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EFFECT OF SOME SALINITY AND FERTILIZATION TREATMENTS ON BERMUDA: A. VEGETATIVE GROWTH

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ABSTRACT: This study was undertaken at the private Farm, Bani Mazar District, Minia governorate. during the two seasons of 2020 and 2021 to investigate the effect of irrigation water salinity, mineral and biofertilization [effective microorganisms (EM) and *Azotobacter chroococcum* bacteria (AC)] treatments, and, their interactions on the vegetative growth of bermudagrass (*Cynodon dactylon*, L.), grown in sandy soil. Our results indicated that the vegetative growth traits (covering density, plant height, as well as, fresh and dry weights of clipping) were increased with the low level of salinity (3000 and 6000 ppm), while, they were decreased with the high level of salinity (9000 ppm) comparing with control treatment, with significant differences in some cases, in the three cuts during both seasons. The mineral and biofertilization treatments significantly increased the previous parameters compared with the control treatment, except some treatments (EM or AC) in 2nd and 3rd cuts with the highest values which were obtained due to 100% mineral NPK followed by biofertilizer (EM + AC), without significant differences in some cases, in the three cuts during both seasons. The interaction treatments were significant for all vegetative growth traits in the three cuts during both seasons. The best interaction treatments that mitigate the adverse effects of salinity (9000 ppm) were 100% mineral NPK followed by biofertilizer (EM + AC).

Keywords: *Cynodon dactylon,* L., salinity, mineral fertilization, biofertilization, vegetative growth.

INTRODUCTION

Bermudagrass (*Cynodon dactylon* (L.) belongs to Family Poaceae that act as a ground cover (Uddin and Juraimi, 2013), it is considered the main element of landscape. Also, it is a foundation part to play or rest, Bermudagrass is used very often on the fairways and tees of golf courses (Santos *et al*., 2008 and Wu and Anderson, 2011).

Soil salinity is one of the major factors that reduce plant growth including turfgrass as clarified by Devitt (1989), Marcum and Murdoch (1990), Ahmed *et al*. (1993), Adavi *et al*. (2006), Hameed and Ashraf (2008) Bauer *et al*. (2009), Nadeem *et al*. (2012), Badawy *et al*. (2018) and Sharifiasl *et al*. (2020).

Mineral NPK fertilization has the greatest effect on the growth of bermudagrass as reported by Doernoden *et al*. (1991), Overman and Evers (1992), El-Tantawy *et al*. (1993), Trenholm *et al*. (1998), Rodriguez *et al*. (2002), Premazzi *et al*. (2003), Snyder and Cisar (2005) AbdelKader and Alhumaid (2012) and Ihtisham *et al*. (2020). Also, biofertilizers have many mechanisms to enhance growth and alleviate adverse effects of salinity (Król, 2006; Yuojen, 2015; Ali *et al*., 2018 and De Luca *et al*., 2020).

Therefore, the aim of this research was to evaluate the effect of irrigation water salinity, mineral and biofertilization treatments and their interactions on the vegetative growth of bermudagrass.

MATERIALS AND METHODS

This study was undertaken at the private Farm, Bani Mazar District, Minia governorate. during the two seasons of 2020 and 2021 to investigate the effect of irrigation water salinity and mineral and/or biofertilization treatments, as well as, their interaction on the vegetative growth traits of bermudagrass (*Cynodon dactylon*, L.), grown in sandy soil.

The seeds of bermudagrass were obtained from Hamza Co., El-Giza, Egypt. The experiment was arranged in a complete randomized block design in a split-plot design with three replicates.

The main plots (A) included four levels of salinity i.e. 0.0, 3000, 6000 and 9000 ppm, of $NaCl{:}CaCl_2$ at a rate of 1:1 w/w. While eight treatments of mineral NPK and/or biofertilizers, included control, mineral NPK at 100%, mineral NPK at 75%, effective microorganisms (EM), *Azotobacter chroococcum* bacteria (AC), mineral NPK at 75% + EM, mineral NPK at 75% + AC, and EM + AC occupied the subplots (B).

Therefore, the interaction treatments (A × B) performed 32 treatments. Each replicate area was 10×10 m, such area was dug out to 30 cm depth and separated into the experimental unit (plot) 1.5 × 1.0 m, to prevent seepage, a 1.0 m between the main plot and 0.25 m between sub-plots, using layers of wood, then refilled with sandy soil plus compost at 10 ton/fed for all treatments (3.6 kg/unit area). Seeds of bermudagrass were sown by broadcasting method on April, 28th for both growing seasons at the rate of 60 g/1.5 m^2.

