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Response of Panicum to Nitrogen Fertilization and Humic Acid under Salinity Conditions

Mahmoud A. Abd El-Aziz*

Plant Production Department, Ecology and Dry Lands Agriculture Division, Desert Research center, **Egypt.**

***Corresponding author:** mahmoud502005@gmail.com

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Abstract: Natural pastures are not available in Egypt as in neighboring countries such as Sudan, as Egypt is located in the belt of arid lands, and this has led to a severe shortage of green fodder. So, two field experiments were conducted during the seasons 2021/2022 and 2022/2023. In order to study the effect of four nitrogen fertilization levels (40, 60, 80 and 100 kg/ha nitrogen) and humic acid rates (without, 2, 4, 6, 8 and 10 kg/ha) on the productivity of panicum under salinity soil conditions in Ras Sudr, South Sinai, Egypt. The obtained results indicated significant differences between nitrogen fertilization levels, where 100 kg N/ha increased plant height, leaf area, fresh leaves weight, fresh stem weight, dry leaves weight, dry stem weight, fresh weight, dry weight, fresh fodder yield, dry fodder yield, protein % and net return in both seasons. Which contained humic acid at a rate of 8 kg / ha gave a higher yield of forage crop compared to the control treatment, and this was evident in both seasons of the study. Nitrogen fertilization at the level of 100 kg/ha was superior compared to the nitrogen fertilization level of 40 kg/ha by 133%. So, it was also possible to obtain a dry forage yield of 42384 kg/ha in the first season and 51688 kg/ha in the second season by using nitrogen fertilization at a rate of 100 kg/ha with humic acid at a rate of 8 kg/ha. Nitrogen fertilization at the level of 100 kg/ha was superior compared to the nitrogen fertilization level of 40 kg/ha by 104%. So, it was also possible to obtain a net return of 147373 L.E/ha in the first season and 179725 L.E/ha in the second season by using nitrogen fertilization at a rate of 100 kg/ha with humic acid at a rate of 8 kg/ha. Recommendation: The study recommends the use of nitrogen fertilization at a level of 100 kg/ha with humic acid at a rate of 8 kg/ha to obtain the highest productivity of the dry forage crop and net return under Ras Sudr, South Sinai of Egypt.

Key words: Panicum, Humic acid, Salinity, Nitrogen**,** Yield, Net return

INTRODUCTION

Several regions have experienced a rise in soil salinity in many parts of the world, which has significantly decreased crop yield the current demand cannot be satisfied by the supply of high-quality animal fodder. Finding new ways to boost fodder production is therefore urgently needed. Panicum Mombasa guinea grass (*Megathyrsus maximus*) is widely cultivated for grazing by cattle. In subtropical and tropical environments, this grass can have an annual dry matter yield up to 33 t/ha with nitrogen fertilizer management **(Galindo *et al.*, 2017).**

Nitrogen is the most important nutrient for forage yield. Due to it is connected to the metabolic route for the creation of proteins, chloroplasts, and other substances that actively participate in photosynthesis, as a result, this nutrient takes on responsibility for the growth of the plant, including its height and the development of its tiller and leaves **(Galindo *et al.*, 2017).** The effects of N levels (0, 60 and 120 kg N/ha/year) were tried, and showed that dry matter yield increased linearly with increasing N levels **(Silveira *et al.*, 2015).** N fertilization increases forage production, green color index, and N accumulation, proving to be an essential complementary practice to soil nitrogen fertilization soil to **(Pietroski *et al.*, 2015).** Additionally, it encourages plant development, and fertilization rates have a good impact on output **(Fernandes, 2011).** In this respect, N rates (0, 50, 100, 150, and 200 kg N/ha/cut) increased it is thought to be an excellent choice for growing under salt stress.

Humic acid assessing a crop's feed value was emphasized, a direct correlation quantity, content, and quality and the time of harvest. A humic acid is also thought to increase crop output in saline conditions because it has been documented to improve nutrient availability, nutritional absorption, nutrient utilization, plant development, physiology, and metabolism through a variety of pathways **(Atis *et al.*, 2015).** Therefore, it is necessary to expand forage cultivation in desert lands that may be lack of nutrients. The aim of the research is to increase the productivity of panicum by using nitrogen fertilization and humic acid under Ras Sudr, South Sinai of Egypt.

