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INFLUENCE OF FOLIAR APPLICATION OF ORGANIC AND AMINO ACIDS UNDER DIFFERENT RATES OF NITROGEN FERTILIZATION ON PRODUCTIVITY AND QUALITY OF SUDANGRASS UNDER SANDY SOIL CONDITIONS

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ABSTRACT

Two field experiments were conducted in two successive summer seasons of 2017 and 2018 at Ismailia, Agricultural Research Station, ARC, Egypt. The experiments are aimed to study the effect of three rates of nitrogen fertilization (0, 60, 90 N kg/ fad) with organic and amino acids on Sudangrass cv. Giza "2" to growth, forage yield and quality of forage Sudangrass (*Sorghum sudangrass* L.) as well as economic return. A randomized complete blocks design with three replicates was used in the two growing seasons. The main obvious results of this study could be summarized as follows; Nitrogen application showed positive impact on studied growth traits, forage yield and quality. Increasing N rates up to 90 kg /fad + organic acid + amino acid led to the highest values of plant height, number of tillers, number of leaves, leaves/ stem ratio, fresh and dry yields for Sudangrass.

The data of nitrogen use efficiency (NUE) indicated that the application of amino acid and organic acid plus soil application was more effective than soil application on Sudangrass productivity especially by using 60 kg N/fad + foliar applications of organic acids + foliar application of amino acids which produced the highest values of NUE.

Also, the present results indicated that increasing N level fertilization led to increasing crude protein content (CP). The results also showed that treatment (90 kg N/fad + organic acid + amino acid) was up in pound dividend investor in Sudangrass crop to farms pound spent on agriculture.

INTRODUCTION

In Egypt the shortage and more needing of green fodder during summer has been increased, therefore, great efforts must be directed towards improving summer forage crops. Sudangrass could be proved as solution to the problem, since it is considered as the most important forage during summer. Also, it is considered one of the most adapted

summer forage under adverse conditions of water shortage, salinity and low soil fertility (**Hagag *et al.*, 2000).** Sudangrass (*Sorghum sudanense* L.) is a fine stemmed and leafy plant with very quick regrowth. It is best used for pasture or in multiple cut systems. If used in a one cut system, yields will be less than that of Sorghum. Forage quality will be high due to low fiber content if cut frequently. Sorghum-Sudan grass forage should always be sampled and tested for feed composition because of the variability in nutrient value **(Monica and James, 2016).**

Sandy soils cover vast areas in Egypt; therefore reclamation of these soils is the main target for the horizontal expansion of our cultivable land. Unfortunately, sandy soils have very poor hydro physical and nutritional values. Thus, the use of soil amendments is a vital importance to improve physical, chemical and nutritional characteristics of these soils, **(El- Hendawy *et al.*, 2008).**

Nitrogen is the most important plant nutrient needed to obtained high yield and quality. Whereas, nitrogen is a primary constituent of proteins, chlorophyll and thus enzymes **(Raun and Johnson, 1999).** Accordingly, there are still many efforts are underway to improve forage crops productivity per unit area through foliar nutrition with nutrition with nutrient compounds contain basically amino acids and applying the optimum nitrogen fertilizer level.

Humic acid is a commercial product contains many elements which improve the soil fertility and increase the availability of nutrients and consequently increase plant growth and yield.

Amino acids can be absorbed and used in different ways, depending on the physiological stage of development of the plant. The increases in yield (quality and quantity) with the idea to apply a product were able to integrate the fertilizing activity directly to the leaves to avoid the interaction with the soil **(Krause, 1974).** Tryptophan is among the less common amino acids found in proteins, but it plays important structural or functional roles whenever it occurs. (**Gollnick *et al.*, 2005 and Saharkhiz and Omid, 2008**),

The aim of this study was to investigate the effect different rates of N fertilization and organic acid (humic acid) or amino acid (tryptophan) on growth, yield, quality and economic evaluation to achieving the goals of sustainable agriculture and decreasing the use of chemical fertilizers of Sudangrass.

