Sudan University of Science and Technology

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Effect of nitrogen fertilizers on growth and yield of three forage genotypes

تأثير السماد النتروجيني في نمو وإنتاجية ثلاثة أصناف من الأعلاف

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الآية الكريمة

قال تعالى:

صِدْقٍ وَ {أَخْرِجْنِي مُخْرَجَ صِدْقٍ وَ اجْعَل لِّي مِن لَّدُنكَ
سُلْطَاناً نَّصِيراً {80}

صدق الله العظيم

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Dedication

To my lovely mother & My Dear Father,

To my brother's specially (Bokhari) and my sisters,

To my small Family, my husband (Mojahed) and my kids (Bokhari & Mohammed)

To my Teachers,

To my Friends.

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ABSTRACT

An experiment was conducted on the demonstration farm of the College of Agricultural Studies Sudan University of Science and technology Shambat during season 2013. The objective of the experiment was to study the effect of different does of nitrogen fertilizer as 0 kg/ha(0N), 86 kg/ha (1N), 129 kg/ha(2N) and 172 kg/ha(3N**)** on three cultivars forage cultivars sorghum (Abu sabein, Sudan grass, and maize).The design used was the Randomized Complete Block Design (a factorial) with three replications. The parameter studied were plant height, number of leaves, stem diameter, leaf area, dry weight and fresh weight.

The result revealed that the cultivars showed different response to the different levels of nitrogen fertilizer . The nitrogen fertilizer significantly affected the number of leaves , leaf area, fresh and dry weight. The nitrogen dose 129 kg/ha (2N) gave best results compared to the other doses. Abu sabein showed the highest response on fresh weight, dry weight and leaf area ,where as Sudan grass showed good response from stem diameter and plant height. It can be concluded that Abu sabein showed higher response to the different doses of nitrogen fertilizer ,Nitrogen at dose 129 kg/ha (N) was the best dose for the three cultivars of grass forage.

مستخلص الأطروحة

أجريت هذه التجربة بمزرعة كلية الدراسات الزراعية جامعة السودان للعلوم والتكنولوجيا (شمبات) في الموسم للعام 2013 وتهدف هذه التجربة لدراسة تاثير جرعات مختلفة من السماد النتروجيني (اليوريا) وهي 0كجم/هكتار,86كجم/هكتار, 129كجم/هكتار و172كجم/هكتار علي ثلاثة أصناف من العلف (ابوسبعين, الذرة الشامية وحشيشة السودان). والتصميم الذي استخدم في هذه التجربة التصميم العاملي تصميم القطاعات العشوائية الكاملة بثلاثة مكررات والصفات التي درست (طول النبات ,عدد الأوراق, سمك الساق, مساحة الورقة,الوزن الرطب والوزن الجاف) .

أظهرت النتائج استجابات مختلفة للأصناف مع جرعات النتروجين المختلفة وقد كان السماد النتروجيني ذو اثر معنوي عالي (عدد الأوراق, مساحة الورقة, الوزن الرطب والوزن الجاف) .جرعة النتروجين 129كجم/هكتار(2N) أعطت أفضل نتيجة مقارنة بالجرعات الأخرى, ابوسبعين اظهر اعلي استجابة في الوزن الرطب ,الوزن الجاف ومساحة الورقة بينما أظهرت حشيشة السودان استجابة جيدة في كل من سمك الساق وطول النبات.

يمكن أن استخلص أن أبو سبعين اظهر اعلي استجابة في مختلف جرعات السماد النتروجيني والجرعة 129كجم/هكتار(2N) كانت أفضل جرعة لأصناف العلف الثلاثة .

CHAPTER ONE

INTRODUCTION

The irrigated forage in Sudan occupy about 121000 hectares (Khair 2006). The annual dry matter production of that area is estimated at 971000 tons. Over 90% of the above area is in Khartoum state. Considering the number of the settled livestock in Khartoum (about 1.1 million heads)(Ministry of Agriculture and Animal health Khartoum State,2006),the daily share of each cow is only 2 kg of dry matter. This situation is further aggravated by the relatively low quality of those forages.