MATERIALS AND METHODS

Field experiments

Two field experiments were carried out at the Agricultural Experiments Desert Station, Desert Research center, Ras Sidr area, South Sinai, Egypt, during the two successive seasons of 2021/2022 and 2022/2023 under drip irrigation system. The experimental site located between "N 29°37'32.07" E 32°42'45.03 with an altitude of 14 meters above sea level. Ammonium sulphate (20.6% N) was added to the irrigation water after cutting, as part of the treatments for nitrogen fertilization (N). Following each harvest, nitrogen applications of 40 kg/ha (N1), 60 kg/ha (N2), 80 kg/ha (N3), and 100 kg/ha (N4) are added. The studies employed a split plot design with four repetitions and 24 treatments, which included combinations of nitrogen fertilization with various humic acid rates (HA): without humic (HA0), with 2 kg/ha humic levels (HA1), with 4 kg/ha humic (HA2), with 6 kg/ha humic (HA3), with 8 kg/ha humic (HA4), and with 10 kg/ha humic (HA5). Humic acid treatments served as the supporting characters in the primary plot, which involved nitrogen fertilization. The area of the subplot was 10.5 m^2, (3.5 m^2 long and 3 m^2 wide). Planting panicum seedlings on March 15, the seedlings were planted in rows spaced 1 m^2 long and 0.30 m^2 between hills. Humic acid was added after planting and before irrigation.

Yield and its attributes

At 60 days, samples each of ten plants were taken randomly from each sub-plot, so the following traits were measured:

1- Plant height (cm): The average height of ten plants from each sub plot was determined by measuring them from the ground to the tips.

2- Leaf area (cm^2) is calculated according to **(Watson, 1952)** as follows: Flag leaf length maximum width x 0.75.

3 - Fresh leaves were weighed at a density of g/m^2.

4 - Fresh stem weight in g/m^2 was measured.

5- Fresh weight in g/m^2 was measured.

6- Fresh fodder kg/ha of crop was measured as g/m^2.

At 60 days, samples each of were taken randomly from each sub-plot, after drying in an electrical oven at 70 °C until consistent weight, was calculated, so the following traits were measured:

1- Dry leaf weight (g/m^2) was calculated.

2- Dry stem weight g/m^2.

3- Dry stem weight in g/m^2.

4- Dry fodder yield (kg/ha).

Nitrogen content (%): Samples of fodder crop dry representing each sub-sub plot were milled and subjected to the chemical analysis using the new kjeldahle method as outlined by the **(A.O.A.C., 2000).**

Protein content. (%): Protein content was estimated as follows**:** Nitrogen content multiplied by 6.25.

Economic evaluation

1 – Total Return (L.E/ha) = Fodder yield dry kg/ha x Price kg. Fodder crop dry panicum (kg) was 3 LE.

2 – Costs (L.E/ha) information for labor, equipment, and all farm inputs were included 8700 LE, shown in Table (6) the cost of using nitrogen fertilization and humic acid.

3 **-** Net Return L.E/ha =Total gain – costs.

Soil characteristics and agronomic practices

At Ras Sidr in South Sinai, Egypt, which is 200 km east of Cairo, experimental trials were conducted.

Before planting seedling (transplanting) auger soil samples were taken from a depth of 0 to 30 cm to conduct physical and chemical analysis. The experimental field was separated into experimental units with the aforementioned dimensions after being twice ploughed, compacted and divided into lines with one meter between each line, and compost was added at a rate of 20/ton per hectare. At a rate of 74 kg P_2O_5/ha, calcium superphosphate (15.5% P_2O_5) was employed to prepare the soil. Prior to sowing, potassium sulphate (48% K_2O) was broadcast at a rate of 115 kg/ha, Ammonium sulphate (20.6% N) was broadcast at a rate of 40 kg N/ha^{-1}. Panicum was grown according to the guidelines Ministry of Agriculture's.

Table (1) shows the analysis of irrigation water and soil (as an average of the two growing seasons), and Table (2) shows the analysis of compost (as an average of the two growing seasons) as the methods outlined.

Table (1). Chemical and physical characteristics of representative soil samples (0–30 cm in depth)

Parameter	Water	Parameter	Soil
pH	7.78	pH	7.75
Electrical conductivity (EC), µS/cm	7436	Electrical conductivity (EC), dS/m	5696
Calcium, mg/l	665.6	Calcium, meq/l	7.681
Magnesium, mg/l	290.6	Magnesium, meq /l	5.404
Sodium, mg/l	1650.0	Sodium, meq /l	5.218
Potassium, mg/l	20.0	Potassium meq /l	0.536
Carbonate, mg/l	Nil	Carbonate, meq /l	Nil
Bicarbonate, mg/l	24.4	Bicarbonate, meq /l	4.599
Sulphate, mg/l	2033.5	Sulphate, meq /l	8.86

Table (2). Chemical analysis of compost

Character	Compost	Character	Compost
Wight (m^3 kg)	665	Humidity (%)	23
Ammonium Nitrogen (ppm)	67	pH	6.87
Nitrate Nitrogen (ppm)	17	E C ($dS.m^{-1}$)	4.57
Organic matter (%)	30.50	Total nitrogen (%)	1
Organic carbon (%)	14.79	Ash (%)	74.5
Total phosphorus (%)	0.73	C/N ratio	1:14
Total potassium (%)	1.03	Grass	0
Nematode Nurse of the plant 200grm	0	Free non-nurse 200grm	0

Statistical analysis

Analysis of data was carried out according to **(Gomez and Gomez, 1984)** description, and data were gathered and statistical analysis using analysis of variance was done. The analyses were carried out using the SPSS 20.0 analysis tool.