MATRIALS AND METHODS

Two field experiments were conducted on sandy soil at Agricultural Research Station Farm in Ismailia Governorate, Egypt. The farm is located at $30^{o}35'$, 41.9" N latitude and 32^{o} 16', 45.8" E longitude during the two successive seasons 2017 and 2018 to study the effect of

mineral nitrogen fertilizer levels, organic acid (Humic acid (HA)) and Amino acids (Tryptophan (Tryp.)) on productivity and quality of Sudangrass (*Sorghum sudanense* L.) Var. Giza 2. Some physical and chemical properties of the study soil were determined according to the methods described by **Page *et el.* (1982)** are presented in Table (1). The experimental design was randomized complete block with three replications.

Table (1): Some physical and chemical properties of soil used (Mean values for the two seasons).

Sand (%)		Silt (%)		Clay (%)	Texture	O.M (%)		$CaCO_3$(%)	
78.35		7.45		14.20	Sandy loam	0.58		1.74	
pH (1:2.5)	EC (dS/m) in soil past	Soluble Cations (meq l^{-1})				Soluble Anions (meq l^{-1})			
		Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	HCO^{-}_3	Cl^{-}	SO^{-2}_4	SAR
7.85	1.78	5.22	3.90	7.88	0.80	1.20	7.03	9.57	3.70
Available Macronutrients (mg kg^{-1})						Available Micronutrients (mg kg^{-1})			
N		P		K		Fe	Mn	Zn	
37.11		4.95		160.00		2.19	1.20	0.59	

The treatments used were as follows:

- T_0= 0 Kg N (to calculate NUE).
- T_1= 60 Kg N/ fad.
- T_2= 60 Kg N/ fad + Organic acids (HA) foliar application.
- T_3= 60 Kg N/ fad + Amino acids (Tryp.) foliar application.
- T_4= 60 Kg N/ fad + Organic acids (HA) + Amino acids (Tryp.) foliar application.
- T_5= 90 Kg N/ fad
- T_6= 90 Kg N/ fad + Organic acids (HA) foliar application.
- T_7= 90 Kg N/ fad + Amino acids (Tryp.) foliar application
- T_8= 90 Kg N/ fad + Organic acids (HA) + Amino acids (Tryp.) foliar application.

The plot size was 12 m^2 (4.0 x 3.0 m). Seeds were hand drilled in rows 20 cm apart at the seeding rate of 20 kg/fad. The preceding winter crop for both seasons was barley. Sowing dates took place on May 15th and 23rd in 1st and 2nd seasons, respectively.

Recommended rates of phosphors (150 kg/fad) super phosphate (15.5% P_2O_5) was applied just after land preparation, The N fertilizer was applied at different rates under study as ammonium nitrate (33.5% N) at three equal doses, *i.e.* after 21, 55 and 95 days from planting, respectively. The treatments of humic and tryptophan were carried out as foliar application on plant on three periods 25, 60 and 100 days from

planting at rates 2 L/400 L water/ fad. The three cuts were taken in both seasons at 50, 90 and 125 days after planting.

Measurements of agronomic traits and yield:

1- Plant height (cm): Ten plants as samples from each plot were taken at harvesting time to measure from ground level to the highest leaf tip.
2- Number of tiller/ m^2.
3- Number of leaves/ plant.
4- Leaves /stems ratio.
5- In each cut, fresh yield was calculated by harvesting the complete plot (kg) and it was converted to ton/ fad. Total fresh yield was calculated by sum of cuts yield.
6- Total dry matter yield was calculated from dry matter % multiplied by fresh yield. (The green plants were chopped manually and were weighed on digital weight balance then placed in shad for drying and was shifted to electric oven at 105 ^{0}C for period till a constant weight was achieved.)
7- Relative yield was calculated according to **Barakat *et al.* (2002)** as follows:-

$$\text{Relative yield} = \frac{\text{Fresh or dry forage yield (ton/fad)}}{\text{Fresh or dry forage yield (ton/fad) at Zero N}} \times 100$$

Chemical Composition:

The following chemical constitute were studied in the first season only on dry weight basis. Plant samples were taken from each cut and then oven dried at 70 ^{0}C until constant weight, followed by fine grinding to estimate.

