Egypt. J. Soil Sci. Vol. 57 No. 1, pp. 23- 30 (2017)

Effect of Sources and Rates of Nitrogen Fertilizers on Forage Yield and Nitrate Accumulation for Sudangrass

S.T. Abo-Zeid[1], Amal L. Abd EL-Latif [1] and S. Elshafey[2]
[1]Dept. Soil Science, Fac. of Agric., Cairo University and [2]Regional Center of Food and Feed, ARC, Ministry of Agric., Giza, Egypt

A FIELD experiment was carried out at the Experimental Station Farm in Giza, Agricultural Research Center, Egypt, during the two successive summer seasons of 2012 and 2013. The experiment was to study the effect of varying sources, rates of nitrogen fertilizers on fresh and dry forage yields of sudangrass, chemical constituents, nitrate and nitrite accumulation in plant using a split-plot design with three replicates. The main plots were assigned to nitrogen fertilizer sources (Ammonium nitrate NH4 NO3 and ammonium sulphate (NH4)2 SO4.While, the sub-plots were occupied with rates of nitrogen fertilizer (50, 75, 100, and 125 Kg N/fed).The results indicated that the fresh and dry forage yield ton/fed, nitrogen, crude protein, phosphorus, potassium, nitrite (NO2) and nitrate (NO3)contents were significantly decreased in the second cutting as compared with the first one over both seasons. Using ammonium sulphate "$(NH_4)_2 SO_4$" was better than using ammonium nitrate "NH4 NO3" as a source of nitrogen fertilizer over both cuttings and seasons.

Fresh and dry forage yields of sudangrass were significantly increased as nitrogen rates increased from 50 to 75 and 100 kg N/fed and significantly decreased due to increasing nitrogen rate from 100 to 125 kg N/fed over both seasons.It can be recommended that mineral fertilizing of sudangrass plants with 75100- kg N/fed is better to get suitable forage yields and reduce nitrate accumulation in plant.

Keywords: Sudangrass, Nitrogen fertilizer sources, Nitrate accumulation.

Introduction

Animal production is suffering scarcity, because of the competition between the production of human food and animal feed in Egypt. Thus, forage become important in mans food supply through its utilization as food by ruminant. In the main time some forage grasses such as sorghum, sudangrass, millet and teosint are the most satisfactory summer fodder crops grown in Egypt to offset the acute deficit in forage production during the summer. Since, the total cultivated area of sudangrass in Egypt reached about 8340 fed in 2011 season, producing 190913 ton, thus the average production was 22.90 ton/fed (El-Nahrawy, 2011).

Nitrogen plays a role in plant nutrition. It is the element that required in the greatest quantity by forage crop plants such as sudangrass and it is the nutrient most often deficit in the Egyptian soils. Thus, the adequate rates, appropriate sources, efficient methods of application and application timing are important strategies (Fageria and Baligar, 2005) in order to increase growth, yield and its components and enhances the protein content of sudangrass crop.

Afzal et al. (2012) showed that increasing nitrogen dose from 0 to 50, 75 and 100 kg N/acre increased plant height, fresh and dry weight of sorghum forage. Anfinruda et al. (2013) found that there was a significant response in yield with increasing nitrogen rates. They added that there was a significant response in quality parameters such as N%, P%, K% and crude protein yield with increasing nitrogen rates.

Ammonium nitrate (NH4NO3) is highly soluble in water and readily available to plants. However, it can be lost through leaching and runoff, polluting groundwater and streams. Ammonium sulphate is used as a synthetic stimulant for alkaline soils. The sulphur in the compound helps to decrease the pH balance of

DOI :

the soil while increasing the nitrogen content. Ammonium nitrate can also be used as a good plant fertilizer; however it is far better suited to controlling acidic soil. Significant differences in growth characters, yield and its components of sorghum forage were detected owing to nitrogen fertilizers sources (Ahmed et al., 2007). Mahmoud et al.(2011) showed that there were significant effects on yield and yield components due to nitrogen sources and rates. Using of nitrogen fertilizers at form of ammonium sulphate and urea at the suitable concentrations according to soil type and plant gave higher yield than ammonium nitrate.

