 2008 e | 3217 f | 752.7 hi | 1271 ef | 36.05 bc | 35.20 cd | 39.46 i | 35.69 ef |
| | Mixture | Giza2 | 4663 c | 5274 c | 1604 d | 1797 bc | 36.49 bc | 35.56 cd | 40.58 h | 35.56 ef |
| | | Piper | 5391 b | 6216 b | 1996 b | 2050 b | 40.18 a | 39.10 ab | 45.80 b | 40.03 c |
| | | Hybrid 102 | 3209 d | 4438 d | 1206 fg | 1558 cd | 37.48 bc | 36.57 cd | 47.07 a | 42.57 ab |
| | | Is 3214 | 3227 d | 4119 e | 1150 g | 1341 de | 36.51 bc | 35.53 cd | 41.69 ef | 39.35 c |
| Salinity of water irrigation 9200 ppm | Recommend 60 kg N/fed. | Giza2 | 1430fg | 1843 j | 589.8 jk | 715.3 ij | 33.83 ef | 32.85 ij | 34.79 no | 29.73mn |
| | | Piper | 1714 f | 2289 i | 679.4 ij | 916.7 hi | 37.75 b | 36.95 cd | 39.55 i | 32.54 jk |
| | | Hybrid 102 | 1494 fg | 1826 j | 561.6 kl | 692.4 j | 35.03 de | 34.20 fg | 42.66 de | 35.44 ef |
| | | Is 3214 | 978.5 ij | 1058 k | 348.6 no | 392.3 k | 34.04 ef | 33.38 hi | 35.70mn | 29.42 no |
| | Control (zero N) | Giza2 | 104.3 o | 94.50 q | 40.53 s | 38.1 l | 26.88 rs | 25.71 uv | 30.71 u | 24.72 rs |
| | | Piper | 124.8 o | 109.9 q | 55.79 rs | 40.8 l | 27.83 qr | 26.93 tu | 29.65 v | 24.44 rs |
| | | Hybrid 102 | 99.13 o | 93.25 q | 40.35 s | 38.42 l | 27.03 qr | 25.90 uv | 31.62 st | 23.69 s |
| | | Is 3214 | 96.99 o | 97.77 q | 42.46 s | 39.5 l | 25.85 s | 24.90 v | 30.99 tu | 24.42 rs |
| | Azotobacter | Giza2 | 497.6mn | 603.8mn | 173.5 po | 235.8 kl | 30.74 lm | 29.70 op | 31.48 tu | 25.12 r |
| | | Piper | 632.3lm | 693.5lm | 234.0 op | 260.0 kl | 31.96 ij | 31.24mn | 32.51 qr | 26.45 p |
| | | Hybrid 102 | 405.0 no | 478.6mn | 144.4 qr | 165.5 kl | 30.09mn | 29.24 pq | 36.47 m | 28.73 no |
| | | Is 3214 | 334.1 no | 345.9 op | 117.9 qr | 148.1 kl | 29.82 op | 28.87 qr | 31.90 rs | 25.24 qr |
| | Azospirillum | Giza2 | 595.8lm | 708.3lm | 233.2 op | 284.8 kl | 31.18 kl | 30.07 no | 32.61 qr | 26.48 p |
| | | Piper | 759.0 kl | 869.0 kl | 280.6 op | 348.4 kl | 35.67 cd | 34.65 ef | 33.76 p | 28.76 no |
| | | Hybrid 102 | 505.5mn | 582.8mn | 192.2 pq | 222.2 kl | 31.85 jk | 31.15mn | 38.57 ij | 30.83 lm |
| | | Is 3214 | 432.4 n | 489.9mn | 167.1 pq | 177.7 kl | 31.17 kl | 30.29 no | 33.41 pq | 26.33 pq |
| | Mixture | Giza2 | 880.3 kl | 1071 k | 321.7 no | 405.7 k | 32.75 gh | 31.69 lm | 34.14 op | 28.36 o |
| | | Piper | 1430 fg | 1950 j | 575.5 jk | 730.1 ij | 37.10 bc | 36.11 cd | 37.75 kl | 32.65 ij |
| | | Hybrid 102 | 945.6 jk | 923.5 kl | 349.6 no | 333.8 kl | 34.73 de | 33.96 gh | 41.84 ef | 35.72 ef |
| | | Is 3214 | 748.3 kl | 922.0 kl | 286.2 op | 348.0 kl | 32.63 hi | 32.00 kl | 35.68mn | 29.64mn |