1- The crud protein (CP): The nitrogen contents of feed sample was determined by Kjeldahl N (**A.O.A.C, 1999)** and the value recorded for nitrogen was then multiplied by 6.25 **(Hymowitz *et al.*, 1972)**.
2- The crude fiber (CF) contents were methods recommended by **Van-Soest *et al.* (1991).**
3- Total digestible nutrient (TDN) was calculated as TDN= 50.41+1.04CP-0.07CF, According to **Church (1979),**
4- The digestible crude protein (DCP) was calculated as DCP= (CP X 0.9115) - 3.62) According to **Mc -Donald *et al.* (1978).**
5- Nitrogen use efficiency (NUE) was calculated according to the formula proposed by **Craswell and Godwin (1984)** as follows:

$$\text{NUE} = \frac{(\text{Total yield F} - \text{Total yield C})(\text{kg})}{\text{Fertilizer N applied}}$$

Where: F = fertilized plants, C = non fertilized plants (zero N)

NUE determine the forage yield produced per one kg of fertilized N (kg forage yield / kg N applied).

Statistical analysis

Data were statistically analyzed according to **Snedecor and Cochran (1991)** and treatment means were compared by least significant difference test (LSD) at 0.05 level of significance. Bartlett's test was done to test the homogeneity of error variance. The test was not significant for all assessed traits, so, the two season's data were combined.

RESULTS AND DISSCUSION

Growth traits:

Data of the combined analysis for plant height (cm), number of tiller/ m^2, no. of leaves/ plant and leaves/stem ratio % as affected by N fertilization different rates and organic acid (HA) or amino acid (tryp.) are presented in Tables 2&3. Obtained data revealed clearly that the studied different fertilizer combinations treatments caused significant increases in all growth traits.

Table (2): Plant height (cm) and number of tillers/ m2 of Sudangrass as affected by different nitrogen rates and organic, amino acids and their combination (combined analysis of two seasons)

Treatments	Plant Height (cm)				Number of tillers/ m^2			
	Cut 1	Cut 2	Cut 3	Mean	Cut 1	Cut 2	Cut 3	Mean
T_0	90.12	105.13	69.90	88.38	31	39	29	33.0
T_1	109.13	118.35	82.04	103.17	35	41	30	35.3
T_2	130.13	142.30	98.00	123.48	41	49	36	42.0
T_3	143.21	151.00	111.20	135.14	47	54	43	48.0
T_4	148.41	160.75	127.46	145.54	51	59	48	52.6
T_5	120.40	131.12	89.00	113.51	39	46	32	39.0
T_6	138.08	146.32	102.14	128.85	43	52	39	44.7
T_7	152.21	166.24	139.21	152.55	54	62	50	55.3
T_8	163.46	178.46	150.46	164.13	59	65	51	58.3
LSD $_{0.05}$	6.119	7.042	6.121	6.140	1.021	1.211	1.019	1.084

T_0 Zero N T_1= 60 kg N/fad T_2= 60kg N/fad + organic acid T_3= 60 kg N/fad + amino acid T_4= 60 N/fad+ organic acid+ amino acid T_5 = 90 kg N/fad T_6 = 90 kg N/fad + organic acid T_7 = 90 kg N/fad + Amino acid T_8 = 90 kg N/fad + organic acid +Amino acid.

The highest mean values of the three cuts for plant height (cm), number of tiller/ m^2 , no. of leaves/ plant and leaves/stem ratio % were obtained with treatment T_8 (90 kg N/fad + organic acid + amino acid**)**. Obtained data are in agreement with those of **Jhones *et al.* (1995**) found that the effect of nitrogen and organic acid fertilization are lower than nitrogen and amino acids which significantly led to increasing the number of leaves and they suggested that the increasing in number of leaves may be as a result of increasing number of nodes. The obtained results revealed that plant height was significantly affected by applied different fertilizer of nitrogen, amino acid and organic acid which results

in progressive increased in plant growth of plant height, number of leaves, number of tillers and leaves / stem ratio with different nitrogen fertilizers can be attributed to the fact that nitrogen with organic acids and amino acid promotes of the internodes. Similar results were recorded by **Gasim, (2001).**

However, the remarkable increase in plant height attained by (organic acid) treatment, in this may be due to the efficiency of nitrogen source which composed of two forms (organic acid and nitrate) and amino as essential nutrient for the plant. This result is in agreement with the finding of **El-Mar, (2001) and Abdel Gadder, (2007).** Also, **Yagoub and Abdelsalam (2010)** reported that fertilizing with nitrogen rate produced the lower value as compared with other sources, this resulted in more nodes and internodes and subsequently more production of leaves and tillers.