Nitrate accumulation in plants is affected by some factors; excessive use of nitrogen fertilizer, nutrient deficiencies (P, K and Mg), environmental factors (drought, sunlight, frost, hail, disease or temperature) and plant factors such as plant type (sorghum, sudangrass, hybrid sorghum and pearl millet), stage of growth, immature or young plants and stalks are highest in nitrate content, followed in order by leaves and grain in decreasing amount(Roozeboom, 2011).

The objective of this study was to evaluate the impact of different nitrogen fertilizer sources and rates on forage yield of sudangrass and its chemical constituents.

Materials and Methods

The field experiment was carried out at the Experimental Station Farm in Giza, Agricultural Research Center, Egypt, during the two successive summer seasons of 2012 and 2013 to study the effect of varying sources, rates of nitrogen fertilizer on forage yield of sudangrass and its chemical constituents.

The experiment was carried out in a split-plot design with three replicates. The main plots were assigned to the following nitrogen fertilizer sources:

1- Ammonium nitrate "NH4 NO3" 33.5 % N.

2- Ammonium sulphate "(NH4)2 SO4" 20.6 % N.

While, the sub-plots were occupied with the following rates of nitrogen fertilizer (50, 75, 100, and 125 Kg N/fed).

The nitrogen fertilizers in the previously mentioned sources and rates were added in three equal portions, one third at sowing, second third after 20 days from sowing and the other third after the first cut.Each experimental basic unit included five ridges, each of 70 cm width and 3 m length, resulted an area of 10.5 m2 (1/400 fed). The preceding winter crop was Egyptian clover (*Trifolium alexandrinum* L.) in the first and second seasons.

Surface soil samples were taken at random from the experimental field area before cultivation to determine the physical and chemical soil properties as shown in Table 1.

Particle size distribution was carried out by pipette method as described by Gee and Bauder (1986). Saturation percentage (SP) was determined using the method described by Klute (1986). Organic matter was determined by wet oxidation method (Sparks, 1996). Total CaCO3 was determined using Collin's calciminer (Sparks, 1996). Available forms of N,P and K were determined in the soil (Sparks,1996).

Soil pH and EC were measured in a 1 : 2.5 soil water suspension using combined electrode pH meter and conductivity meter , respectively. Soluble cations, Na and K were measured by flame photometer while Ca, Mg and soluble anions (Cl , SO4 , CO3 and HCO3) were determined titrimetrically according to Page et al. (1982). Nitrate was determined using micro-kjeldahl,as described by A.O.A.C (2012).

Superphosphate (15.5 % P2O5) was applied during soil preparation at the rate of 200 kg/fed. Potassium sulphate (48 % K2O) at the rate of 100 kg/fed was applied with the second dose of nitrogen fertilizer.

Sudangrass seeds were hand sown in pits in the two sides of the ridge and the distance between every two pits was about 20 cm using dry sowing method (Afire) during the last week of April in 2012 and 2013 seasons. Irrigation was conducted every 12 days throughout the growing season. The other agricultural practices were kept the same as normally practiced in sudangrass fields according to the recommendations of Ministry of Agriculture and Land Reclamation.

The first cutting was done after 60 days from sowing. The second cutting was done after 40 days from the first cutting, where one meter square from each sub-plot was randomly chosen to estimate fresh forage yield. Dry forage yield was calculated after washing and oven drying of fresh samples at 70°C until constant weight.