RESULTS AND DISCUSSION

Five cuttings were made from plant shoots each year, 60 days after emergence.

Effects of Nitrogen fertilization levels

Plant height (cm)

The effects of nitrogen fertilization on plant height (cm) were significant in the two seasons (Table 3). The highest values of plant height were significantly obtained from the maximum dose of N fertilization. Moreover, the results showed that the relative increase percentages were 17.94%, 26.93% and 33.35% due to addition of 60, 80 and 100 kg N/ha in the 2022 and 2023 seasons. These results are in agreement with the finding of **(Abd El-Aziz and El Sahed, 2021 and Farias *et al.*, 2020).**

Leaf area index (cm)

Also the results in Table (3) showed that Leaf area index (cm) was significantly affected by using different nitrogen fertilization. The lowest values were significantly obtained by untreated plants, while the maximum values were significantly gained from the highest fertilization in the 2022 and 2023 seasons.

Fresh leaves weight (g/m^2)

On the other hand, the effects of nitrogen fertilization on Fresh leaves weight (g/m^2) were significant in the two seasons (Table 3). The highest values of Fresh leaves weight were significantly obtained from the maximum dose of N fertilization. Moreover, the results showed that the relative increase percentages were 38.92%, 60.54% and 90.68% due to addition of 60, 80 and 100 kg N/ha in the 2022 and 2023 seasons.

Fresh stem weight (g/m^2)

Also the results in Table (3) showed that fresh stem weight (g/m^2) was significantly affected by using different nitrogen fertilization. The lowest values were significantly obtained by untreated plants, while the maximum values were significantly gained from the highest fertilization in the 2022 and 2023 seasons. A variation difference of **(Oliveira and Deminicis, 2022 and Dourado *et al.*, 2021).**

Dry leaves weight (g/m^2)

On the other hand, the effects of nitrogen fertilization on dry leaves weight were significant in the two seasons (Table 3). The highest values of dry leaves weight were significantly obtained from the maximum dose of N fertilization. Moreover, the results showed that the relative increase percentages were 32.10%, 64.73% and 99.54% due to addition of 60, 80 and 100 kg N/ha in the 2022 and 2023 seasons. These results are in agreement with the finding of **(Marchant and Boyle, 2020 and Attia *et al.*, 2022).**

Table (3). Performance of panicum yield characteristics as affected by nitrogen fertilization levels over 2022 and 2023 seasons

Nitrogen Fertilization (kg/ha)	plant height (cm)		Leaf area (cm)		Fresh leaves weight (g/m2)		Fresh stem weight (g/m^2)		Dry leaves weight (g/m^2)	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
40	116.86 d	137.17 d	241.00 d	293.83 d	740 d	902 d	383.00 d	467.17 d	220.67 d	269.00 d
60	137.83 c	162.17 c	269.17 c	328.00 c	1028 c	1254 c	473.00 c	576.67 c	291.50 c	355.67 c
80	148.33 b	174.50 b	287.00 b	350.00 b	1188 b	1449 b	625.17 b	762.33 b	363.50 b	443.33 b
100	155.83 a	183.33 a	318.50 a	388.50 a	1411 a	1721 a	748.50 a	912.67 a	440.33 a	537.00 a
LSD 0.05	3.98	4.61	4.77	5.77	30.29	36.95	18.75	22.76	6.45	7.76

Dry stem weight (g/m^2)

On the other hand, the effects of nitrogen fertilization on dry stem weight (g/m^2) were significant in the two seasons (Table 4). The highest values of dry stem weight were significantly obtained from the maximum dose of N fertilization. Moreover, the results showed that the relative increase percentages were 38.01%, 73.83% and 103.85% due to addition of 60, 80 and 100 kg N/ha in the 2022 and 2023 seasons. These results are in agreement with the finding of **(Vinha *et al.*, 2021 and Nail *et al.*, 2021).**

Fresh weight (g/m^2)

Also the results in Table (4) showed that fresh weight (g/m^2) was significantly affected by using different nitrogen fertilization. The lowest values were significantly obtained by untreated plants, while the maximum values were significantly gained from the highest fertilization in the 2022 and 2023 seasons. These results are in agreement with the finding of **(Tóth and Dupl'ák, 2023 and Song *et al.*, 2023).**

Dry weight (g/m^2)

On the other hand, the effects of nitrogen fertilization on dry weight (g/m^2) were significant in the two seasons (Table 4). The highest values of dry weight were significantly obtained from the maximum dose of N fertilization. Moreover, the results showed that the relative increase percentages were 27.31%, 65.91% and 97.55% due to addition of 60, 80 and 100 kg N/ha in the 2022 and 2023 seasons. These results align with those attained by **(Razar *et al.*, 2021 and Sacristán *et al.*, 2021).**

Fresh fodder yield (kg/ha)