salinity of irrigation water of 3700ppm with the recommended dose of mineral nitrogen fertilizer followed by mixture of biofertilizers at the two cuts (Table 3). Whereas, the lowest values were recorded by Is3214 variety with using salinity of irrigation water 9200ppm under treatment without nitrogen fertilization. Similar results were obtained by **Hassan (1994)** and **Nassar *et al* (2000)**. Data in Table (4) demonstrated that the high values of fresh and dry weight of forage yield/fed., were recorded by Piper variety under salinity of irrigation water of 3700ppm at the recommended dose of mineral nitrogen fertilizer, followed by mixture of biofertilizers of the same variety at the two cuts. Meantime, Piper variety had the maximum mean values of fresh and dry weight of forage yield/fed., at the recommended dose of mineral nitrogen fertilizer followed by mixture of biofertilizers with adding saline water 9200ppm of the same variety at the two cuts. The minimum values of fresh and dry weight of forage yield/fed., were obtained by Is3214, Hybrid102, Giza2 and Piper varieties under treatment without nitrogen fertilization at salinity of irrigation water 9200ppm in both cuts. Such results confirm those of **Patel *et al* (1992); Barik *et al* (1998); Panwar *et al* (1999) and Kaoud & El-Fieshawy (1990),** who indicated that sorghum is a moderately salt tolerant plant. The N, P, $Ca^{++}$ and $K^{+}$ concentrations were decreased while $Na^{+}$ and $Mg^{++}$ increased with increasing salt levels.

## 2. Effect of irrigation water salinity and nitrogen fertilizers on some chemical components

The average values of total carbohydrates, protein, *proline*, fibers and ash percentages are shown in Tables (4 and 5). Data show that, high level of salinity (9200ppm) decreased the mean values of all these chemical contents except of proline percentage in leaves at first cut whereas, insignificant increase in such chemical components has been recorded by decreasing the level of salinity from (9200 to 3700 ppm). On the other hand, proline percentage in leaves increased by increasing the salinity of irrigation water from (3700 to 9200 ppm), similar results were mentioned by **Hassan (1994) and Nassar *et al* (2000)** who indicated that proline helps in osmoregulation and protects the cells against salinity stress. The highest mean values of total carbohydrates percentages in stem was found in Piper variety at the recommended dose of mineral nitrogen fertilizer followed by treatment mixture of biofertilizers on salinity of irrigation water (3700ppm). Hybrid102 had the highest mean values of total carbohydrates percentages in leaves with adding the recommended dose of mineral nitrogen fertilizer and mixture of biofertilizers at the two cuts and Piper variety at the recommended dose of mineral nitrogen fertilizer in the first cut. However Is3214 variety had the lowest significant values of total carbohydrates percentages in stems and leaves under treatment without nitrogen fertilizer on salinity of irrigation water (9200ppm) in the both cuts, as shown in Table (4). These results are in harmony with those obtained by **Mustafa & Shaheen (1984); Abbas *et al* (1993); Hassan (1994); Nassar *et al* (2000) and Ram & Bhagwan (2003).**

Data in Table (5) show that the protein and fiber percentages in leaves and stems of the four sudan grass varieties significantly differed in there response to

Table 5. Effects of Salinity x N fertilizers x Varieties interaction on some chemical properties of four Sudan grass varieties at Ras Sudr over 2001 and 2002 growing seasons.