TABLE 1. Some Physical and chemical analysis of the experimental soil

Soil analyses		Value
Physical analyses		
Clay (g/kg)		455
Silt (g/kg)		393
Fine sand (g/kg)		110
Coarse sand (g/kg)		42
Texture class		Silty loam
SP %		42.0
Chemical analyses		
Organic matter (g/kg)		18
$CaCO_3$ (g/kg)		5
N (mg/kg)		50.1
P (mg/kg)		7.0
K (mg/kg)		314.6
NO_3 (mg/kg)		25.0
EC (ds/m) at 25 °C		1.1
pH		8.1
Cations (meq/L)	K^+	2.3
	Na^+	4.0
	Mg^{++}	1.7
	Ca^{++}	2.0
Anions (meq/L)	$SO_4^=$	1.6
	Cl^-	6.1
	HCO_3^-	2.3
	$CO_3^=$	-

The wet digestion of dry matter was carried out using mixed concentrated acids (perchloric and sulphoric acids) according to Page et al.(1982).

Nitrogen content was determined by micro-kjeldahl apparatus, according to O'Dell (1993). Phosphorus was estimated colorimetrically by using the molybdenum blue method according to Pierzynski (2000). Potassium was estimated flamephotometrically according to Page et al. (1982).Crude protein content (CP %) was calculated according to its total N content, using the 6.25 factor. Nitrate (NO3) and nitrite (NO2) determinations were measured as described by A.O.A.C. (2012).

Statistical analysis

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split – plot design as published by Gomez and Gomez (1984).

Results and Discussion

1- Fresh and dry forage yields (ton/fed)

Means of fresh and dry forage yields (ton/fed) as affected by different nitrogen fertilizer sources and rates produced from the first and the second cuttings as combined over both seasons are presented in Table (2). The data indicated that fresh and dry forage yields were significantly decreased in the second cutting as compared with the first cutting over both seasons.

In the first cutting, the use of ammonium nitrate was significantly exceeded using ammonium sulphate as sources of nitrogen fertilizer over both seasons. On the contrary, using ammonium sulphate was significantly higher than using ammonium nitrate in the second cutting over both seasons. Similar results were obtained by Ahmed et al. (2007)who showed that significant differences in yield of sorghum forage were detected owing to use different nitrogen fertilizers sources.

Over both seasons, fertilizing sudangrass plants with 50 kg N/fed as ammonium sulphate or ammonium nitrate tended to produce the lowest values of fresh and dry forage yields in the first and second cutting .

TABLE 2. Fresh and dry forage yields (ton/fed) as affected by sources and rates of nitrogen fertilizer produced from first and second cuttings as combined over both seasons.

Cuttings	Fresh forage yield (ton/fed)			
	50 kg N/fed	75 kg N/fed	100 kg N/fed	125 kg N/fed
Ammonium nitrate "NH_4 NO_3"				
First cutting	25.10 ± 0.31	27.15 ± 0.30	29.07 ± 0.40	28.10 ± 0.38
Second cutting	18.05 ± 0.36	20.05 ± 0.56	21.15 ± 0.31	20.18 ± 0.30
Ammonium sulphate "$(NH_4)_2$ SO_4"				
First cutting	24.90 ± 0.30	26.83 ± 0.65	28.65 ± 0.23	27.67 ± 0.23
Second cutting	18.75 ± 0.51	20.90 ± 0.28	21.85 ± 0.28	20.90 ± 0.23
LSD at 5%	0.71	0.89	0.58	0.54
Dry forage yield (ton/fed)				
Ammonium nitrate "NH_4 NO_3"				
First cutting	3.82 ± 0.08	4.26 ± .12	4.87 ± .11	4.51 ± 0.10
Second cutting	2.65 ± 0.08	3.25 ± .26	3.36 ± .08	3.14 ± 0.08
Ammonium sulphate "$(NH_4)_2$ SO_4"				
First cutting	3.64 ± 0.05	4.08 ± .11	4.50 ± .06	4.19 ± 0.08
Second cutting	2.81 ± 0.11	3.24 ± .05	3.63 ± .08	3.36 ± 0.08
LSD at 5%	0.16	0.30	0.16	0.55

- Each value in the table was obtained by calculating the average of the three replicates ±S.D.
- The superscript letters indicated statistically significant differences, with P <0.05.