Also the results in Table (4) showed that fresh fodder yield (kg/ha) was significantly affected by using different nitrogen fertilization. The lowest values were significantly obtained by untreated plants, while the maximum values were significantly gained from the highest fertilization in the 2022 and 2023 seasons. These results agree with those from **(Xu *et al.*, 2020 and Pankhaniya *et al.*, 2023).**

Dry Fodder yield (kg/ha)

On the other hand, the effects of nitrogen fertilization on dry fodder yield (kg/ha) were significant in the two seasons (Table 4). The highest values of dry fodder yield were significantly obtained from the maximum dose of N fertilization. Moreover, the results showed that the relative increase percentages were 27.41%, 66.08% and 97.66% due to addition of 60, 80 and 100 kg N/ha in the 2022 and 2023 seasons. These results align with those attained by **(Amabogha *et al.*, 2023 and Bonfim-Silva *et al.*, 2023).**

Protein (%)

Also the results in Table (4) showed that protein (%) was significantly affected by using different nitrogen fertilization. The lowest values were significantly obtained by untreated plants, while the maximum values were significantly gained from the highest fertilization in the 2022 and 2023 seasons. These results align with those attained by **(Amaleviciute *et al.*, 2020 and Tóth *et al.*, 2022).**

Table (4). Performance of panicum yield characteristics as affected by nitrogen fertilization levels over 2022 and 2023 seasons

Nitrogen Fertli. (kg/ha)	Dry stem weight (g/m2)		Fresh weight (g/m2)		Dry weight (g/m2)		Fresh fodder yield kg/ha		Dry fodder yield kg/ha		Protein %	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
40	147.33 d	179.83 d	960 d	1171 d	531 d	647 d	9602 d	11710 d	26527 d	32350 d	8.43 d	10.31 d
60	203.33 c	247.67 c	1320 c	1609 c	676 c	824 c	13196 c	16093 c	33798 c	41217 c	9.57c	11.68 c
80	256.17 b	312.17 b	1551 b	1892 b	881 b	1075 b	15514 b	18920 b	44056 b	53725 b	10.43 b	12.72 b
100	300.33 a	366.17 a	1852 a	2258 a	1049 a	1279 a	18511 a	22575 a	52432 a	63942 a	11.13 a	13.56 a
LSD 0.05	5.76	7.08	33.54	40.91	23.40	28.48	335.5	409.1	884.1	1078.	0.10	0.14

Costs (L.E/ha)

The costs of rent, plowing, seedlings, cultivation, irrigation, fertilization, and 40 kg nitrogen units were calculated at (8700 L.E/ha) the cost of humic was calculated (80 L.E/kg) and the cost of nitrogen was calculated (1000 L.E/20 kg N).

Net return (L.E/ha)

On the other hand, the effects of nitrogen fertilization on net return (L.E/ha) were significant in the two seasons (Table 6). The highest values of net return were significantly obtained from the maximum dose of N fertilization. Moreover, the results showed that the relative increase percentages were 29.11%, 70.64% and 104.35% due to addition of 60, 80 and 100 kg N/ha in the 2022 and 2023 seasons. These results align with those attained by **(Abd El-Aziz, and Attia2022 and El-Metwally. *et al.* 2010).**

Table (5). The cost of using nitrogen fertilization and humic acid

Nitrogen (kg/ha)	Humic acid (kg/ha)	Humic acid (L.E/kg)	Nitrogen (L.E)	Total (L.E)	Fixed costs (L.E)	Costs (L.E)
40	Without	0	0	0	8700	8700
	2	160	0	160	8700	8860
	4	320	0	320	8700	9020
	6	480	0	480	8700	9180
	8	640	0	640	8700	9340
	10	800	0	800	8700	9500
60	Without	0	1000	1000	8700	9700
	2	160	1000	1160	8700	9860
	4	320	1000	1320	8700	10020
	6	480	1000	1480	8700	10180
	8	640	1000	1640	8700	10340
	10	800	1000	1800	8700	10500
80	Without	0	2000	2000	8700	10700
	2	160	2000	2160	8700	10860
	4	320	2000	2320	8700	11020
	6	480	2000	2480	8700	11180
	8	640	2000	2640	8700	11340
	10	800	2000	2800	8700	11500
100	Without	0	3000	3000	8700	11700
	2	160	3000	3160	8700	11860
	4	320	3000	3320	8700	12020
	6	480	3000	3480	8700	12180
	8	640	3000	3640	8700	12340
	10	800	3000	3800	8700	12500

Table (6). Performance of panicum yield characteristics as affected by nitrogen fertilization levels over 2022 and 2023 seasons

Nitrogen Fertilization (kg/ha)	Total return L.E/ha		Costs L.E/ha		Net return L.E/ha	
	2022	2023	2022	2023	2022	2023
40	79575	97050	7462	9100	72118d	87950d
60	101385	123645	8282	10100	93111c	113550c
80	132165	161175	9102	11100	123065b	150075b
100	157290	191820	9922	12100	147373a	179725a
LSD 0.05					2652.5	3234.4

Effect of humic acid rates

Plant height (cm)

Results presented in Table (7) showed that plant height (cm) was significantly affected by using different humic acid rates. The lowest values were significantly obtained by untreated plants, while the maximum values were significantly gained from the highest humic acid in the 2022 and 2023 seasons.