The physical and chemical analysis of the used soil is determined according to Jackson (1973) and is shown in Table (a).

The full dose of mineral NPK (100%) was 300 kg/fed of ammonia nitrate (33.5% N) + 200 kg/fed calcium super phosphate (15.5% P_2O_5) + 100 kg/fed potassium sulphate (48% K_2O), therefore, the NPK 100% = 112.5 + 75 + 37.5 g/1.5 m^2 while 75% NPK = 84.4 + 56.3 + 28.1 g/1.5 m^2.

All assigned calcium superphosphate fertilizer was applied to the sandy soil during soil preparation for bermuda cultivation, while the amounts of N and K fertilizers were divided into three equal doses and were applied in monthly intervals pattern, starting on the second day of June then 2nd July and 2nd August in both seasons.

Fresh and active biofertilizer, Effective microorganisms containing lactic acid bacteria, photosynthetic bacteria and yeasts (EM) and *A. chroococcum* (AC) strain were obtained from Microbiology Department, Faculty of Agriculture, Mansoura University were sprayed by hand sprayer at the rate of 500 cm^3/1.5 m^2 (each 1.0 ml containing 10^7 cells of bacteria) and (50 ml/1.5 m^2), respectively.

The first dose for EM and AC was applied on 9th June, the second dose on 9th

Table a. Physical and chemical properties of the used soil before planting of bermudagrass during 2020 and 2021 seasons.

Soil character	Values 2020	Values 2021	Soil character	Values 2020	Values 2021
Physical properties			**Nutrients**		
Sand (%)	90.00	91.00	**Total N (%)**	0.01	0.01
Silt (%)	7.30	6.40	**Available P (%)**	2.81	2.96
Clay (%)	2.70	2.60	**Na^+ (mg/100 g soil)**	2.34	2.45
Soil type	Sandy	Sandy	**K^+ (mg/100 g soil)**	0.78	0.83
Chemical properties			**DTPA-extractable nutrients**		
pH (1:2.5)	8.15	8.22	**Fe (ppm)**	1.04	1.10
E.C. (dS/m)	1.11	1.13	**Cu (ppm)**	0.33	0.39
O.M.	0.03	0.04	**Zn (ppm)**	0.34	0.31
$CaCO_3$	13.70	13.85	**Mn (ppm)**	0.56	0.67

July and the last spray was on 9th August (after one week of the dose of mineral fertilizer), and then the plants were irrigated immediately.

Data recorded:

Covering density (%), plant height (cm), and fresh and dry weights of clipping (g) during the three cuts in both seasons.

The obtained results were tabulated and statistically analyzed according to MSTAT–C (1986), and LSD test at 5% was followed to compare the means of treatments.

RESULTS AND DISCUSSION

Vegetative growth traits:

Covering density (%):

Data presented in Table (1), regardless of the treatments, showed that covering density (%) in the third cut was higher than either the first or the second cuts.

The treatments of 3000 and 6000 ppm irrigation water salinity significantly increased covering density (%) compared with the control treatment, while the high level of salinity (9000 ppm) decreased covering density (%) compared with the control treatment during the three cuts in both seasons.

These results were in agreement with those obtained by Badawy *et al*. (2018), Karimi *et al*. (2018) and Sharifiasl *et al*. (2020) on bermudagrass.

All used seven treatments of mineral and/or biofertilizers significantly increased covering density (%) compared with the control during the three cuts, except in the 3rd cut in both seasons. Among these treatments, mineral NPK 100%, followed by EM + AC, were the best without significant differences between them.

The superiority of mineral fertilization in increasing the covering density of bermudagrass was investigated by Manoly *et al*. (2008), Guertal and Hicks (2009), AbdelKader and Alhumaid (2012), Ammar (2018), Jena and Mohanty (2020) and Ihtisham *et al*. (2020).

At the same time, the role of biofertilization in enhancing covering density was emphasized by Yuojen (2015) and Ali *et al*. (2018) on *Cynodon dactylon*, L., Dwivedi *et al*. (2016) on *Paspalum scrobiculatum* and Shaheen *et al*. (2017), on spinach plant.