Table (3): No. of leaves/ plant and leaves / stem ratio of Sudangrass as affected by different nitrogen rates and foliar application of organic and amino acids (combined analysis of two seasons).

Treatments	No. of leaves/ plant				Leaves / stem ratio			
	Cut 1	Cut 2	Cut 3	Mean	Cut 1	Cut 2	Cut 3	Mean
T_0	5.18	5.91	4.00	5.03	0.275	0.361	0.255	0.297
T_1	5.32	6.35	4.36	5.34	0.287	0.375	0.280	0.314
T_2	5.96	7.18	4.77	5.97	0.303	0.388	0.295	0.329
T_3	6.47	7.73	5.24	6.48	0.313	0.405	0.301	0.339
T_4	6.52	7.91	5.68	6.70	0.317	0.463	0.312	0.364
T_5	5.54	6.82	4.56	5.64	0.309	0.394	00.298	0.334
T_6	6.24	7.50	5.09	6.28	0.311	0.409	0.300	0.340
T_7	6.93	8.25	5.92	7.03	0.370	0.485	0.316	0.390
T_8	7.33	8.51	6.87	7.57	0.387	0.496	0.365	0.416
LSD $_{0.05}$	0.130	0.120	0.110	0.125	0.001	0.003	0.004	0.003

T_0 Zero N T_1= 60 kg N/fad T_2= 60kg N/fad + organic acid T_3= 60 kg N/fad + amino acid T_4= 60 N/fad+ organic acid+ amino acid T_5 = 90 kg N/fad T_6 = 90 kg N/fad + organic acid T_7 = 90 kg N/fad + Amino acid T_8 = 90 kg N/fad + organic acid +Amino acid.

Fresh and dry yields:

The data presented in Table 4 indicated the effects of spray of amino acid and humic acid combined with mineral nitrogen on fresh and dry forage yields which were significantly affected with increasing mineral nitrogen. Fresh and dry yields (ton/fad) were increased due to increasing mineral nitrogen combined with amino acid compared with the mineral nitrogen combined with organic acid. Highest values of fresh and dry yields in first cut were for foliar of organic acid combined with amino acid and 90 kg N/fad (T_8) compared with the other treatments.

Table (4): Fresh and dry yields (ton/ fad) of Sudangrass as affected by different nitrogen rates and foliar application of organic and amino acids (combined analysis of two seasons).

Treatments	Fresh yield ton/fad				Dry yield ton/fad			
	Cut 1	Cut 2	Cut 3	Total	Cut 1	Cut 2	Cut 3	Total
T_0	2.015	2.650	1.375	6.040	0.503	0.664	0.330	1.497
T_1	4.046	5.142	3.936	13.124	0.971	1.234	0.995	3.200
T_2	7.141	7.986	6.452	21.579	1.713	1.917	1.548	5.178
T_3	7.904	9.234	6.906	24.044	1.895	2.216	1.657	5.768
T_4	8.255	9.878	7.250	25.383	1.981	2.372	1.703	6.056
T_5	6.919	7.265	5.980	20.164	1.668	1.743	1.435	4.846
T_6	7.693	8.728	6.657	23.078	1.846	2.094	1.597	5.537
T_7	8.590	10.150	7.518	26.258	2.060	2.445	1.812	6.317
T_8	9.354	11.720	8.243	29.317	2.245	2.880	1.986	7.378
$LSD_{0.05}$	0.350	0.310	0.290	0.350	0.190	0.140	0.200	0.140

T_0 Zero N T_1= 60 kg N/fad T_2= 60kg N/fad + organic acid T_3= 60 kg N/fad + amino acid T_4= 60 N/fad+ organic acid+ amino acid T_5 = 90 kg N/fad T_6 = 90 kg N/fad + organic acid T_7 = 90 kg N/fad + Amino acid T_8 = 90 kg N/fad + organic acid +Amino acid.