Leaf area (cm^2)

On the other hand, the effects of humic acid on Leaf area (cm^2) were significant in the two seasons (Table 7). The highest values of Leaf area were significantly obtained from the maximum dose of humic acid. Moreover, the results showed that the relative increase percentages were 5.24%, 8.79% 12.65%, 16.01% and 18.77% due to addition of 2, 4, 6, 8 and 10 kg humic acid /ha in the 2022 and 2023 seasons.

Fresh leaves weight (g/m^2)

Results presented in (Table 7) showed that fresh leaves weight (g/m^2) was significantly affected by using different humic acid rates. The lowest values were significantly obtained by untreated plants, while the maximum values were significantly gained from the highest humic acid in the 2022 and 2023 seasons. These results are consistent with those obtained by **(Toth *et al.* 2023 and Tóth, 2022).**

Fresh stem weight (g/m^2)

On the other hand, the effects of humic acid on fresh stem weight (g/m^2) were significant in the two seasons (Table 7). The highest values of fresh stem weight were significantly obtained from the maximum dose of humic acid. Moreover, the results showed that the relative increase percentages were 3.68%, 9.02% 11.37%, 13.92% and 17.79% due to addition of 2, 4, 6, 8 and 10 kg humic acid /ha in the 2022 and 2023 seasons. Also documented by were variations in **(Traversa *et al.* 2014).**

Dry leaves weight (g/m^2)

Results presented in Table (7) showed that dry leaves weight (g/m^2) was significantly affected by using different humic acid rates. The lowest values were significantly obtained by untreated plants, while the maximum values were significantly gained from the highest humic acid in the 2022 and 2023 seasons. The varietal differential in this regard was documented by **(Ahmadi *et al.*, 2021).**

Table (7). Performance of panicum yield characteristics as affected by humic acid levels over 2022 and 2023 seasons

Humic acid (kg/ha)	Plant height (cm)		Leaf area (cm)		Fresh leaves (g/m^2)		Fresh stem weight (g/m^2)		Dry leaves weight (g/m^2)	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
Without	132.75 d	156,25 d	253.00 f	308,25 f	1013 c	1235 c	510.00 c	622.25 c	298.75 e	364.25 e
2	134.50 cd	158.25 cd	266.25 e	324.25 e	1056 b	1287 b	528.75 c	644.75 c	311.50 d	379.75 d
4	138.50 bc	162.75 bc	275.25 d	335.75 d	1102 a	1343 a	556.00 b	677.75 b	321.50 c	392.25 c
6	141.50 ab	166.25 ab	285,00 c	347.50 c	1111 a	1355 a	568.00 b	692.25 b	335.00 b	408.50 b
8	144.75 b	170.50 b	293.50 b	358.25 b	1138 a	1388 a	581.00 ab	708.50 ab	353.00 a	430.50 a
10	146.00 a	171.75 a	300.50 a	366.50 a	1131 a	1380 a	600.75 a	732.75 a	354.25 a	432.25 a
LSD 0.05	5.42	6.29	6.51	7.87	41.31	50.40	25.58	31.04	8.79	10.58

Dry stem weight (g/m^2)

On the other hand, the effects of humic acid on dry stem weight (g/m^2) were significant in the two seasons (Table 8). The highest values of dry stem weight were significantly obtained from the maximum dose of humic acid. Moreover, the results showed that the relative increase percentages were 2.42%, 7.02% 12.23%, 17.80% and 19.49% due to addition of 2, 4, 6, 8 and 10 kg humic acid /ha in the 2022 and 2023 seasons.

Fresh weight (g/m^2)

Results presented in Table (8) showed that fresh weight (g/m^2) was significantly affected by using different humic acid rates. The lowest values were significantly obtained by untreated plants, while the maximum values were significantly gained from the highest humic acid in the 2022 and 2023 seasons. A variety of variations were also found, according to **(Ameen *et al.*, 2019).**

Dry weight (g/m^2)

On the other hand, the effects of humic acid on dry weight (g/m^2) were significant in the two seasons (Table 8). The highest values of dry weight were significantly obtained from the maximum dose of humic acid. Moreover, the results showed that the relative increase percentages were 3.24%, 8.37% 11.48%, 15% and 18.31% due to addition of 2, 4, 6, 8 and 10 kg humic acid /ha in the 2022 and 2023 seasons. These results align with those attained by **(Tóth *et al.*, 2023).**

Fresh fodder yield (kg/ha)

Also the results in (Table 8) showed that fresh fodder yield (kg/ha) was significantly affected by using different humic acid rates. The lowest values were significantly obtained by untreated plants, while the maximum values were significantly gained from the highest humic acid in the 2022 and 2023 seasons. These results align with those attained by **(Abd El-Aziz and Attia, 2023; Abd El-Aziz and Anter, 2023 and Tang *et al.*, 2020).**

Dry fodder yield (kg/ha)

On the other hand, the effects of humic acid on dry fodder yield (kg/ha) were significant in the two seasons (Table 8). The highest values of dry fodder yield were significantly obtained from the maximum dose of humic acid. Moreover, the results showed that the relative increase percentages were 3.26%, 8.48% 11.48%, 14.98% and 18.28% due to addition of 2, 4, 6, 8 and 10 kg humic acid /ha in the 2022 and 2023 seasons.