The interaction treatments were significant for covering density during the three cuts in both seasons. The best interaction treatments that alleviated the harmful effects of the highest level of saline water (9000 ppm) were mineral NPK 100%, followed by EM + AC, then mineral NPK 75% + EM without significant differences between such three interaction treatments in the first and third cuts.

Plant height (cm):

Regardless of the treatments either in the main or sub-plots, the tallest plant was recorded in the first and second seasons during the third cut as shown in Table (2).

There was a significant reduction in plant height in the first and second seasons during the three cuts when *Cynodon dactylon* was irrigated with salinity stress at 6000 and 9000 ppm compared with the low level (3000 ppm). The reduction was pronounced with the highest level of irrigation water salinity (9000 ppm) which produced the shortest plants during the three cuts in both seasons.

The negative impacts of irrigation water salinity on plant height were stated by many authors such as Adavi *et al*. (2006), Hameed and Ashraf (2008) Nadeem *et al*. (2012), Badawy *et al*. (2018) and Sharifiasl *et al*. (2020) on bermudagrass.

Data presented in Table (2) mentioned that mineral and/or biofertilization treatments gave a significant increase in bermuda plant height during the three cuts in both growing seasons, except the treatments of EM and AC in the 2nd and 3rd cuts during the first season, and the treatment of AC in

Table 1. Effect of salinity concentration, mineral and biofertilization on covering density (%) of bermudagrass during three cuts in the two growing seasons (2020 and 2021).

Mineral and biofertilization treatments (B)	Salinity concentrations (ppm) (A)									
	0.0	3000	6000	9000	Mean (B)	0.0	3000	6000	9000	Mean (B)
	The 1st season (2020)					The 2nd season (2021)				
	First cut									
Control	49.98	64.97	59.98	48.98	55.98	52.48	70.85	67.17	51.43	60.48
Mineral NPK 100%	67.83	88.18	81.40	66.47	75.97	71.22	96.15	91.16	69.80	82.08
Mineral NPK 75%	55.93	72.71	67.12	54.81	62.64	58.73	79.28	75.17	57.55	67.68
EM (500 cm^3/1.5 m^2)	54.74	71.16	65.69	53.65	61.31	57.48	77.59	73.57	56.33	66.24
AC (50 ml/1.5 m^2)	54.15	70.40	64.98	53.07	60.65	56.86	76.76	72.78	55.72	65.53
NPK 75% + EM	64.44	83.77	77.33	63.15	72.17	67.66	91.34	86.61	66.31	77.98
NPK 75% + AC	61.05	79.37	73.26	59.83	68.38	64.10	86.54	82.05	62.82	73.88
EM + AC	66.05	85.87	79.26	64.73	73.98	69.35	93.63	88.77	67.97	79.93
Mean (A)	51.02	66.32	61.22	49.99		53.57	72.31	68.56	52.49	
L.S.D. at 5 %	A: 3.10		B: 2.00		AB: 4.00	A: 3.65		B: 2.16		AB: 4.32
	Second Cut									
Control	44.72	53.66	51.43	43.38	48.30	46.96	55.90	49.64	43.83	49.08
Mineral NPK 100%	70.40	84.48	80.96	68.29	76.03	73.92	88.00	78.14	68.99	77.26
Mineral NPK 75%	59.06	70.87	67.92	57.29	63.78	62.01	73.83	65.56	57.88	64.82
EM (500 cm^3/1.5 m^2)	58.30	69.96	67.05	56.55	62.96	61.22	72.88	64.71	57.13	63.98
AC (50 ml/1.5 m^2)	57.90	69.48	66.59	56.16	62.53	60.80	72.38	64.27	56.74	63.55
NPK 75% + EM	61.60	73.92	70.84	59.75	66.53	64.68	77.00	68.38	60.37	67.61
NPK 75% + AC	59.00	70.80	67.85	57.23	63.72	61.95	73.75	65.49	57.82	64.75
EM + AC	68.92	82.70	79.26	66.85	74.43	72.37	86.15	76.50	67.54	75.64
Mean (A)	59.99	71.99	68.99	58.19		62.99	74.98	66.59	58.79	
L.S.D. at 5 %	A: 3.00		B: 1.70		AB: 3.40	A: 3.58		B: 1.81		AB: 3.62
	Third cut									
Control	59.06	69.69	65.56	58.47	63.19	62.60	73.83	69.10	60.83	66.59
Mineral NPK 100%	75.85	89.50	84.19	75.09	81.16	80.40	94.81	88.74	78.13	85.52
Mineral NPK 75%	64.89	76.57	72.03	64.24	69.43	68.78	81.11	75.92	66.84	73.16
EM (500 cm^3/1.5 m^2)	60.98	71.96	67.69	60.37	65.25	64.64	76.23	71.35	62.81	68.75
AC (50 ml/1.5 m^2)	59.71	70.46	66.28	59.11	63.89	63.29	74.64	69.86	61.50	67.32
NPK 75% + EM	70.95	83.72	78.75	70.24	75.92	75.21	88.69	83.01	73.08	80.00
NPK 75% + AC	64.71	76.36	71.83	64.06	69.24	68.59	80.89	75.71	66.65	72.96
EM + AC	73.05	86.20	81.09	72.32	78.16	77.43	91.31	85.47	75.24	82.36
Mean (A)	66.15	78.06	73.43	65.49		70.12	82.69	77.40	68.13	
L.S.D. at 5 %	A: 4.02		B: 3.13		AB: 6.60	A: 4.18		B: 3.17		AB: 6.34