From above mentioned results, it could be concluded that foliar application of humic acid and/or amino acids (Tryp.) promoted growth and possessed the best yield in plant. Based on the experimental results it may be recommend the treatment of 90 kg N/fad with humic acid and amino acids to produce high mass production under such condition. These results are in agreement with those obtained by **Wahba *et al.* (2002)** who reported that tryptophan (amino acid) at 25, 50 and 75 ppm treatments led to increasing fresh and dry weights and the highest value was obtained by tryptophan at 75 ppm. High concentrations of tryptophan may stimulate growth by increasing leaves and size of photosynthesizing surface. **(Kowalczyk and Zielony, 2008)** found that the Amino acids are well known bio stimulant which have positive effects on plant growth**.** These results may be due to the role of the used amino acids at a specific concentration in plants. Tryptophan combined with nitrogen led to improving the crop vegetative and enriched biomass of crop yield, **Ahmad *et al.* (2008).** Furthermore, the obtained results could be attributed to the beneficial effect of amino acids on new cell production through restoring the specific enzymes for protein synthesis as mentioned by **Aly and Swedan, (2009).**

As well as, this may be attributed to the positive effect of humic acid on plant physiology, and enhancement of biomass yields, induction of lateral roots emergence, increase cell respiration and membrane uptake of nutrients and exertion of hormone- like activities **(El-Mekser *et al.*, 2014 and Shafeek *et al*., 2018).**

Relative Yield (R.Y.):

Data of the combined analysis of two seasons for relative yield for fresh and dry yields (ton/fad) are presented in Table (5) show that in the last treatment (T_8) gave the highest values (485.4 and 492.9) for total fresh and dry yields ton/ fad, respectively. Treatment T_3 (60 Kg N fad^{-1} + Amino acids (Tryp.)) foliar application had higher values than T_6 (90 Kg N fad^{-1} + Organic acids (HA)) foliar application, use amino acid was recorded highest values than organic acid of catalyst for soil under the conditions of reclaimed and poor land.

Table (5): Relative yield (ton/fad) for fresh and dry yields of Sudangrass as affected by different nitrogen rates and foliar application of organic and amino acids (combined analysis of two seasons).

Treatments	Relative yield % Fresh yield (ton/fad)				Relative yield % Dry yield (ton/fad)			
	Cut 1	Cut 2	Cut 3	Total	Cut 1	Cut 2	Cut 3	Total
T_0	100	100	100	100	100	100	100	100
T_1	200.8	194.0	286.3	217.3	193.0	185.8	301.5	213.8
T_2	354.4	301.4	469.2	357.3	340.6	288.7	469.1	345.9
T_3	392.3	348.5	502.3	398.8	376.7	333.7	502.1	385.3
T_4	409.7	372.8	527.3	420.2	393.8	357.2	516.1	404.5
T_5	343.4	274.2	434.9	333.8	331.6	262.3	434.8	323.7
T_6	381.8	329.4	484.1	382.1	366.9	315.4	483.9	369.9
T_7	426.3	383.0	546.8	434.7	409.5	368.2	549.1	421.9
T_8	464.2	442.3	599.5	485.4	446.3	433.7	601.8	492.9
$LSD_{0.05}$	6.13	7.35	7.99	6.98	8.15	9.54	7.32	7.66

T_0 Zero N T_1= 60 kg N/fad T_2= 60kg N/fad + organic acid T_3= 60 kg N/fad + amino acid T_4= 60 N/fad+ organic acid+ amino acid T_5 = 90 kg N/fad T_6 = 90 kg N/fad + organic acid T_7 = 90 kg N/fad + Amino acid T_8 = 90 kg N/fad + organic acid +Amino acid.

In conclusion, high potential for fresh and dry yields is still achieved by using high level of nitrogen fertilization. Furthermore, taking into the side effects and residuals in the soil and plants as a result of using high levels of mineral fertilization, acceptable dry matter with high quality forage; could be obtained from using less mineral fertilization supported with organic acid **(Hanife *et al.*, 2017)** Integration of inorganic, organic and amino acid play vital role for enhancing crop productivity and sustaining soil fertility; this proves great promise for farmers.

Chemical composition:

A comparison of nutrient value of Sudangrass is shown in Tables 6, 7. Sudangrass forage should always be sampled and tested for feed composition because of the variability in nutrient value **(NRC, 1989**). Forage quality parameters i. e crude protein (CP %), digestible crude protein (DCP %) and total digestible nutrients (TDN %) (Tables 6, 7) had the highest values in treatment T_8, while had the lowest values in the same treatment for crude fiber (CF %).