Fresh and dry forage yields of sudangrass were significantly increased as nitrogen rates increased from 50 to 75 and 100 kg N/fed and significantly decreased due to increasing nitrogen rate from 100 to 125 kg N/fed over both seasons. The increases in fresh forage yield/fed as a result of increasing nitrogen fertilizer rates up to 100 kg N/fed may be attributed to the role of nitrogen in enhancement meristematic activity and cell division, increasing the vegetative growth through enhancing leaf initiation, increment chlorophyll concentration in leaves and photosynthesis process (Lawlor, 2002), consequently enhancement forage yield/fed. These results are in agreement with those reported by Ćupina et al. (2011) and Anfinruda et al. (2013).

2- Nitrogen (N%) and crude protein (CP%) contents:

Means of nitrogen and crude protein contents as affected by nitrogen fertilizer sources and rates produced from the first and the second cuttings as combined over both seasons are presented in Table (3).

From obtained results, it could be observed that N and CP contents were markedly decreased in the second cutting as compared with nitrogen percent in sudangrass plants in the first cutting over both seasons. Nitrogen percent in sudangrass plants was higher when using ammonium sulphate than using ammonium nitrate in both cuttings and seasons.

Nitrogen percent and CP% in sudangrass plants were significantly increased as nitrogen fertilizer rates increased from 50 to 75, 100 and 125 kg N/fed in the first and the second cuttings, respectively over both seasons. The steady increases in nitrogen percent (N%) in sudangrass plants as a result of increasing nitrogen fertilizer rates up to 125 kg N/fed may be attributed to the role of nitrogen in improving growth and dry matter accumulation as well as by the influence of nitrogen availability at critical stages on plant metabolism in a manner which leading to increase synthesis of amino acids (Lawlor, 2002), and consequently enhancement nitrogen percent in forage yield of sudangrass. Beyaert and Roy (2005), Rahman et al. (2008) and Anfinruda et al. (2013) came to similar results.

- The superscript letters indicated statistically significant differences, with P <0.05.

3- Phosphorus and potassium percent

Averages of phosphorus and potassium percent in sudangrass plants as affected by various nitrogen fertilizer sources and rates resulted from the first and the second cuttings as combined over both growing seasons are shown in Table (4).

The data show that phosphorus (P %) and potassium (K %) in sudangrass plants produced from the first cutting were significantly higher than those resulted from the second one.

TABLE 3. Nitrogen and crude protein contents as affected by sources and rates of nitrogen fertilizers produced from first and second cuttings as combined over both seasons.

Cuttings	Nitrogen content (%)			
	50 kg N/fed	75 kg N/fed	100 kg N/fed	125 kg N/fed
Ammonium nitrate "NH_4 NO_3"				
First cutting	1.43 ± 0.06	1.57 ± 0.06	1.80 ± 0.03	2.00 ± 0.06
Second cutting	1.40 ± 0.00	1.53 ± 0.06	1.70 ± 0.04	1.80 ± 0.03
Ammonium sulphate "$(NH_4)_2$ SO_4"				
First cutting	1.53 ± 0.06	1.63 ± 0.06	1.90 ± 0.57	2.10 ± 0.03
Second cutting	1.47 ± 0.06	1.60 ± 0.00	1.80 ± 0.05	2.00 ± 0.02
LSD at 5%	0.09	0.09	0.09	0.09
Crude protein content (CP%)				
Ammonium nitrate "NH_4 NO_3"				
First cutting	8.97^{ab} ± 0.21	9.70^{ab} ± 0.100	10.8^{a} ± 0.20	12.2^{ab} ± 0.10
Second cutting	8.73^{b} ± 0.15	9.50^{ab} ± 0.436	10.6^{a} ± 0.26	11.3^{b} ± 0.61
Ammonium sulphate "$(NH4)_2$ SO_4"				
First cutting	9.60^{a} ± 0.36	10.47^{a} ± 0.153	11.9^{a} ± 0.79	12.90^{a} ± 0.36
Second cutting	9.17^{ab} ± 0.21	9.97^{b} ± 0.252	11.5^{a} ± 0.53	12.00^{ab} ± 0.25
LSD at 5%	0.46	0.50	0.95	0.71

- Each value in the table was obtained by calculating the average of the three replicates ±S.D.
- The superscript letters indicated statistically significant differences, with P <0.05.