EM: Effective microorganisms and AC: *Azotobacter chroococcum* bacteria

Table 2. Effect of salinity concentration, mineral and biofertilization on plant height (cm) of bermudagrass during three cuts in the two growing seasons (2020 and 2021).

Mineral and biofertilization treatments (B)	Salinity concentrations (ppm) (A)									
	0.0	3000	6000	9000	Mean (B)	0.0	3000	6000	9000	Mean (B)
	The 1st season (2020)					The 2nd season (2021)				
	First cut									
Control	8.40	12.60	10.08	8.06	9.79	8.82	13.67	11.29	8.64	10.61
Mineral NPK 100%	11.4	17.10	13.68	10.94	13.28	11.97	18.55	15.32	11.73	14.39
Mineral NPK 75%	9.40	14.10	11.28	9.02	10.95	9.87	15.30	12.63	9.67	11.87
EM (500 cm^3/1.5 m^2)	9.20	13.80	11.04	8.83	10.72	9.66	14.97	12.36	9.47	11.62
AC (50 ml/1.5 m^2)	9.10	13.65	10.92	8.74	10.60	9.56	14.81	12.23	9.36	11.49
NPK 75% + EM	10.83	16.25	13.00	10.40	12.62	11.37	17.83	14.56	11.14	13.67
NPK 75% + AC	10.26	15.39	12.31	9.85	11.95	10.77	16.70	13.79	10.93	12.95
EM + AC	11.10	16.65	13.32	10.66	12.93	11.66	18.07	14.92	11.42	14.02
Mean (A)	8.57	12.86	10.29	8.23		9.00	13.95	11.52	8.82	
L.S.D. at 5 %	A: 1.11		B: 0.55		AB: 1.10	A: 1.19		B: 0.40		AB: 0.80
	Second Cut									
Control	8.13	11.53	11.22	7.66	9.64	8.90	10.90	10.38	7.63	9.45
Mineral NPK 100%	12.53	20.00	16.76	11.87	15.29	12.75	20.73	15.39	14.80	15.92
Mineral NPK 75%	10.80	12.67	12.10	8.33	10.98	9.90	13.30	11.17	8.63	10.75
EM (500 cm^3/1.5 m^2)	10.60	12.63	11.63	8.00	10.72	9.86	11.76	10.77	8.06	10.11
AC (50 ml/1.5 m^2)	10.47	11.60	10.77	7.73	10.14	9.97	11.66	10.99	8.43	10.26
NPK 75% + EM	11.20	15.00	11.66	9.63	11.87	11.76	14.70	12.67	11.26	12.60
NPK 75% + AC	11.10	14.10	12.26	8.50	11.49	11.03	13.03	12.01	9.66	11.43
EM + AC	12.80	18.30	14.10	11.10	14.08	12.43	18.26	14.16	12.10	14.24
Mean (A)	10.95	14.48	12.56	9.10		10.83	14.29	12.19	10.07	
L.S.D. at 5 %	A: 1.35		B: 1.22		AB: 2.44	A: 1.31		B: 1.77		AB: 3.54
	Third cut									
Control	10.13	14.30	10.33	8.33	10.77	10.66	14.83	11.03	8.20	11.18
Mineral NPK 100%	13.76	20.76	17.82	13.07	16.36	13.93	22.33	19.00	13.16	17.11
Mineral NPK 75%	11.13	18.06	11.50	9.06	12.44	11.40	18.20	11.90	9.73	12.81
EM (500 cm^3/1.5 m^2)	10.46	15.93	11.25	9.23	11.72	11.53	16.93	11.70	9.50	12.42
AC (50 ml/1.5 m^2)	10.13	14.82	11.02	8.70	11.17	11.30	15.16	11.30	8.93	11.67
NPK 75% + EM	12.17	18.78	15.29	11.27	14.38	12.86	19.13	15.80	11.66	14.86
NPK 75% + AC	11.10	16.73	14.01	10.53	13.09	13.06	17.06	14.26	10.90	13.82
EM + AC	13.01	19.87	17.12	12.47	15.62	12.53	22.01	18.83	12.99	16.59
Mean (A)	11.33	17.56	13.67	10.32		12.31	18.05	14.10	10.64	
L.S.D. at 5 %	A: 1.40		B: 0.97		AB: 1.94	A: 1.51		B: 0.75		AB: 1.50