Abu sabein (*Sorghum bicolor*) is annual plant which belongs to the family poaceae it is considered as the principal cereal forage grown in Sudan (Khair, 1999 and Abusuwar,2005),its grown in summer season. The implication of the Arabic name, Abu Sabin is that it completely mature in about seventy days (Bacon,1948)it grows on a wide range of soil types and is moderately tolerant to salinity and is grown on salt affected soils(Khair and Jarrel, 1987, Mustafa and Abdelmagid, 1982, Abusuwar,1994), is cultivated on a large scale in Sudan specially in Khartoum and River Nile states about 70000 hectors .Abu Sabein is a leafy forage sorghum and the leaves constitute about 20 per cent of the total dry weight and has low regrowth capacity hence it is suitable for single cut system (Khair,1999) it contains toxics material hydrocyanic acid (HCN) in early growth stages .

Sudan grass (*Sorghum Sudanese*) locally named As Grawia in the Sudan, it is an annual grass, belong to the family poaceae with leafier and thinner stems (Khair, 1999). It has good green fodder and hay and performs well in salt-affected soils(Bacon,1948).sudangrass is characterized by high nutritive value compared to Abu Sabin as it has greater crude protein probably due to its greater

number of leaves and slender stems (Khair,1999).A variety was selected from the local landrace and was released as anew variety under the name sudan-1by the National Variety Released Committee

Maize(*Zea mays*) is an annual plant which belongs to the family Graminceae naturally cross-pollinated a domesticated from a wild grass. First cultivated over 5,000 years ago in tropical Mexico that produces an adaptable and productive grain. It has been inextricably linked with the rise of the South American civilizations and following their conquest by the Spanish, Maize is grown largely for forage. In Sudan it has become an important crop being the most important forage after grass with around 100,000 hectares grown annually, mainly in the south of the country. Nearly all is ensiled to produce a quality, high-energy silage that complements grass silage for the winter feeding of livestock. forage maize is not completely without its difficulties being low in both protein and minerals and as a crop sometimes difficult to fit into the Cropping rotation. Maize is grown on approximately140 million hectares worldwide. In Sudan Maize utilization as human food for making Bread was limited the total area of maize was 160 hectors in 1999 and the total production was 406kg/ha (FAO,1999).however, the objectives of this study were

1. Evaluate the effect of different doses of nitrogen fertilizers on growth and yield of some forage crops (Abu Sabein, Sudan grass and Maize).
2. Indentify the optimum dose of nitrogen fertilizers for different crops.

CHAPTER TWO

LITRITURE REVIEW

2-1 Effect of nitrogen on sorghum forage cultivar:

Nitrogen is the most important and most limiting nutrient for plant growth in soils of the Sudan Nitrogen application increases the crude protein content and metabolizable energy, besides improving succulence and palatability of fodder crops. (Patel *et al*.,2007) reported that application of 120 kg N/ ha gave significantly higher green and dry fodder yields of Napier grass, while lower nitrogen rates of 40 and 80 kg N/ ha produced lower yields. The author stated that the beneficial effect of nitrogen on green fodder yield may be attributed to the production of more growth attributes. El Awad (2004) investigated the effect of nitrogen on growth attributes and forage yield of teffrass (Eragrostis teff.Zucc.) and he reported that 86 kg N/ha gave higher number of plants per unit area. He also reported that 0N and 43 kg N/ha resulted in shorter plants whereas 86 N/kg gave the tallest plants. Moreover, 86 kg N/ha treatment scored the highest fresh and dry forage yield at harvest. Adam (2004) reported that there were no significant differences observed among nitrogen levels on shoot density, plant height, number of tillers per plant and fresh and dry forage yields of teff grass. However, there was a trend of increasing these traits with increasing nitrogen levels from 0N up to 2 N/ha. Gasim (2001) studied the effect of nitrogen on growth and forage yield of maize and reported that plant height and leaf to stem ratio were significantly affected by nitrogen fertilization, they increased with increasing nitrogen levels. On the other hand, nitrogen had no significant effect on plant population and fresh and dry forage yields. Sheoran and Ran (2006) evaluated the effect of varying levels of nitrogen viz.,0,20,40,60,80 and 100 kg N/ ha on yield of forage sorghum var.