TABLE 4. Phosphorus and potassium percent (%) as affected by sources and rates of nitrogen fertilizer produced from first and second cuttings as combined over both seasons.

Cuttings	Phosphorus (%)			
	50 kg N/fed	75 kg N/fed	100 kg N/fed	125 kg N/fed
Ammonium nitrate "NH_4 NO_3"				
First cutting	0.238^{ab} ± 0.008	0.248^{b} ± 0.004	0.280^{b} ± 0.003	0.279^{b} ± 0.007
Second cutting	0.219^{b} ± 0.008	0.238^{b} ± 0.003	0.270^{c} ± 0.003	0.264^{c} ± 0.006
Ammonium sulphate "$(NH_4)_2$ SO_4"				
First cutting	0.247^{a} ± 0.007	0.265^{a} ± 0.005	0.292^{a} ± 0.002	0.294^{a} ± 0.005
Second cutting	0.231^{ab} ± 0.007	0.246^{b} ± 0.005	0.271^{bc} ± 0.004	0.274^{bc} ± 0.004
LSD at 5%	0.14	0.08	0.06	0.10
Potassium (%)				
Ammonium nitrate "NH_4 NO_3"				
First cutting	2.410^{ab} ± 0.060	2.686^{b} ± 0.020	2.963^{a} ± 0.025	3.266^{a} ± 0.060
Second cutting	2.296^{b} ± 0.030	2.610^{b} ± 0.010	2.826^{a} ± 0.040	2.906^{b} ± 0.030
Ammonium sulphate "$(NH_4)_2$ SO_4"				
First cutting	2.440^{a} ± 0.060	2.856^{a} ± 0.061	2.990^{a} ± 0.572	3.343^{a} ± 0.025
Second cutting	2.306^{ab} ± 0.060	2.650^{b} ± 0.036	2.850^{a} ± 0.045	2.956^{b} ± 0.020
LSD at 5%	0.102	0.070	0.542	1.369

- Each value in the table was obtained by calculating the average of the three repicates ±S.D.
- The superscript letters indicated statistically significant differences, with P <0.05.

Fertilizing sudangrass plants with 50 kg N/fed as ammonium nitrate resulted in the lowest value of P % and K % in both cuttings of sudangrass. While higher values of P % and K % in the plants were obtained from fertilizing sudangrass plants with 125 kg N/fed as ammonium sulphate in the first and second cuttings.

Moreover the data show also that phosphorus percent in sudangrass plants fertilized by "(NH4)2 SO4" was higher than that of "NH4 NO3" over both cuttings and seasons. Regarding "NH4 NO3", increasing fertilizer rates from 50 to 75 and 100 kg N/fed, showed that P % and K % in sudangrass plants were significantly increased in the first and the second cuttings in both seasons.

But, increasing its rate from 100 to 125 kgN/fed caused remarkable decrease in P % in sudangrass plants for the first and the second cuttings combined over both seasons. While, in the case of using "(NH4)2 SO4",data show that P % and K % in the plants were significantly increased as its rate increased from 50 to 75, 100 and 125 kg N/fed in the first and the second cuttings over both seasons. These results are in line with those obtained by Anfinruda et al.(2013) who reported that there was a significant response in P% with increasing nitrogen rates.

4- Nitrite (NO2%) and nitrate (NO3%)

Averages of nitrite (NO2) and nitrate (NO3) in sudangrass plants as affected by various nitrogen fertilizer sources and rates resulted from the first and the second cuttings as combined over both seasons are shown in Table 5.