EM: Effective microorganisms and AC: *Azotobacter chroococcum* bacteria

the 3rd cut in the second season as well as the treatments of mineral NPK 75%, EM and AC in the 2nd cut during the second season. It is noticed that mineral NPK 100% and/or EM + AC recorded the tallest plants in both seasons. Such two superior treatments came in the first order, while NPK 75% + EM and mineral NPK 75% + AC came in the second order, mineral NPK 75%, EM and AC treatments came in the third order, and the control gave the shortest plants.

The role of NPK fertilization in improving plant height was also mentioned by Ammar (2018), Ihtisham *et al*. (2018), Jena and Mohanty (2020) and Ihtisham *et al*. (2020) on *Cynodon dactylon*, L.

Meanwhile, the increase in plant height due to biofertilizer deduced by Yuojen (2015) and Ali *et al*. (2018) on *Cynodon dactylon* L.

The interaction was significant for plant height. The interaction treatment of 9000 ppm with mineral NPK 100%, followed by EM + AC, then mineral NPK 75% + EM mitigated the stress of salinity.

Clipping fresh and dry weights (kg):

No matter what the treatments either in main or sub-plots, the heaviest clipping fresh and dry weights came from the 3rd cut in both seasons as shown in Tables (3 and 4).

Data presented in Tables (3 and 4) stated that clipping fresh and dry weights were gradually decreased with the increase in salinity concentration during the three cuts in both seasons facing the low level (3000 ppm). Significant differences were detected between each two salinity water irrigation. At the same time the irrigation water salinity at 3000, followed by 6000 ppm increased the clipping fresh and dry weights than the control, while, 9000 ppm reduced the clipping fresh and dry weights facing the control.

The above-mentioned findings were in harmony with those reported by Al-Khalifah (2004), Alshammary *et al*. (2004), Berndt (2007), Karimi *et al*. (2018), Mohammed *et al*. (2019) and Sharifiasl *et al*. (2020) on bermudagrass.

Concerning the effect of mineral and/or biofertilization treatments on clipping fresh and dry weights, with respect to mineral NPK 100% produced the maximum clipping fresh and dry weights in both seasons, followed by using biofertilization (EM + AC). The control treatments gave the lightest clipping fresh and dry weights in both seasons for the 1st, 2nd and 3rd cuts. The other treatments gave intermediate values.

Concerning the impact of mineral NPK fertilization, our findings are in agreement with those indicated by Trenholm *et al*. (2000), Rodriguez *et al*. (2002), Snyder and Cisar (2005), Alderman *et al*. (2011), Bald *et al.* (2013) and Ihtisham *et al*. (2020) on *Cynodon dactylon*, L.

Regarding the effect of biofertilizers, many researchers stated that biofertilizers enhanced plant fresh weight such as Yuojen (2015) and Ali *et al*. (2018) on *Cynodon dactylon*, L.