Table (6): crude protein (CP %) and crude fiber (CF %) of Sudangrass as affected by different nitrogen rates and foliar application of organic and amino acids in the first season.

Treatments	CP %				CF %			
	Cut 1	Cut 2	Cut 3	Mean	Cut 1	Cut 2	Cut 3	Mean
T_0	7.96	8.01	7.80	7.92	25.14	25.54	24.85	25.18
T_1	8.33	8.42	8.21	8.32	25.80	25.92	25.74	25.82
T_2	10.80	10.98	10.65	10.81	23.41	23.63	23.22	23.42
T_3	12.45	12.53	12.13	12.37	23.73	23.81	23.54	23.69
T_4	14.25	14.40	14.11	14.25	21.85	22.05	21.64	21.85
T_5	9.85	9.96	9.74	9.85	24.13	24.34	24.00	24.16
T_6	11.63	11.85	11.53	11.67	23.43	23.64	23.21	23.43
T_7	13.23	13.38	13.09	13.23	22.65	22.72	22.35	22.57
T_8	14.95	15.06	14.82	14.94	21.54	21.67	21.41	21.54
LSD $_{0.05}$	0.31	0.23	0.25	0.34	0.59	0.51	0.51	0.64

T_0 Zero N T_1= 60 kg N/fad T_2= 60kg N/fad + organic acid T_3= 60 kg N/fad + amino acid T_4= 60 N/fad+ organic acid+ amino acid T_5 = 90 kg N/fad T_6 = 90 kg N/fad + organic acid T_7 = 90 kg N/fad + Amino acid T_8 = 90 kg N/fad + organic acid +Amino acid.

The results of this study are compatible with results of other investigators such as **(Afzal *et al.*, 2012 & 2013). Chen and Aviad (1990)** reported that foliar use of humic acid and amino acid derivatives were very effective because the humic and amino molecules can get into the cellular nutrient stream and make the cellular membrane more permeable allowing the improvement of nutrient flow and cell division**.**

Table (7): Digestible crud protein (DCP %) and total digestible nutrients (TDN %) of Sudangrass as affected by different nitrogen rates and foliar application of organic and amino acids in the first season.

Treatments	DCP %				TDN%			
	Cut 1	Cut 2	Cut 3	Mean	Cut 1	Cut 2	Cut 3	Mean
T_0	3.64	3.68	3.49	3.60	56.93	56.95	56.78	56.89
T_1	3.97	4.05	3.86	3.96	57.26	57.35	57.15	57.25
T_2	6.18	6.39	6.09	6.22	60.00	60.18	56.86	59.01
T_3	7.73	7.80	7.44	7.66	61.70	61.77	61.38	61.62
T_4	8.44	8.58	8.31	8.44	62.66	62.74	62.46	62.62
T_5	4.14	5.46	5.26	4.95	59.01	59.04	58.86	58.97
T_6	6.98	7.18	6.89	7.02	60.82	61.08	60.78	60.89
T_7	9.37	9.51	9.24	9.37	63.70	63.84	63.57	63.70
T_8	10.01	10.11	9.89	10.00	64.37	64.56	64.32	64.42
LSD $_{0.05}$	0.41	0.32	0.41	0.35	0.54	0.48	0.44	0.51

T_0 Zero N T_1= 60 kg N/fad T_2= 60kg N/fad + organic acid T_3= 60 kg N/fad + amino acid T_4= 60 N/fad+ organic acid+ amino acid T_5 = 90 kg N/fad T_6 = 90 kg N/fad + organic acid T_7 = 90 kg N/fad + Amino acid T_8 = 90 kg N/fad + organic acid +Amino acid.

Almodares, *et al.* (2009) showed a positive association between nitrogen rates and protein values. The CP contents with elevated nitrogen levels are connected with the buildup of amino acids as results of

nitrogen being a structural component. The results regarding the CF were in consistency with those obtained by **Ayub *et al.* (2007)** on summer forage and **Abo – Zeid *et al.* (2017)** on Sudangrass.