| Salinity | N | Varieties | Protein in leaves% | Protein in stems (%) | | Fiber in leaves (%) | | Proline in leaves (μm/g) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1st cut | 2nd cut | 1st cut | 2nd cut | 1st cut | 2nd cut | 1st cut |
| Salinity of water irrigation 3700 ppm | Recom-mend 60 kg N/fed. | Giza2 | 12.06 ab | 12.41 ab | 6.85 ab | 7.09 ab | 23.55 bc | 22.72 bc | 1.873 hi |
| | | Piper | 12.56 a | 12.92 a | 7.49 a | 7.59 a | 26.10 a | 25.72 a | 2.259 de |
| | | Hybrid 102 | 11.30 bc | 11.60 bc | 6.38 bc | 6.52 bc | 22.42 cd | 21.99 cd | 1.126 mn |
| | | Is 3214 | 10.21 d | 10.51 d | 6.44 bc | 6.59 bc | 20.67 de | 20.34 de | 1.224 lm |
| | Control (zero N) | Giza2 | 9.10 ef | 9.44 ef | 3.51 kl | 3.64 op | 16.80 mn | 16.72 lm | 0.428 r |
| | | Piper | 8.20 gh | 8.52 gh | 3.77 kl | 3.91 no | 18.33 jk | 17.99 jk | 0.502 r |
| | | Hybrid 102 | 7.30 ij | 7.58 hi | 3.01 op | 3.10 rs | 16.97 mn | 16.61 mn | 0.346 r |
| | | Is 3214 | 6.27 mn | 6.50 lm | 3.42 mn | 3.48 pq | 15.11 op | 14.64 op | 0.350 r |
| | Azotobac-ter | Giza2 | 9.22 e | 9.72de | 5.20 fg | 5.36 gh | 18.93 hi | 18.49 ij | 0.793 p |
| | | Piper | 9.26 e | 9.51 ef | 5.46 ef | 5.56 fg | 20.30 fg | 19.96 ef | 1.118 mn |
| | | Hybrid 102 | 8.30 fg | 8.54 gh | 4.53 hi | 4.72 jk | 19.39 fg | 19.04 gh | 0.559 qr |
| | | Is 3214 | 7.34 hi | 7.62 hi | 4.46 ij | 4.59 kl | 17.91 kl | 17.55 kl | 0.763 pq |
| | Azospiril-lum | Giza2 | 10.21 d | 10.55 d | 6.15 cd | 6.31 bc | 20.08 fg | 19.67 fg | 1.138 m |
| | | Piper | 10.24 d | 10.53 d | 5.87 cd | 6.01 de | 21.08 de | 20.75 de | 1.385 kl |
| | | Hybrid 102 | 9.29 e | 9.49 ef | 5.91 cd | 6.02 de | 20.93 de | 20.60 de | 0.878 no |
| | | Is 3214 | 8.30 fg | 8.52 gh | 5.61 de | 5.76 ef | 19.72 fg | 19.46 fg | 0.855 op |
| | Mixture | Giza2 | 11.03 cd | 11.48 c | 6.06 cd | 6.16 cd | 20.84 de | 20.54 de | 1.410 kl |
| | | Piper | 11.28 bc | 11.60 bc | 7.17 ab | 7.25 ab | 24.23 b | 23.85 b | 1.775 hi |
| | | Hybrid 102 | 10.23 d | 10.49 d | 6.78 ab | 6.87 ab | 23.02 bc | 22.66 bc | 1.083 mn |