Protein (%)

Also the results in (Table 8) showed that protein (%) was significantly affected by using different humic acid rates. The lowest values were significantly obtained by untreated plants, while the maximum values were significantly gained from the highest humic acid in the 2022 and 2023 seasons. A variation in types for net gain was also reported by **(Abd El-Aziz *et al.*, 2018 and Ihsanullah, 2016).**

Net return (L.E/ha)

On the other hand, the effects of humic acid on net return (L.E/ha) were significant in the two seasons (Table 9). The highest values of net return were significantly obtained from the maximum dose of humic acid. Moreover, the results showed that the relative increase percentages were 3.40%, 8.82% 12.07%, 15.72% and 19.15% due to addition of 2, 4, 6, 8 and 10 kg humic acid /ha in the 2022 and 2023 seasons. These results align with those attained by **(Abd El-Aziz *et al.* 2022, Attia et al. 2022 and Abd El-Aziz *et al.* 2017).**

Table (8). Performance of panicum yield characteristics as affected by humic acid levels over 2022 and 2023 seasons

Humic acid (kg/ha)	Dry stem weight (g/m^2)		Fresh weight (g/m2)		Dry weight (g/m^2)		Fresh fodder yield (kg/ha)		Dry fodder yield (kg/ha)		Protein (%)	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
Without	206.50 d	251.75 d	1312 d	1599 d	716.75 d	874.0 d	13114 d	15992 d	35835 f	43700 f	9.508 e	11.588 e
2	211.50 d	257.75 d	1367 c	1667 c	740.00 d	902.5 d	13670 c	16670 c	37004 e	45125 e	9.668 d	11.790 d
4	221.00 c	269.50 c	1423 b	1735 b	776.75 c	947.4 c	14229 b	17353 b	38873 d	47363 d	9.868 c	12.028 c
6	231.75 b	282.25 b	1446 ab	1763 ab	799.00 bc	974.5 bc	14459 ab	17633 ab	39950 c	48725 c	9.970 bc	12.178 bc
8	243.25 a	296.50 a	1491 a	1818 a	824.25 ab	1005 ab	14909 a	18183 a	41204 b	50250 b	10.105 ab	12.340 ab
10	246.75 a	301.00 a	1486 a	1812 a	848.00 a	1033.8 a	14856 a	18117 a	42384 a	51688 a	10.210 a	12.470 a
LSD at 0.05	7.86	9.67	45.75	55.80	31.92	38.85	457.7	558.0	1082	1320	0.147	0.196

Table (9). Performance of panicum yield characteristics as affected by humic acid levels over 2022 and 2023 seasons

Humic acid (kg/ha)	Total return L.E/ha		Costs L.E/ha		Net return L.E/ha)	
	2022	2023	2022	2023	2022	2023
Without	107505	131100	8364	10200	99141e	120900e
2	111015	135375	8495	10360	102516d	125015d
4	116520	142095	8626	10520	107887c	131567c
6	119865	146175	8758	10680	111103c	135495c
8	123615	150750	8889	10840	114722b	139910b
10	127155	155055	9020	11000	118131a	144063a
LSD at 0.05					3248.7	3961.4

Interactions effects between humic acid and nitrogen fertilization treatments

Dry fodder yield (kg/ha)

Five cuttings were made from plant shoots each year, samples each of were taken randomly from each sub-plot, after drying in an electrical oven at 70 °C until consistent weight, was calculated, so the following traits were measured, dry fodder yield (kg/ha) was measured at 60 days from seedling illustrated in (Table 10). This indicates an increase in yield with rising temperatures and the cessation of production in the cold months, as well as a high response to nitrogen fertilization and the role of humic acid in alleviating the damage of excess salts by using the rates nitrogen fertilization 100kg N/ha with 8 kg humic acid /ha a statistically and significantly gave the maximum dry fodder yield (kg/ha) compared with the other interactions in the seasons 21/22 and 22/23.