HC171.They reported that nitrogen fertilization in sorghum had a significant effect on forage yield as well as yield attributes. Increasing levels of nitrogen from 0 to 60 kg N ha brought a significant improvement in green and dry matter yields of sorghum over lower doses. Also, plant height and number of tillers were significantly increased with increasing nitrogen level up to 60 kg N ha .The authors concluded that, the improvement in herbage yield with increasing levels of nitrogen was due to the integrated effect of increasing plant height and number of tillers per running meter row length. Response of different forage sorghum cultivar to four levels of nitrogen viz.,0,40,80, and 120 kg N ha was investigated by Singh and Summeriya (2005), whose results showed that plant height, green and dry fodder were significantly influenced by the application of nitrogen. Amongst nitrogen levels, 80 kg N ha recorded significantly higher plant height, green and dry fodder yields over control and 40 kg N ha and they were at par with the highest level i.e. 120 kg N ha . Agarwal *et al*. (2005) tested the effect of four nitrogen levels (0,50,100, and 150 kg N ha) on growth and fodder yield of fodder sorghum varieties, and reported that plant height, stem thickness and number of functional leaves were significantly affected by nitrogen application. They also showed increasing trend with increasing levels of nitrogen from 0 to 150 kg N ha and where 150 kg N ha produced significantly taller as well as thicker plants.

They also, reported that green fodder and dry matter yields increased with increasing nitrogen levels, and application of 150 kg N ha recorded maximum yields of green fodder and dry matter over preceding levels. Leaf to stem ratio also increased with increasing levels of nitrogen up to 150 kg N ha .The authors concluded that increased fodder yield with increasing levels of nitrogen was due to its beneficial effect on plant height, stem thickness and number of green leaves. Chotiya and Singh (2005) investigated the effect of four levels of nitrogen (i.e. control, 40,80 and 120 kg N/ ha) on yield and yield attributes of

sorghum fodder. Their investigation revealed that application of nitrogen significantly increased plant height, dry matter accumulation, stem girth, leaves per plant and green and dry fodder yields at harvest, and 80 kg N /ha proved significantly superior over 40 kg N/ha.Furthermore, 120 kg N/ha did not show any significant variation over other treatments. The authors stated that increasing of nitrogen might have promoted morphological development by virtue of active cell division and elongation which ultimately led to higher yield of fodder sorghum. Verma *et al.* (2005) studied the response of sorghum cultivar plant Chari-5 to five nitrogen levels (0,40,80,120 and 160 kg N/ha).They found that Stover yield increased significantly with increase in nitrogen levels up to 120 kg N/ha. However, further increase in nitrogen application from 120 to 160 kg N/ha had no significant effect. On the other hand, plant height and number of plant per unit area also increased with increase in nitrogen application up to 120 kg N/ha ,and this might explain the higher Stover yield at the aforementioned nitrogen dose . Iptas and Brohi (2003) reported that replanting Application of nitrogen had no significant effect on dry matter yield in The first cut and concluded that the nitrogen rate of 120 kg N/ha at sowing was found to be sufficient for forage production of pioneer 988.Rathod *et al* (2002) reported that the application of 80 kg N/ha was found to be the optimum dose to increase green as well as dry fodder yield of forage sorghum variety GJ-37. Mirlohi et al. {2000) determined the effect of two nitrogen levels viz., 300 and 500 kg urea ha on yield and silage value of some forage sorghum hybrids, and found that when the nitrogen rate increased, forage yields and percent of protein in forage and silage increased. On the other hand, nitrogen had no significant effect on other growth traits. In afield experiment, forage sorghum cultivars Rajasthan Chari-1, Rajasthan Chari-2 and Su-1 were given 0, 40.80 and 120 kg N/ha (Dadheech *et al.*, 2000). The results showed that green and dry fodder yields increased with increasing nitrogen rate up to 80 kg N/ha . Gadhethariya *et al.* (2000) studied the effect of four nitrogen rates viz.,0,40,80 and 120 kg N/ha on the growth and