NO2 and NO3 in sudangrass plants produced from the first cutting were significantly higher than those in the plants resulted from the second cutting . The obtained data showed also that NO2 in sudangrass plants fertilized by "NH4 NO3" was higher than those fertilized by "(NH4)2 SO4" in the first and the second cuttings over both seasons.

Mineral fertilizing sudangrass plants at 50 kg N/fed as ammonium sulphate (in the first cutting) and as ammonium nitrate (in the second cutting) resulted in the lowest values of NO3 in the plants. By increasing nitrogen fertilizer rates from 50 to 75, 100 and 125 kg N/fed, NO2 and NO3in sudangrass plants were significantly increased in the first and the second cuttings as combined over both seasons. The increments in NO3 in sudangrass plants as a result of increasing nitrogen fertilizer rates up to 125 kg N/fed may be attributed to the same reasons that mentioned in nitrogen percent and similar discussion could be cited. In this manner, Ćupina et al. (2011) reported that nitrogen rates significantly affect NO3-N content.In both cuttings of sudangrass, maximum value of NO3 in the plants was produced from fertilizing with 125 kg N/fed as ammonium nitrate (in the first cutting) and as ammonium sulphate (in the second cutting).

According to Ensley and Barnhart (2012). It can be recommended that mineral fertilization of sudangrass with 75- 100 kgN/fed in order to get suitable feed quality respecting NO3-accumulation (2000-4000 ppm) and should be restricted to 25% of the total ration DM.

TABLE 5. Nitrite (NO_2 ppm) and nitrate (NO_3 ppm) contents as affected by sources and rates of nitrogen fertilizer produced from first and second cuttings as combined over both seasons.

Cuttings	50 kg N/fed	75 kg N/fed	100 kg N/fed	125 kg N/fed
Nitrite (NO_2 ppm)				
Ammonium nitrate "NH_4 NO_3"				
First cutting	35.43^a ± 0.71	42.40^a ± 0.75	54.33^a ± 1.31	61.90^a ± 0.26
Second cutting	31.33^{bc} ± 0.87	37.00^c ± 0.80	44.80^c ± 1.11	51.00^c ± 0.62
Ammonium sulphate "$(NH_4)_2$ SO_4"				
First cutting	32.60^b ± 1.25	39.73^b ± 0.40	50.00^b ± 0.26	54.90^b ± 0.62
Second cutting	29.60^c ± 0.66	35.17^d ± 0.35	41.37^d ± 1.31	45.93^d ± 1.12
LSD at 5%	1.699	1.152	2.045	1.369
Nitrate (NO_3ppm)				
Ammonium nitrate "NH_4 NO_3"				
First cutting	2760.3^a ± 36.2	3574.0^a ± 38.9	4837.7^a ± 40.4	5830.0^a ± 99.7
Second cutting	2059.0^d ± 20.0	3029.7^d ± 32.1	3213.0^d ± 7.5	3430.7^c ± 11.6
Ammonium sulphate "$(NH_4)_2$ SO_4"				
First cutting	2418.0^b ± 5.5	3482.0^b ± 7.5	4570.0^b ± 21.0	5584.0^b ± 31.4
Second cutting	2176.0^c ± 31.5	3218.0^c ± 33.5	3349.0^c ± 17.4	3486.3^c ± 16.0
LSD at 5%	49.31	57.54	46.49	100.18

- Each value in the table was obtained by calculating the average of the three replicates ±S.D.
- The superscript letters indicated statistically significant differences, with P <0.05.

NO_3-N(ppm) *	Response
<1000	Safe to feed: Use caution when feeding pregnant or young animals, and prevent over-consumption.
1000-2000	Generally safe when fed balanced rations. Best to limit to half of the total dry ration for pregnant animals and also be sure water is low in nitrate.
2000-4000	Feeds in this range should be restricted to 25% of the total ration DM.
4000-6000	Moderately safe for most situations, limit use for stressed animals to 50% of the total ration.
6000-9000	Potentially toxic to cattle depending on the situation; should not be the only source of feed.
>9000	Danger, do not feed: Potential for toxicity high.