| | | Is 3214 | 9.29 e | 9.50 ef | 6.51 bc | 6.69 ab | 20.62 de | 20.28 de | 0.996 mn |
| Salinity of water irrigation 9200 ppm | Recom-mend 60 kg N/fed. | Giza2 | 9.29 e | 9.35 fg | 6.42 bc | 6.57 bc | 20.61 de | 20.21 de | 2.790 c |
| | | Piper | 10.14 d | 10.33 de | 6.88 ab | 6.99 ab | 22.18 cd | 21.74 cd | 3.371 a |
| | | Hybrid 102 | 8.17 gh | 8.35 hi | 5.18 fg | 5.24 hi | 20.92 de | 20.61 de | 2.619 c |
| | | Is 3214 | 8.14 hi | 8.39 hi | 4.46 ij | 4.51 lm | 20.24 fg | 19.87 ef | 2.229 de |
| | Control (zero N) | Giza2 | 6.22 n | 6.38 n | 2.94 op | 3.00 st | 15.05 op | 14.56 op | 1.400 kl |
| | | Piper | 7.07 kl | 7.31 kl | 3.64 kl | 3.84 no | 16.98 mn | 16.63 mn | 1.463 kl |
| | | Hybrid 102 | 4.16 p | 4.34 p | 2.27 pq | 2.36 bc | 16.26 no | 15.94 no | 1.210 lm |
| | | Is 3214 | 4.04 p | 4.26 p | 1.96 q | 2.05 u | 14.38 p | 13.93 p | 1.080 mn |
| | Azotobac-ter | Giza2 | 6.30 mn | 6.57 lm | 3.96 jk | 4.08 mn | 17.61 lm | 17.22 kl | 1.612 jk |
| | | Piper | 7.15 jk | 7.37 jk | 4.36 ij | 4.40 lm | 20.09 fg | 19.75 fg | 1.798 hi |
| | | Hybrid 102 | 5.21 o | 5.45 o | 3.09 no | 3.16 qr | 18.87 ij | 18.99 gh | 1.638 ij |
| | | Is 3214 | 5.21 o | 5.40 o | 2.98 op | 3.07 rs | 17.93 kl | 17.57 kl | 1.460 kl |
| | Azospiril-lum | Giza2 | 7.20 jk | 7.38 jk | 4.42 ij | 4.49 lm | 19.12 gh | 18.43 ij | 1.983 gh |
| | | Piper | 8.21 gh | 8.37 hi | 4.92 gh | 5.04 ij | 20.35 ef | 19.99 ef | 2.392 d |
| | | Hybrid 102 | 6.36 lm | 6.58 lm | 3.46 lm | 3.56 op | 19.88 fg | 19.55 fg | 1.999 fg |
| | | Is 3214 | 6.23 n | 6.43 mn | 3.26 no | 3.37 qr | 19.07 gh | 18.65 hi | 1.808 hi |
| | Mixture | Giza2 | 8.08 hi | 8.29 hi | 5.59 de | 5.69 ef | 20.07 fg | 19.71 fg | 2.327 de |
| | | Piper | 9.17 ef | 9.37 fg | 6.33 bc | 6.46 bc | 21.27 de | 20.97 de | 3.045 b |
| | | Hybrid 102 | 7.21 jk | 7.45 ij | 4.46 ij | 4.57 kl | 20.80 de | 20.43 de | 2.347 de |
| | | Is 3214 | 7.12 jk | 7.33 kl | 4.09 jk | 4.16 mn | 20.04 fg | 19.56 fg | 2.124 ef |