The interaction treatments were significant for clipping fresh and dry weights during the three cuts in both seasons. Generally, in both seasons during the three cuts, the heaviest weights (fresh or dry) were produced from mineral NPK 100% or EM + AC under 3000 ppm salinity. In addition, the best treatments that alleviated the harmful effects of the highest level of saline water (9000 ppm) were mineral NPK 100%, followed by EM + AC, then mineral NPK 75% + EM, without significant difference between such superior interaction treatments in the first cut for fresh weight.

The bermudagrass can tolerate moderate concentrations of salinity, however, the high concentrations reduce vegetative and root growth. Where, the high level of salinity resulted in osmotic stress (Berndt, 2007), reduced photosynthetic capacity, damage to photosynthetic systems by excessive energy, structural disorganization, or reduction in photochemical quenching (Flowers *et al*., 1985 and Lee *et al*., 2004) and proline

Table 3. Effect of salinity concentration, mineral and biofertilization on clipping fresh weight/unit (kg) of bermudagrass during three cuts in the two growing seasons (2020 and 2021).

Mineral and biofertilization treatments (B)	Salinity concentrations (ppm) (A)									
	0.0	3000	6000	9000	Mean (B)	0.0	3000	6000	9000	Mean (B)
	The 1st season (2020)					The 2nd season (2021)				
	First cut									
Control	1.999	2.599	2.399	1.959	2.239	2.099	2.834	2.687	2.057	2.419
Mineral NPK 100%	2.713	3.527	3.256	2.659	3.039	2.849	3.846	3.647	2.792	3.283
Mineral NPK 75%	2.237	2.908	2.685	2.192	2.506	2.349	3.171	3.007	2.302	2.707
EM (500 cm^3/1.5 m^2)	2.190	2.846	2.628	2.146	2.452	2.299	3.104	2.943	2.253	2.650
AC (50 ml/1.5 m^2)	2.166	2.816	2.599	2.123	2.426	2.274	3.070	2.911	2.229	2.621
NPK 75% + EM	2.578	3.351	3.093	2.526	2.887	2.706	3.654	3.464	2.652	3.119
NPK 75% + AC	2.442	3.175	2.930	2.393	2.735	2.564	3.462	3.282	2.513	2.955
EM + AC	2.642	3.435	3.170	2.589	2.959	2.774	3.745	3.551	2.719	3.197
Mean (A)	2.041	2.653	2.449	2.000		2.143	2.893	2.743	2.100	
L.S.D. at 5 %	A: 0.101		B: 0.080		AB: 0.160	A: 0.121		B: 0.087		AB: 0.134
	Second Cut									
Control	1.789	2.147	2.057	1.735	1.932	1.878	2.236	1.986	1.753	1.963
Mineral NPK 100%	2.816	3.379	3.238	2.732	3.041	2.957	3.520	3.126	2.760	3.091
Mineral NPK 75%	2.360	2.832	2.714	2.289	2.549	2.478	2.950	2.620	2.313	2.590
EM (500 cm^3/1.5 m^2)	2.332	2.798	2.682	2.262	2.519	2.449	2.915	2.589	2.285	2.559
AC (50 ml/1.5 m^2)	2.316	2.779	2.663	2.247	2.501	2.432	2.895	2.571	2.270	2.542
NPK 75% + EM	2.464	2.957	2.834	2.390	2.661	2.587	3.080	2.735	2.415	2.704
NPK 75% + AC	2.362	2.835	2.717	2.292	2.551	2.481	2.953	2.622	2.315	2.593
EM + AC	2.757	3.308	3.170	2.674	2.977	2.895	3.446	3.060	2.702	3.026
Mean (A)	2.400	2.879	2.759	2.328		2.519	2.999	2.663	2.352	
L.S.D. at 5 %	A: 0.105		B: 0.064		AB: 0.128	A: 0.141		B: 0.066		AB: 0.132
	Third cut									
Control	2.362	2.788	2.622	2.339	2.528	2.504	2.953	2.764	2.433	2.664
Mineral NPK 100%	3.097	3.653	3.419	3.010	3.295	3.216	3.793	3.550	3.125	3.421
Mineral NPK 75%	2.588	3.054	2.873	2.563	2.770	2.744	3.236	3.028	2.666	2.918
EM (500 cm^3/1.5 m^2)	2.439	2.878	2.708	2.415	2.610	2.586	3.049	2.854	2.512	2.750
AC (50 ml/1.5 m^2)	2.388	2.818	2.651	2.365	2.556	2.532	2.986	2.794	2.460	2.693
NPK 75% + EM	2.838	3.349	3.150	2.810	3.037	3.008	3.548	3.320	2.923	3.200
NPK 75% + AC	2.596	3.063	2.881	2.570	2.777	2.751	3.245	3.037	2.673	2.927
EM + AC	2.922	3.448	3.243	2.893	3.127	3.034	3.671	3.368	3.004	3.246
Mean (A)	2.646	3.122	2.937	2.620		2.805	3.308	3.096	2.725	
L.S.D. at 5 %	A: 0.118		B: 0.190		AB: 0.340	A: 0.161		B: 0.176		AB: 0.352