* Ensley and Barnhart,(2012).

References

A.O.A.C. (2012) *Official Methods of Analysis of AOAC International*.19th ed. Gaithersburg, MD, USA, Association of Analytical Communities.

Afzal, M. , Ahmad , A. and Ahmad, AU.H. (2012)Effect of nitrogen on growth and yield of sorghum forage (*Sorghum bicolor* (L.) Moenchcv.) under three cuttings system. *CercetăriAgronomiceîn Moldova,* XLV **4,** 57-64.

Ahmed, Amal G., Zaki, Nabila M. and Hassanein, M.S. (2007) Response of grain sorghum to different nitrogen sources. *Res. J. of Agric. and Biol. Sci.,* **3**(6) ,1002-1008.

Al-Suhaibani, N.A. (2006) Effect of irrigation intervals and nitrogen fertilizer rates on fresh forage yield of sudangrass [Sorghum sudanense (Piper) Stapf.].*Res. Bull.*, Food Sci. & Agric. Res. Center, King Saud Univ., **142,** 1-14.

Anfinruda, R. ,Cihacekb , L., Johnsona, B.L., Jic ,Y. and Bertia, M.T. (2013) Sorghum and kenaf biomass yield and quality response to nitrogen fertilization in the Northern Great Plains of the USA. *Industrial Crops and Products,* **50,**159-165.

Beyaert, R.P. and Roy, R.C. (2005) Influence of nitrogen fertilization on multi-cut forage sorghum-sudangrass yield and nitrogen use. *Agron. J.,* **97,** 1493-1501.

Ćupina, B., Manojlović M., Krstić1, D., Ĉabilovski , R., Mikić, A., Ignjatović-Ćupina, A. and Erić, P. (2011) Effect of winter cover crops on the dynamics of soil mineral nitrogen and yield and quality of Sudan grass [*Sorghum bicolor* (L.) Moench]. *Australian J. of Crop Sci.,* **5**(7),839-845.

El-Nahrawy, M.A. (2011) Country pasture/forage resource profiles, Egypt. FAO, Publishing Policy and Support Branch, Office of Knowledge Exchange, Research and Extension, FAO, Vialedelle Terme di Caracalla, 00153 Rome, Italy, p. 27.

Ensley, S. and Barnhart, S.K. (2012) Nitrate toxicity. Iowa State Univ., Iowa Beef Center, Extension and Outreach, Ames, Iowa, File: Animal Science 11.

Fageria, N.K. and Baligar ,V.C. (2005) Enhancing nitrogen use eficiency in crop plant. *Adv. Agron.,* **88,**97–185.

Gee,G.W. and Bauder, J.W. (1986)Particle-size analysis in :Klute, A. (Ed.), *Methods of Soil Analysis,* Part 1: *Physical and Mineralogical: Methods.* Soil Sci Soc. Amer., Madison, WI, pp.383 – 411.

Gomez, K.N. and Gomez, A.A. (1984) *Statistical procedures for Agricultural Research.* John Wiley and Sons, New York, 2nd ed., 68 p.

Klute, A. (1986) *Methods of Soil Analysis.* Part I. *Physical and Mineralogical Methods.* Soil Sci Soc.. Madison, Wisconsin, U.S.A.

Lawlor, D.W. (2002)Carbon and nitrogen assimilationin relation to yield: mechanisms are the key to understanding production systems. *J. Exp. Botany,* **53,** 773–787.

Mahmoud, Safaa, A., Abd-Elfattah, M.S , Khaled, S.M and Siam, Hanan.S. (2011) Effect of cobalt, and nitrogen forms on nitrate accumulation in Jew's mallow plant as affected by a nitrification inhibitor (N-serve). *J. of American Sci.,* **7**(4),336-348.