Table (10). Interaction between humic acid and nitrogen fertilization on Panicum dry fodder yield, of five cuttings during the seasons 21/22 and 22/23

Nitrogen (kg/ha)	Humic (kg/ha)	Dry fodder yield (kg/ha)									
		Cutting date in 2020					Cutting date in 2021				
		15/3	15/5	15/7	15/9	15/11	15/3	15/5	15/7	15/9	15/11
40	Without	4509X	4594X	5278X	5180X	4874X	5492X	5602X	6437X	6318X	5951X
	2	4684W	4771W	5482W	5381W	5062W	5705W	5819W	6685W	6561W	6180W
	4	4828V	4918V	5651V	5546V	5217V	5879V	5997V	6890V	6763V	6371V
	6	4980U	5064U	5818U	5710U	5363U	6056U	6176U	7096U	6964U	6558U
	8	5108T	5210T	5986T	5876T	5535T	6234T	6354T	7301T	7166T	6745T
	10	5254S	5365S	6164S	6049S	5703S	6416S	6542S	7517S	7378S	6947S
60	Without	5539R	5650R	6492R	6372R	6002R	6760R	6890R	7916R	7770R	7314R
	2	5739Q	5851Q	6722Q	6597Q	6211Q	6997Q	7135Q	8197Q	8045Q	7576Q
	4	6061P	6181P	7102P	6971P	6565P	7395P	7539P	8662P	8501P	8003P
	6	6266O	6374O	7323O	7188O	6754O	7623O	7774O	8932O	8766O	8255O
	8	6431N	6559N	7536N	7397N	6967N	7837N	7999N	9191N	9021N	8502N
	10	7359M	7508M	8626M	8466M	7976M	8965M	9156M	10519M	10324M	9736M
80	Without	7694L	7847L	9016L	8849L	8334L	9374L	9569L	10994L	10791L	10172L
	2	7913K	8078K	9282K	9110K	8587K	9658K	9851K	11318K	11109K	10464K
	4	8112J	8271J	9503J	9327J	8782J	9888J	10086J	11588J	11374J	10714J
	6	8258I	8425I	9680I	9501I	8951I	10068I	10274I	11804I	11586I	10918I
	8	8315H	8494H	9759H	9578H	9034H	10147H	10359H	11902H	11681H	11011H
	10	8409G	8579G	9857G	9675G	9115G	10255G	10462G	12020G	11798G	11115G
100	Without	8679F	8857F	10176F	9987F	9411F	10585F	10801F	12409F	12179F	11476F
	2	8940E	9126E	10486E	10292E	9701E	10909E	11130E	12787E	12550E	11824E
	4	9638D	9835D	11300D	11091D	10451D	11752D	11994D	13781D	13526D	12747D
	6	9977C	10182C	11699C	11482C	10820C	12162C	12417C	14267C	14003C	13201C
	8	10501A	10722A	12318A	12090A	11400A	12803A	13075A	15023A	14745A	13904A
	10	10213B	10421B	11973B	11751B	11072B	12457B	12709B	14602B	14331B	13501B
LSD 0.05		1.6480	1.6734	1.7869	1.7015	1.6915	1.6549	1.6781	1.7897	1.7086	1.6963

Dry fodder yield (kg/ha)

As illustrated in Fig.2, nitrogen fertilization 100kg N/ha with 8 kg humic acid /ha a statistically and significantly gave the maximum dry fodder yield (kg/ha) compared with the other interactions in the tow-year average. These results agree with those of **(Pankhaniya *et al*. 2023; Abd El-Aziz, 2023 and Bonfim-Silva *et al.* 2023).**