EM: Effective microorganisms and AC: *Azotobacter chroococcum* bacteria

Table 4. Effect of salinity concentration, mineral and biofertilization on clipping dry weight/unit (kg) of bermudagrass during three cuts in the two growing seasons (2020 and 2021).

Mineral and biofertilization treatments (B)	Salinity concentrations (ppm) (A)									
	0.0	3000	6000	9000	Mean (B)	0.0	3000	6000	9000	Mean (B)
	The 1st season (2020)					The 2nd season (2021)				
	First cut									
Control	0.180	0.234	0.216	0.176	0.202	0.180	0.234	0.216	0.176	0.202
Mineral NPK 100%	0.326	0.423	0.391	0.319	0.273	0.326	0.423	0.391	0.319	0.273
Mineral NPK 75%	0.224	0.291	0.269	0.219	0.225	0.224	0.291	0.269	0.219	0.225
EM (500 cm^3/1.5 m^2)	0.219	0.285	0.263	0.215	0.221	0.219	0.285	0.263	0.215	0.221
AC (50 ml/1.5 m^2)	0.217	0.282	0.260	0.212	0.218	0.217	0.282	0.260	0.212	0.218
NPK 75% + EM	0.284	0.369	0.340	0.278	0.260	0.284	0.369	0.340	0.278	0.260
NPK 75% + AC	0.269	0.349	0.322	0.263	0.246	0.269	0.349	0.322	0.263	0.246
EM + AC	0.317	0.412	0.380	0.311	0.266	0.317	0.412	0.380	0.311	0.266
Mean (A)	0.254	0.331	0.305	0.249		0.254	0.331	0.305	0.249	
L.S.D. at 5 %	A: 0.010		B: 0.008		AB: 0.016	A: 0.015		B: 0.011		AB: 0.022
	Second Cut									
Control	0.179	0.215	0.206	0.174	0.193	0.188	0.224	0.199	0.175	0.196
Mineral NPK 100%	0.394	0.473	0.453	0.382	0.426	0.414	0.493	0.438	0.386	0.433
Mineral NPK 75%	0.260	0.312	0.299	0.252	0.280	0.273	0.325	0.288	0.254	0.285
EM (500 cm^3/1.5 m^2)	0.257	0.308	0.295	0.249	0.277	0.269	0.321	0.285	0.251	0.282
AC (50 ml/1.5 m^2)	0.255	0.306	0.293	0.247	0.275	0.268	0.318	0.283	0.250	0.280
NPK 75% + EM	0.296	0.355	0.340	0.287	0.319	0.310	0.370	0.328	0.290	0.325
NPK 75% + AC	0.283	0.340	0.326	0.275	0.306	0.298	0.354	0.315	0.278	0.311
EM + AC	0.345	0.414	0.397	0.335	0.373	0.362	0.431	0.383	0.338	0.379
Mean (A)	0.240	0.288	0.276	0.233		0.252	0.300	0.267	0.236	
L.S.D. at 5 %	A: 0.012		B: 0.030		AB: 0.060	A: 0.033		B: 0.031		AB: 0.062
	Third cut									
Control	0.239	0.282	0.265	0.236	0.247	0.253	0.298	0.279	0.246	0.254
Mineral NPK 100%	0.437	0.515	0.482	0.424	0.333	0.453	0.535	0.501	0.441	0.346
Mineral NPK 75%	0.313	0.370	0.348	0.310	0.280	0.332	0.392	0.366	0.323	0.295
EM (500 cm^3/1.5 m^2)	0.295	0.348	0.328	0.292	0.264	0.313	0.369	0.345	0.304	0.278
AC (50 ml/1.5 m^2)	0.289	0.341	0.321	0.286	0.258	0.306	0.361	0.338	0.298	0.272
NPK 75% + EM	0.372	0.439	0.413	0.368	0.307	0.394	0.465	0.435	0.383	0.323
NPK 75% + AC	0.340	0.401	0.377	0.337	0.281	0.360	0.425	0.398	0.350	0.296
EM + AC	0.412	0.486	0.457	0.408	0.316	0.428	0.505	0.475	0.424	0.328
Mean (A)	0.337	0.398	0.374	0.333		0.253	0.298	0.279	0.246	
L.S.D. at 5 %	A: 0.011		B: 0.016		AB: 0.032	A: 0.018		B: 0.018		AB: 0.036