yield of multicut forage sorghum cultivar GFSH-1 and reported that increased response was observed up to the highest level of nitrogen.Moreover every increment in nitrogen rate produced significantly higher forage yield over the preceding nitrogen rate. Escalada and Plucknett (1977) studied the effect of four nitrogen rates,0,100,200 annd 250 kg N/ha applied as split dose on the performance of sorghum ratoon under field conditions and reported that in plant crop and second ratoon more tillers, larger leaf area, larger stalks and taller plants, and therefore, increased stover yield were produced with higher nitrogen treatments up to 250 kg N/ha .They stated that more tillers Per plant were produced in plots with no applied nitrogen in the first ratoon. Eltelib (2004) studied the effect of time of nitrogen application on growth of some forage sorghum cultivars, and reported that the effect of time of nitrogen application on fresh and dry forage yields and plant population was not significant at at first and second harvests, but nitrogen significantly increased dry matter yield and plant height over control.Abusuwar and Mohamed (1997) evaluated the production and quality of some graminaceous forage viz., Sudan grass, Pioneer 988 and Napier-grass in response to the application of nitrogen fertilizer at sowing, both for the first ratoon crops. Nitrogen fertilizer at rate of 186 kg urea/ha significantly increased plant height, number of green leaves and plant density of first crop of these graminaceous forages. They also reported that nitrogen fertilizers significantly increased forage resh and dry yields of the graminaceous forages for the first and ratoon crops. On the other hand, nitrogen application did not affect growth attributes of these forages for the second crop, except Napier grass.Hago and Mahmoud (1996) studied the effect of five nitrogen levels 0,48,72,96 and 120 kg N/ha on yield of hybrid forage sorghum for seed and ratoon crop, nitrogen was applied at sowing and after the first and second cuts. Their results revealed that nitrogen had a significant effect on forage yield for seed and ratoon crops, but the effect was greatest on the ratoon crop. Forage yield tended to increase with nitrogen application up to 120 kg N

ha .The authors concluded that the greater response to applied nitrogen in the ratoon crops could be attributed to depletion of soil nitrogen with successive growth and cutting cycles .Abusuwar (1994) reported that nitrogen application did not cause any significant effect on shoot number of Abu Sabin in first and ratoon crops, however, the control (0N) outnumbered the nitrogen treatment. He also reported that nitrogen significantly increased fresh and dry matter yields in the first and ratoon crops. Bebawi (1987) studied the effect of five nitrogen levels 0,18,,36, and 72 kg N/ha on tiller density and green chop of pioneer and Abu Sabin. Nitrogen fertilizer was broadcasted at sowing except the 36 and 72 kg N/ha. His results showed that nitrogen did not significantly influence tiller density in all harvests. Saeed (1988) reported that nitrogen fertilizer applied to Abu Sabin resulted in significantly taller plants at first harvest, the taller plant grew towards maturity under higher nitrogen levels of 120,80,40, kg N/ha respectively . He also reported that nitrogen fertilizer , on the other hand , significantly affected dry matter production of Abu Sabin . The highest nitrogen level of 120 kg N/ha showed the maximum dry matter production followed by 80 and 40 kg N/ha , whereas the control resulted in the least dry matter production. Mustafa and Abdelmagid (1982) studied the effect of four levels of urea-nitrogen viz.,0,92, 184 and 276 kg/ha at sowing and half dose applied after first cut on growth and yield of Abu Sabien , and reported that plant height ,leaf area index and dry matter yield of first cut increased significantly and linearly with increase in nitrogen level. Their data also showed that plant height, leaf area index and dry matter yield of the second cut increased significantly and linearly with increase in nitrogen level. However, the second cut yields were considerably lower than those of the first cut as plants were shorter with smaller leaves.

2-2 Effect of N fertilizer on maize:

Maize has high demand for nitrogen and other nutrients, where nitrogen is often the limiting nutrient in maize production. reported that the amount of fertilizer to be applied depends mainly on two factors; the projected maize yield that appears attainable in the locality and the fertility level of the soil as determined by soil tests, Anonymous (2000).

In this connection, John and Martin (1970) reported that corn crop requires an abundance of readily available plant nutrients and soil reaction between pH 5.5 and pH 8.0 for the best production. On poor soils, vegetative growth may use most of the available nutrients at the expense of seed production later in the season.

Provision for an adequate supply of nitrogen throughout the growing season is necessary and is one of the important functions of soil management Kurtz and Smith (1967).

In maize, nitrogen is taken up at slow rate during early development stages, but the rate of uptake picks up rapidly at tasseling stage to reach about 4 kg/ha /day. The rate of uptake, however, decreases after seed formation FAO (1980).

Grangwar and Karla (1982) found that the level of nitrogen significantly influenced maize yield and yield attributes. He added that application of 80 and 120kg N/ha increased yield significantly. Similar results were reported by Pathak *et al.*, (1970).

Also Sharma *et al.* (1979) tested nitrogen at the rates of 60, 120 and 180kg N/ha where they reported yield increases with increasing dose of nitrogen up to the level of 180kg N/ha. With higher doses of nitrogen there were fewer barren plants and more cobs/ha, and the cob size and yield per cob increased,Ram and

Thahur(1996) indicated that soil nitrogen is one of the principle agents influencing the yield of maize crop.