O'Dell, J.W. (1993) Determination of total kjeldahl nitrogen by semi-automated colorimetry,Method 351.2. Environmental Monitoring Systems Laboratory Office of Research and Development U.S. Environmental Protection Agency Cincinnati, Ohio 45268, Revision 2.0.

Page, A. L. ,Miller, R. H. and Keeney, D.R. (1982) *Methods of Soil Analysis,* Part 2, 2, nd., Agronomy monograph No 9. ASA, SSSA Madison. 1159P.

Pierzynski, G.M. (2000) Methods of phosphorus analysis for soils, sediments, residuals, and waters. *Southern Cooperative Series Bulletin* No. 396, June, 2000.

Rahman, M.M., Yamamoto, M., Niimi, M. and Kawamura ,O. (2008) Effect of nitrogen fertilization on oxalate content in rhodesgrass, guineagrass and sudangrass. *Asian-Aust. J. Anim. Sci.,* **21**(2), 214-219.

Roozeboom, K. (2011) Nitrate Toxicity. Kansas State University Agricultural Experiment Station and Cooperative Extension Service.

Sparks, D. L. (1996) Soil Science Society of America; and American Society of Agronomy.*Methods of Soil Analysis.*Part 3, *Chemical Methods.* Soil Science Society of America book series, No.5,Madison.

(*Received* 16 / 9 /2015;
(*accepted*: 15/ 5 / 2016)

تأثير مصادر ومعدلات الأسمدة النيتروجينية علي كلا من محصول العلف وتراكم النترات في حشيشة السودان

سيد طه أبو زيد* ، أمل لطفى عبداللطيف* و سيد الشافعي**

*قسم الاراضى- كلية الزراعة- جامعة القاهرة و **المركز الاقليمي للأغذية والأعلاف – مركز البحوث الزراعية- الجيزة – مصر.

أجريت تجربة حقلية في محطة تجارب مركز البحوث الزراعية بالجيزة خلال موسم الصيف لعامي 2012 و 2013 لدراسة تأثير المصادر والمعدلات المختلفة من التسميد النيتروجيني علي محصول العلف الأخضر والجاف من نبات حشيشة السودان والتركيب الكيميائي وتراكم النترات والنيتريت. وقد أجريت هذه التجربة تحت تصميم القطع المنشقة بثلاث مكررات ، وتم وضع القطع الرئيسية لمصادر الأسمدة النيتوجينية (نترات الأمونيوم 33.5% وكبريتات الأمونيوم 20.6%) في حين تم تعيين القطع المنشقة لمعدلات التسميد 125،100،75،50 كجم نيتروجين للفدان.

وأوضحت النتائج ان كلا من المحصول الطازج و الجاف مقدرا بالطن/ فدان وكذلك المحتوي العنصري لكلا من النيتروجين والفوسفور والبوتاسيوم و البروتين الخام انخفض انخفاضا معنويا في الحشة الثانية مقارنة بالحشة الاولي في كلا الموسمين . كما دلت النتائج علي أن سلفات الأمونيوم كانت أفضل تأثيرا مقارنة بنترات الأمونيوم وذلك في كلتا الحشتين وكلا الموسمين.كما أن عائد المحصول الأخضر و الجاف من نبات حشيشة السودان زاد بشكل ملحوظ مع ارتفاع معدلات التسميد من50 الي 100 كجم نيتروجين للفدان كما انه انخفض انخفاضا معنويا بزيادة معدل النيتروجين من 100 الي 125 كجم نيتروجين للفدان وذلك في كلا الموسمين . وأوضحت هذه الدراسة أن تسميد نبات حشيشة السودان بمعدل 100-75 كجم نيتروجين للفدان يعطي عائد من العلف مناسب وفي نفس الوقت يحد من تراكم النترات في النبات.

الكلمات الدالة : مصادر النيتروجين –تراكم النترات – حشيشة السودان.