EM: Effective microorganisms and AC: *Azotobacter chroococcum* bacteria

accumulation could add to the salinity tolerance through osmoregulation or by acting as carbon and nitrogen sink for stress recovery (Shahba *et al*., 2012).

The positive effect of NPK fertilization on alleviating the harmful effects of salinity was: moderate N has improved tolerance and hastened recovery from injury (Trenholm *et al*., 2001).

Potassium aids in the uptake and movement of different nutrients within the plants, maintains osmotic pressure and is important in the metabolism and formation of carbohydrates and proteins (Bidwell, 1974). Potassium may enhance wear tolerance through the regulation of turgor potential (Trenholm *et al*., 2001). Potassium is important in improving the stress tolerance of turfgrasses and is essential to plant growth (Snyder and Cisar, 2000).

Biofertilizers also, increase plant growth and help to super pass the harmful effects of salinity stress. *Azotobacter spp*. fixing nitrogen (Jnawali *et al*., 2015), synthesizing auxins, cytokinins, and GA–like substances, and these growth materials are the primary substance controlling the enhanced growth of plants. In addition, there are various other facets of *Azotobacter spp*. prominent characteristics that enhance the tolerance index of the plant in a hostile environment (Ruzzi and Aroca, 2015). Using isolated salt-tolerant bacteria from different sources of saline could promote seedling growth under salinity stress (Siddique *et al*., 1997).

EM has several beneficial effective microorganisms that work together to produce N, and plant hormones and enhances plant physiological processes which are reflected to tolerate salinity stress (Cóndor_Golec *et al*., 2007). Also, EM produces substances that play the role of antioxidants (Mayer *et al*., 2010).

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تأثير بعض معاملات الملوحة والتسميد علي نباتات البرمودا
أ. النمو الخضري

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أجريت هذه الدراسة بمزرعة خاصة بمركز بني مزار، محافظة المنيا خلال موسمي النمو ٢٠٢٠ و ٢٠٢١ لبحث تأثير ملوحة مياه الري ومعاملات التسميد المعدني و/أو الحيوي [الكائنات الحية الدقيقة الفعالة (EM) و بكتريا الأزوتوباكتر (AC)]، وكذلك التفاعل بينها على النمو الخضري للبرمودا (*Cynodon dactylon*, L.) المنزرع في التربة الرملية. أشارت النتائج إلي أن صفات النمو الخضري (الغطاء النباتي، ارتفاع النبات، الوزن الطازج والجاف/حشة) قد زادت مع مستوى الملوحة المنخفض (٣٠٠٠ و ٦٠٠٠ جزء في المليون)، بينما انخفضت مع ارتفاع مستوى الملوحة (٩٠٠٠ جزء في المليون) مقارنة بمعاملة الكنترول، مع وجود فروق معنوية في بعض الحالات، في الحشات الثلاث خلال موسمي النمو. أدت جميع معاملات التسميد المعدني و/أو الحيوي المستخدمة إلى زيادة معنوية في الصفات المذكورة، ما عدا المعاملات الحيوية المنفردة في الحشة الثانية والثالثة، مع أعلى القيم التي تم الحصول عليها باستخدام معاملة ١٠٠٪

NPK معدني يليه معاملة EM + AC في الحشات الثلاث خلال الموسمين، مع عدم وجود فروق معنوية بينهما في بعض الحالات. كانت معاملات التفاعل معنوية لجميع صفات النمو الخضري في الحشات الثلاث خلال الموسمين. وكانت أفضل معاملات التفاعل التي خففت من الآثار الضارة للملوحة (٩٠٠٠ جزء في المليون) هي معاملة ١٠٠٪ NPK معدني تليها معاملة التسميد الحيوي EM + AC.