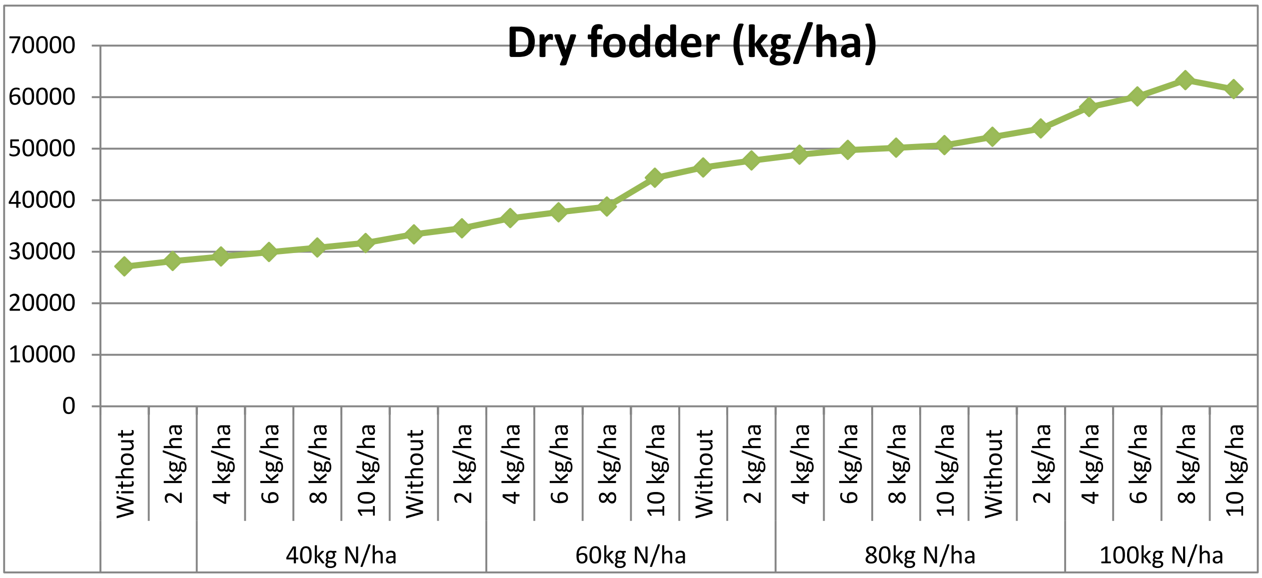

Fig. (2). Results of the interaction between humic acid and nitrogen fertilization of Panicum plants in terms of dry fodder yield kg/ha for an average of five cuttings during the seasons 21/22 and 22/23. LSD. 0.05 (2203.4)

Net return (L.E/ha)

Maximum net return (L.E/ha) from panicum dry fodder yield (kg/ha) were recorded with the interaction between 100 kg/ha nitrogen fertilization and humic acid (8 kg/ha) with significant differences among the other interactions (Fig 3). Also, 100 kg/ha nitrogen fertilization without humic acid gave higher net gain than the other interactions without humic acid. It is clear that the lowest net gains were significantly obtained from the interaction between 40 kg/ha nitrogen fertilization without humic acid (Fig 3). These results align with those attained by **(Abd El-Aziz, and Attia 2022; Abd El-Aziz, 2023 and El-Metwally. *et al*. 2010).**

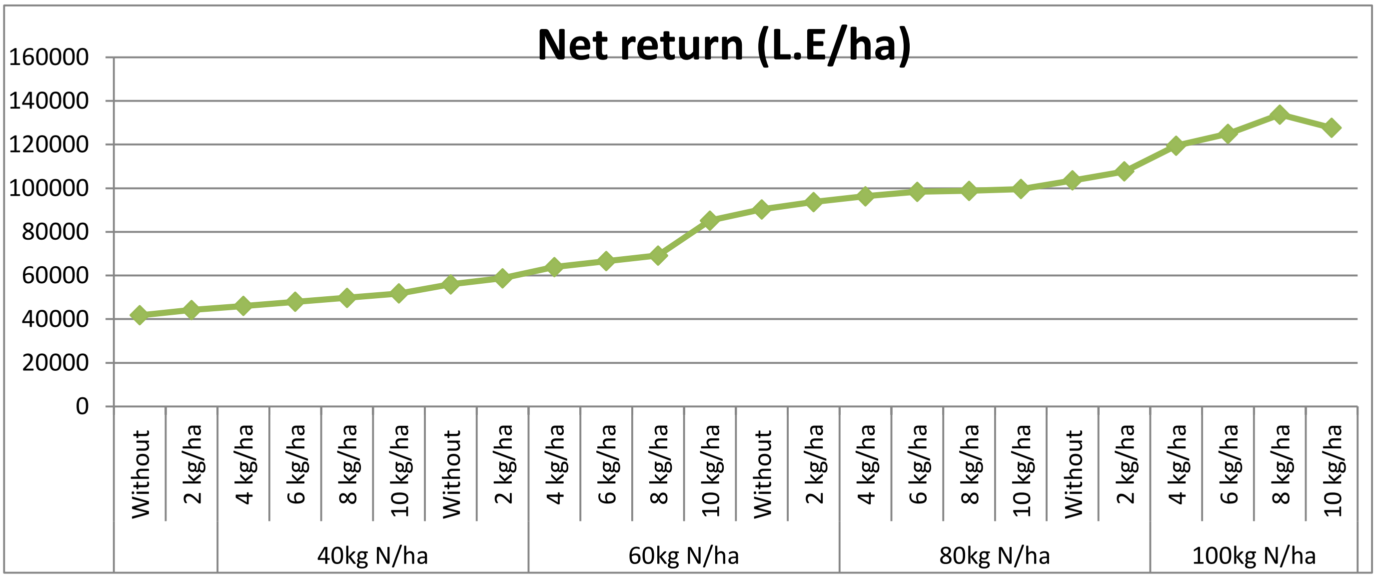

Fig. (3). Results of the interaction between humic acid and nitrogen fertilization of Panicum plants in terms of net gain (L.E/fad) for an average of five cuttings during the seasons 21/22 and 22/23. LSD. 0.05 (7110.1).

Conclusion

With a salinity of 7436 parts per million, the Ras Sidr region of Egypt is one of the regions that is most dependent on groundwater. The lack of green fodder in these areas, which are 200 km from Cairo, as well as the contribution of 100 kg/ha nitrogen fertilization and 8 kg/ha humic application by increasing panicum productivity and supplying animal feed contribute to improvements that are in remote desert areas.

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