Table 5. Cont.

| Salinity | N | Varieties | Fiber in stems (%) | | Ash in leaves (%) | | Ash in stems (%) | |
|---|---|---|---|---|---|---|---|---|
| | | | 1st cut | 2nd cut | 1st cut | 2nd cut | 1st cut | 2nd cut |
| Salinity of water irrigation 3700 ppm | Recommended 60 kg N/fed | Giza2 | 27.98 de | 27.62 bc | 10.81 bc | 11.37 bc | 13.85bc | 12.65 b |
| | | Piper | 30.96 a | 30.42 a | 12.32 a | 12.78 a | 15.27 a | 14.09 a |
| | | Hybrid 102 | 29.17 ab | 28.43 ab | 10.08 cd | 10.55 de | 13.05 d | 11.64 cd |
| | | Is 3214 | 27.72 ef | 27.34 cd | 8.45 f | 8.85 f | 11.35fg | 10.32 ef |
| | Control (zero N) | Giza2 | 18.82 q | 18.49 p | 7.33 g | 7.72 hi | 9.74 ij | 8.42 ij |
| | | Piper | 21.44 no | 21.04mn | 8.13 fg | 8.57 fg | 10.80gh | 9.58 fg |
| | | Hybrid 102 | 18.88 q | 18.42 p | 5.95 kl | 6.42 lm | 8.87 kl | 7.37 kl |
| | | Is 3214 | 19.45 pq | 18.85 op | 4.50 r | 4.96 rs | 7.47 no | 6.24 no |
| | Azotobacter | Giza2 | 23.89 kl | 23.41 jk | 8.43 f | 8.83 f | 11.32fg | 9.92 fg |
| | | Piper | 26.28 gh | 25.83 ef | 9.60 de | 10.20 de | 12.70de | 11.15 de |
| | | Hybrid 102 | 22.73 mn | 22.25 lm | 7.29 gh | 7.81 gh | 10.32hi | 8.95 gh |
| | | Is 3214 | 22.74 mn | 22.35 kl | 6.04 kl | 6.51 lm | 9.00 jk | 7.95 jk |
| | Azospirillum | Giza2 | 25.84 hi | 25.40 fg | 9.45 e | 9.92 e | 11.91ef | 10.43 ef |
| | | Piper | 28.52 cd | 28.04 bc | 10.07 cd | 10.55 de | 13.01d | 11.61 cd |
| | | Hybrid 102 | 26.35 gh | 25.97 ef | 8.13 fg | 8.61 fg | 11.12fg | 9.62 fg |
| | | Is 3214 | 25.29 ij | 24.89 hi | 6.96 ij | 7.44 ij | 9.94 i | 8.63 hi |
| | Mixture | Giza2 | 27.69 ef | 27.15 cd | 10.42 cd | 10.83 cd | 13.22cd | 11.81 bc |
| | | Piper | 30.65 ab | 30.25 a | 11.33 b | 11.79 b | 14.17 b | 12.47 bc |
| | | Hybrid 102 | 29.41 ab | 28.48 ab | 9.61 de | 10.07 de | 12.55de | 11.20 de |
| | | Is 3214 | 26.69 fg | 26.20 de | 8.08 fg | 8.53 fg | 11.03gh | 9.68 fg |
| Salinity of water irrigation 9200 ppm | Recommended 60 kg N/fed | Giza2 | 26.10 gh | 25.51 fg | 7.21 hi | 7.67 ij | 8.91 kl | 7.63 jk |
| | | Piper | 30.10 ab | 29.65 ab | 7.54 gh | 8.03 fg | 9.04 jk | 8.07 ij |
| | | Hybrid 102 | 29.99 ab | 29.22 ab | 6.78 ij | 7.26 ij | 8.27 kl | 7.67 jk |
| | | Is 3214 | 29.38 ab | 28.03 bc | 6.69 ij | 7.14 ij | 8.13 lm | 7.19 kl |
| | Control (zero N) | Giza2 | 17.78 q | 17.21 p | 3.46 u | 3.90 u | 4.91 v | 4.02 t |
| | | Piper | 18.67 hi | 18.15 p | 4.03 tu | 4.44 tu | 5.49 uv | 4.55 st |
| | | Hybrid 102 | 17.97 q | 17.40 p | 5.02 pq | 5.46 pq | 6.44 rs | 5.44 pq |
| | | Is 3214 | 17.88 q | 17.18 p | 4.42 st | 4.84 st | 5.81 tu | 4.90 rs |
| | Azotobacter | Giza2 | 21.12 op | 20.51 no | 5.07 op | 5.48 pq | 6.48 rs | 5.25 qr |
| | | Piper | 25.57 ij | 25.05 hi | 5.35 no | 5.85 op | 6.88 qr | 5.65 pq |
| | | Hybrid 102 | 24.76ij | 24.27 hi | 5.21 no | 5.71 op | 6.67 qr | 5.69 pq |
| | | Is 3214 | 23.23 lm | 22.54 kl | 4.77 qr | 5.21 qr | 6.21 st | 5.26 qr |
| | Azospirillum | Giza2 | 24.31 jk | 23.82 ij | 5.88 lm | 6.24 mn | 7.26 po | 6.13 op |
| | | Piper | 27.71 ef | 27.20 cd | 5.52 no | 6.04 no | 7.07 pq | 6.07 op |
| | | Hybrid 102 | 28.32 cd | 27.82 bc | 5.96 kl | 6.38 lm | 7.39 op | 6.47 mn |
| | | Is 3214 | 26.01 gh | 25.41 fg | 5.68 mn | 6.11 mn | 7.14 pq | 6.18 op |
| | Mixture | Giza2 | 25.76 q | 25.27 gh | 6.86 ij | 7.45 jk | 8.47 kl | 7.25 kl |
| | | Piper | 29.81 ab | 29.24 ab | 7.06 ij | 7.50 ij | 8.52 kl | 7.30 kl |
| | | Hybrid 102 | 29.66 ab | 28.94 ab | 6.44 jk | 6.85 kl | 7.83mn | 6.83 lm |
| | | Is 3214 | 28.71 bc | 28.18 bc | 6.49 jk | 6.94 jk | 7.88mn | 7.23 kl |