Nitrogen Use Efficient (NUE)

The data of nitrogen use efficiency NUE in Table (8) indicated that each kilogram nitrogen applied as soil application (T_1 and T_5) produced about 118.0 and 156.9 of total fresh yield/ fad; respectively, more than zero N treatment (T_0). However, each kilogram nitrogen was applied as soil application plus organic and amino acids (T_4 and T_8) produced about 322.4 and 258.6 kg/ fad, respectively, more than control treatment (T_0). Moreover, the same trend was observed also for the nitrogen fertilizer efficiency on dry yield /fad. From these results, it could be concluded that the nitrogen fertilization was much more efficient on Sudangrass productivity when it was applied especially at 60 kg N/fad plus foliar application treatment of organic and amino acids. The superiority of nitrogen use efficiency as foliar application rather than soil application may be attributed to the completely absorption of nitrogen fertilization by foliar application by the leaves and translocated directly to the assimilation organs, without any losses, for building the metabolites synthesized **(Barakat *et al.*, 2002).**

Table (8): Nitrogen use efficiency on Sudangrass as affected by different nitrogen rates and foliar application of organic and amino acids (combined analysis of two seasons).

Treatments	Fresh forage yield (ton/ fad.)	NUE	Dry forage yield (ton/ fad.)	NUE
T_0	6.040	-----	1.497	------
T_1	13.124	118.0	3.200	28.4
T_2	21.579	258.9	5.178	61.4
T_3	24.044	300.1	5.768	71.2
T_4	25.383	322.4	6.056	75.9
T_5	20.164	156.9	4.846	37.2
T_6	23.078	189.3	5.537	44.8
T_7	26.258	224.6	6.317	53.5
T_8	29.317	258.6	7.378	65.3
$LSD_{0.05}$	0.350	6.53	0.140	3.12

T_0 Zero N T_1= 60 kg N/fad T_2= 60kg N/fad + organic acid T_3= 60 kg N/fad + amino acid T_4= 60 N/fad+ organic acid+ amino acid T_5 = 90 kg N/fad T_6 = 90 kg N/fad + organic acid T_7 = 90 kg N/fad + Amino acid T_8 = 90 kg N/fad + organic acid +Amino acid.

Economic Evaluation:

Results in Table (9) showed that the economic returns for combined seasons. The net return values for treatment ranged from 11568 LE to 31055 LE.The highest net return, without including land rent (31055) was achieved by treatment foliar of organic acid combined with amino acid and 90 kg N/fad (T_8) followed by treatment (T_6)

(17547L.E.) then treatment (T_7) (27737 L. E.). Meanwhile, the treatment T_0 had the lowest net return and net invested Egyptian pound. Also, the highest revenue was obtained from the high level of fertilization (90 kg N/ fad), in spite of the low revenue of one pound (LE/LE) than the other treatments. Similar results were obtained by **Jat *et al.* (2012).**

Table (9): Estimated net return L.E. fad $^{-1}$ of forage Sudangrass as affected by as affected by different nitrogen rates and foliar application of organic and amino acids (combined analysis of two seasons).

Cost of production inputs	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Land preparation									
Tillage	500	500	500	500	500	500	500	500	500
Planting	300	300	300	300	300	300	300	300	300
Seeds	700	700	700	700	700	700	700	700	700
Irrigation	500	500	500	500	500	500	500	500	500
Land rent	4000	4000	4000	4000	4000	4000	4000	4000	4000
Total preparation land	5250	5250	5250	5250	5250	5250	5250	5250	5250
Mineral fertilization									
Ammonium nitrate (33.5% N)	-	500	500	500	500	700	700	700	700
Organic acid (Humic acid)	-	-	70	-	70	-	70	-	70
Amino acid (Tryptophan)	-	-	-	50	50	-	-	50	50
Super phosphate (15.5% P_2O_5)	300	300	300	300	300	300	300	300	300
Potassium sulphate (48% K_2O)	300	300	300	300	300	300	300	300	300
Hoeing	400	400	400	400	400	400	400	400	400
Harvesting	600	600	600	600	600	600	600	600	600
Total variable cost	7600	8100	8170	8150	8220	8300	8370	8350	8420
Yield ton fad^{-1}	6.040	13.124	15.779	19.944	22.58	13.715	17.278	24.058	26.317
Price ton^{-1}	1500	1500	1500	1500	1500	1500	1500	1500	1500
Total revenue	9060	19686	23668	29916	33870	20572	25917	36087	39475
Net return	1460	11586	15498	21766	25650	12272	17547	27737	31055
Return of invested L. E.	1.19	2.43	2.90	3.67	4.12	2.48	3.10	4.32	4.69
Net return of invested L. E.	0.19	1.43	1.90	2.67	3.12	1.48	2.10	3.32	3.69

Net return (L.E. fad $^{-1}$) = Total revenue- Total variable costs Return of invested L. E. = Total revenue/Total variable costs

Net return of invested L. E. = Return of invested L.E.$^{-1}$

T_0 Zero N T_1= 60 kg N/fad T_2= 60kg N/fad + organic acid T_3= 60 kg N/fad + amino acid T_4= 60 N/fad+ organic acid+ amino acid T_5 = 90 kg N/fad T_6 = 90 kg N/fad + organic acid T_7 = 90 kg N/fad + Amino acid T_8 = 90 kg N/fad + organic acid +Amino acid.

CONCLUSION

Generally it could be concluded that application of 90 kg N/fad + foliar application of organic acid (HA) +Amino acid (Tryp.) produced the highest productivity and quality of Sudangrass under Sandy Soil Conditions.

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تأثير الرش الورقي بالاحماض العضوية والامينية تحت مستويات مختلفة من التسميد النيتروجيني على إنتاجية وجودة حشيشه السودان تحت ظروف الاراضى الرملية

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اقيمت تجربتان حقليتان بمحطة البحوث الزراعية بالاسماعيلية بقسم بحوث العلف. خلال موسمى 2017 و 2018 لدراسة تأثير معدلات مختلفة من التسميد النيتروجينى (0 ,60 ,90 كجم /فدان) مع التسميد العضوى (حمض الهيوميك) والتسميد بالحمض الاميني (التربتوفان) رشا علي النبات لدراسة تاثيرها علي النمو والمحصول والجودة في حشيشه السودان حيث كان تصميم التجربة القطاعات الكاملة العشوائية فى ثلاثة مكررات.

وكانت اهم النتائج المتحصل عليها وجود تاثير ايجابي علي صفات النمو الخضري والمحصول والجودة عند اضافة 90 كجم نيتروجين /فدان مع الرش بالتسميد العضوى (حمض الهيوميك) و الاميني (تربتوفان) حيث اعطت اعلي القيم لطول النبات وعدد الافرع وعدد الاوراق ونسبة الاوراق للسيقان والمحصول الأخضر والجاف لحشيشة السودان.

وقد وجد ان معامل كفاءة استخدام التسميد النيتروجيني لمعاملات الاضافة الارضية فقط (60 كجم نيتروجين /فدان) اقل مقارنة بالاضافة الورقية مع الارضية خاصة عند اضافة 60 كجم نيتروجين مع الرش بالهيوميك والتربتوفان

وقدرت كفاءة استخدام النيتروجين لهذه المعاملة ب 322.4 و 75.9 كجم علف اخضر وجاف / 1كجم نيتروجين علي الترتيب. ممايشير الي ان كفاءة استخدام السماد النيتروجيني عند اضافة التسميد العضوي والتسميد الاميني كاضافة ورقية في وجود الاضافة الارضية كان اكثر كفاءة مقارنة باضافته كاضافة ارضية فقط في زيادة انتاجية حشيشة السودان.

اشارت النتائج بصفة عامة ان حشيشة السودان المسمده ب 90 كجم نيتروجين والرش بالتسميد العضوى (حمض الهيوميك) وبالحمض الاميني تربتوفان اعطت اعلي محصول اخضر وجاف تحت ظروف الاراضي الرملية الفقيرة بالاسماعيلية. كما ادت زيادة التسميد النيتروجيني الي زيادة نسبة البروتين. كما اثبتت النتائج ان هذه المعاملة (90 كجم نيتروجين + التسميد العضوي+ التسميد بالحمض الاميني) الأعلي في عائد الجنيه المستثمر في زراعة محصول حشيشة السودان تعود علي المزارع بالجنيه الذي تم انفاقه في الزراعة.