nitrogen form. Giza2 and Piper varieties fertilized with the recommended dose of mineral nitrogen gave the highest mean values of protein percentage in leaves and stems at the two cuts. Whereas, Piper and Hybrid102 varieties with mixture of biofertilizers had the highest mean values of protein percentage in leaves and stems at the second cut. On the other hand Hybrid102 and Is3214 varieties had the lowest mean values of protein percentage in leaves and stems under no nitrogen fertilization. Concerning fiber percentages, Piper variety gave the highest mean values of fiber percentages in leaves followed by Giza2 after treatment with the recommended dose of mineral nitrogen. Whereas, Piper and Hybrid102 with the mixture of biofertilizers recorded the highest mean values of fibers percentages in leaves under salinity of irrigation water (3700 ppm). On the other hand, Is3214 variety had the lowest mean values under the treatment without nitrogen fertilization at salinity of irrigation water (9200ppm). It is clear from results presented in Table (5) that Piper and Hybrid102 varieties gave the highest mean values of fibers percentages in stems with adding the recommended dose of mineral nitrogen followed by the mixture of biofertilizers treatment under salinity of irrigation water (3700ppm). While Giza2 and Is3214 varieties gave the lowest mean values of fiber percentages in stems under no nitrogen fertilization under saline water (9200 ppm). Similar results were obtained by **Panwar *et al* (1999)**; **Parasuraman *et al* (2000) and Patidar & Mali (2004)**.

Data in Table (5) show that Piper variety gave the highest mean values of ash percentages in leaves and stems followed by Giza2 on the recommended dose of mineral nitrogen fertilizer and Piper on the mixture of biofertilizers under saline water 3700ppm in the both cuts. Whereas, Giza2 had the lowest mean values of ash percentages in leaves and stems followed by Piper under treatment without nitrogen fertilization of irrigation water 9200ppm. **Patel *et al* (1975)**; **Patel & Rajagopal (2003) and Ramesh & Sammi (2004)** demonstrated that chemical composition of leaves in addition to familiar dilution effects and ion competition revealed increased accumulation of Ca, Na, and Cl related to high level of P supply at high salinity conditions only.

## REFERENCES


**A.O.A.C., Association of Official Analytical Chemists, (1990).** ***Methods of Analysis, 15th Ed., pp. 1045-1106.*** Washington D.C.,USA.

**Abbas, M.T.; A. Rammah; M. Monib; E.H. Ghanem; M.A.M. Eid; M.F.Z. Emara and N.A. Hegazi (1993).** ***International Symposium N2-Fixation, pp. 485-487.*** Cairo. Univ. Press, Egypt.

**Barik, A.K.; A.K. Mukherjee and B.K. Mandal (1998).** Growth and yield of sorghum (*Sorghum bicolor*) and groundnut (*Arachis hypogaea*) grown as sole and intercrops under different nitrogen regimes. ***Indian J. of Agron., 43(1): 27-32.***

**Bates, L.S.; R.P. Waldren and I.D. Teare (1973).** Rapid determination of free proline for water stress studies. ***Plant and Soil, 39: 205-207.***

**Datta, K.S.; A. Kumar; S.K. Varma and R. Angrish (1996).** Studies on salt tolerance of three tropical forage crops on the basis of mineral ion uptake. ***Forage Res., 22 (2&3): 129-138.***

**Dahiya, O.S.; B.S. Dahiya; R.C. Punia and C. Ram (1997).** Respiration rate as a measure of seedling establishment in forage sorghum (*Sorghum bicolor* (l.) Moench). ***Forage Res.,23(3&4):149-152.***

**Desale, J.S.; R.M. Babar; S.H. Pathan and R.L. Bhilare (1999).** Effect of biofertilizers with various nitrogen levels on green forage yield of sorghum. ***Forage Res., 24 (4): 195-198.***

**Duncan, D.B. (1955).** Multiple range and multiple "F" tests. ***Biometrics, pp. 1-42.***

**Francois, L.E.; T. Donovan and E.V. Maas. (1984).** Salinity effects on seed yield, growth and germination of grain sorghum. ***Agron. J., 76: 742-754.***

**Hassan, S.A. (1994).** ***Studies on Some Sorghum Mutation Types Induced by Gamma-ray and Ethylamine Treatments under Stress Conditions.*** **pp. 22-23 & 53-59.** Ph.D. Thesis Moshtohor, Egypt.

**Kaoud, E.E. and M.A.B. El-Fieshawy (1990).** Influence of soil salinity on growth and mineral composition of sorghum (*sorghum bicolor,* L.). ***Egypt. J. Appl. Sci., 5 (2): 256-271.***

**Karwasra, R.S. and D.R. Dahiya (1997).** Performance of forage sorghum (*Sorghum bicolor*) varieties under nitrogen fertilization. ***Forage Res., 23 (1&2): 121-123.***

**Karwasra, R.S.; R.S. Kadian and D.R. Dahiya (1996).** Effect of varieties and nitrogen on yield and yield attributes in forage sorghum. ***Forage Res., 22 (2&3): 203-206.***

**Kramer, P.J. (1969).** ***Plant and Soil Water Relationships: A Modern Synthesis. pp. 102-168.*** McGraw-Hill Book, Co., Inc., New York.

**Kumar, A.; K.S. Datta; J. Gorham; R.G. Wyn Jones and P.A. Hollington (1991):** Influence of salinity levels at two growing stages on the performance of three tropical forge crops. ***J. Indian Soc. Coastal Agric. Res., 9: 493-502.***

**Mustafa, S.M.I. and N. Shaheen (1984).** Physiological and physiochemical evaluations of four sorghum cultivars. ***J. Agric. Res. Tanta Univ., 10 (1): 1-11.***

**Nassar, Z.M.; M.N. Nour El-Dein and A.A. El-Houssini (2000).** Effect of moisture stress and presoaking with IAA on forage yield of *Sorghum bicolor* (L.) Moench grown in salt affected soils at Wadi-Sudr. ***Annals Agric. Sci., Ain Shams Univ., Cairo, 45 (1): 201-214.***

**Panwar, V.S.; Tewatin, B.S. and Lodhi, G.P. (1999).** Chemical composition and in vitro dry matter digestibility of some varieties of Sorghum fodder harvested at different stages. ***Forage Res., 24(4): 209-211.***

**Parasuraman, P.; P. Duraisamy and A.K. Mani (2000).** Effect of organic, inorganic and bio-fertilizers on soil fertility under double-cropping system in rainfed red soils. ***Indian J. of Agron., 45 (2): 242-247.***

**Patel, P.M.; A. Wallace and E.F. Wallihan (1975).** Influence of salinity and N-P fertility levels on mineral content and growth of sorghum in sand culture. ***Agron. J., 67: 622-625.***

**Patel, P.C.; J.R. Patel and A.C. Sadhu (1992).** Response of forage sorghum (*Sorghum bicolor*) to biofertilizer and nitrogen levels. ***Indian J. Agron., 37 (3): 466-469.***

**Patel, J.R. and S.J. Rajagopal (2003).** Nitrogen management for production of sorghum (*Sorghum bicolor*) and cowpea (*Vigna unguiculata*) forage under intercropping system. ***Indian J. Agron., 48 (1): 43-37.***

**Patidar, M. and A.L. Mali (2004).** Effect of farmyard manure, fertility levels and boi-fertilizers on growth, yield and quality of sorghum (*Sorghum bicolor*). ***Indian J. Agron., 49 (2): 117-120.***

**Peach, K. and M. V. Tracey (1956).** ***Modern Methods of Plant Analysis. Vol. 1, pp. 13-19***, Springer Verlag Berlin.

**Ramamurthy, V. (2002).** Effect of nitrogen and *Azospirillum* inoculation on growth and green forage yield of *Pennisetum* trispecific hybrid. ***Indian J. Agron., 47 (4): 566-570.***

**Ram, S.N. and Bhagwan Singh (2003).** Physiological growth parameters, forage yield and nitrogen uptake of sorghum (*Sorghum bicolor*) as influenced with legume intercropping, harvesting time and nitrogen level. ***Indian J. Agron., 48 (1): 38-41.***

**Ramesh, P. and K.R. Sammi (2004).** Productivity and nutrient-use efficiency of soybean (*Glycin max*) and sorghum (*Sorghum bicolor*) intercropping at different levels of nitrogen in rainfed deep vertisols. ***Indian J. Agron., 49 (1): 31-33.***

**Rawat, C.R. and C.R. Hazra (1998).** Effect of nitrogen and *Azotobacter* on forage yield of oats. ***Forage Res., 23 (3&4): 241-243.***

**Saffa, M. Ismaeil; Om Mohamed A. Khafagi and Samya M. Sohsah (1993).** Effect of some seed hardening treatments on germination, growth and yield of Sudan grass grown under saline conditions. ***Desert Inst. Bull., 43 (2): 221-242.***

**Smith, D.; G. M. Paulsen and C. A. Roguse (1964).** Extraction of total available carbohydrates from grass and legume tissues. ***Plant Physiol., 39: 960-962.***

**Steel, R. G. D. and J. H. Torrie (1980).** ***Principles and Procedures of Statistics, $2^{nd}$ Ed. 633 pp.***, McGraw-Hill Book Co., Inc., New York.

**Subba Rao, N.S.; K.V.R. Tilak and M.L. Kumari (1979).** Effect of biofertilizers with various nitrogen levels on root growth and forage yield of sorghum. ***Curr. Sci., 48: 133-134.***

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# تأثير الملوحة و التسميد الحيوى على إنتاجية بعض أصناف من حشيشة السودان (جنس السورجم) بوادى سدر

[٥٠]

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اجري هذا البحث بمحطة بحوث راس سدر - جنوب سيناء خلال موسمي ٢٠٠٠ و ٢٠٠١ لدراسة تأثير مستوين من ملوحة مياه الري (٣٧٠٠، ٩٢٠٠ جزء/مليون) وخمسة معاملات من التسميد النيتروجيني، المعدني و ثلاث مستويات من التسميد

الحيـوي (الأزوتوبـاكتر و الايزوسـبيريلم وخليط من الاثنين) علي النمو والمحصـول الأخضر والجاف وبعض الصفات الكيميائية لأربعة مـن أصـناف حشيشـة السـودان (السورجم).

**وفيما يلي أهم النتائج التي تم الحصول عليها**

١-أظهرت النتائج أن هناك نقص معنـوي في كل من صـفات النمـو الخضـري والمحصول الغض والجـاف لأصـناف السورجم الأربعـة المختبـرة بزيـادة مستوي ملوحة مياه الري مـن ٣٧٠٠ إلي ٩٢٠٠ جزء/مليون.

٢-تفوق الصنف بيبر علي باقي الأصـناف في صفة الوزن الغض ( محصول العلف الأخضـر) وذلـك بإضـافة التسـميد النيتروجيني المعدني الموصي بـه (٦٠ كجم نيتروجين / فدان) يليـة التسـميد الحيـوي ( خلـيط مـن الأزوتوبـاكتر والايزوسبيريلم ) عند الحشتين الأولـي والثانية وذلك تحت مستوي ملوحة ميـاه الري٣٧٠٠ و ٩٢٠٠ جزء/ مليون.

٣-تفوق الصنف بيبر علي باقي الأصـناف في محتـوي السـيقان والأوراق مـن الكربوهيدرات والبـروتين و الأليـاف والرماد بإضافة التسـميد النيتروجينـي المعـدني الموصـي بـه ( ٦٠كجـم نيتروجين/ فدان) يلية التسميد الحيـوي (خليط من الأزوتوباكتر والايزوسبيريلم) عند الحشتين الأولي والثانية وذلك تحت كل من مستوي ملوحة ٣٧٠٠ و ٩٢٠٠ جزء/مليون من مياه الري.

٤- زيادة محتوي الأوراق مـن البـرولين بزيادة مستوي ملوحة مياه الـري مـن ٣٧٠٠ إلي ٩٢٠٠ جزء/ مليـون. فـي الوقت نفسه حقق الصنف بيبر اعلي قيمة معنوية من محتوي الأوراق من البرولين تحت ظروف الري بمياه اعلي ملوحـة (٩٢٠٠ جزء/مليون).

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