Also Radma (2004) reported that the application of 41, 82 and 123 kg N/ha increased seed yield over the control by 110, 168 and 220%, respectively.

Reves *et al*. (1993) found that the dry matter production was greater when N was applied at planting compared to split application or application later than 3 weeks after planting. Consequently, they recommended the application of the entire N fertilizer at planting.

CHAPTER THREE

MATERIAL AND METHODS

3-1 The Site of Experiment

The experiment was carried in the season of 2012/2013 at the demonstration farm of the College of Agricultural Studies, Sudan University of Science and Technology at Shambat is located 23 °35-, longitude 15 °31-, and altitude 288 m above sea level, within semi-desert region Adam, (2002) .The soil of the site is described by Abdel haffez (2001) as loam clay. It is characterized by a deep cracking, moderately alkaline clays, and low permeability, low nitrogen content and pH ranged between (7.5-8) and high exchangeable sodium percentage (ESP), in subsoil.

3-2 Source of seeds:

The seeds used in the experiment were obtained from the College of Agricultural Studies, Sudan University of Science and Technology Shambat .

3-3 Land preparation:

The land was prepared by disc plough , disc harrowed leveled and ridged up north-south ,The spacing between ridges was 70cm , 10cm between holes and 3m consisting of four ridges of length 250 cm. ×the size of the plot was 3 Fertilizer (urea) was applied two week after the sowing date. Crops were sown on 29/4/2013, Irrigation was applied immediately after sowing and sub-sequent irrigations were applied according to the crop need.

The first hand weeding was frequently done to get rid of weeds including nageala (Cynodon dactylon), saeda (Cyperus rotundus) and second hand weeding after two weeks from the first one.

3-4 Treatments:

The treatments used in the experiment consists of four doses of nitrogen fertilizer (urea) 0N (control), 1N (86kg N /ha) 2N (129kg N/ha), and 3N (172kg N/ha).

3-5 Parameters studied:

3-5-1Growth attributes:

five plants were selected randomly and all parameters (plant height, number of leaves, stem diameter, leaf area, fresh weight and dry weight) were taken from the samples of five plants.

3-5-1-1 Plant height (cm):

Measured from a point above the soil surface to the top of the plant. Five plant were tagged and reading starting after 100% flowering.

3-5-1-2 Number of leaves:

It was determined by counting all the leaves of the five plants and obtaining mean number of leaves/plant for each treatment.

3-5-1-3 Stem diameter(cm):

It was determined at maturity on the stalk at 10cm above the ground level.

3-5-1-4 Leaf area $(cm)^2$:

It was calculated according to the following formula as described by (sticker,1961) method :

Leaf area (L A)=Maximum length ×Maximum width×0.75

3-6 Yield parameter :

3-6-1 Fresh Wight:

The five plants which were selected were cut at 100% flowering and weighed.

3-6-2 Dry Weight:

Samples were oven dried at 180 c for 48 hours and weighed.

3-6-3 Analysis of data :

The data were analyzed by computer , using the M stat. C program .

The means were compared using the Least Significant Difference (LSD) .

Table 3. 1: The form of ANOVA with a Randomized Complete Block Design for four treatments between three varieties from forage.

S.O.V	**D.F**	**S.S**	**M.S**	**F.value**	**Prob.**
Replication	r-1	M_3			
Treatments	t-1				
Variety	v-1				
Error	(r-1)(t-1)(v-1)				
Total	trv-1				

CHAPTER FOUR

RESULTS

4.1 Growth characters

4.1.1 Plant height (cm)

The analysis of variance revealed that, there were non significant differences among vanities as well as fertilizers treatments for this character. The variation due to the interaction between fertilizers*varieties was non significant difference (Table 4.1).

For Abu Sabein, the highest values of plant height (135.3cm) was recorded under nitrogen fertilizer (1N) where as, the lowest value (116.9cm) of plant height was detected under the nitrogen level (2N) (Table 4.2).

For maize, the highest value of plant height (135.1cm) was recorded under nitrogen fertilizer (2N) where as the lowest value (112.1cm) of plant height was detected under the nitrogen level (3N) (Table 4.2).

For Sudan grass, the highest values of plant height (135.2cm) was recorded under dose (0N) where as the lowest value (102.1cm) of plant height was detected under the nitrogen level (3N) (Table 4.2).

Table 4.1: Analysis of Variance (ANOVA) For Plant height of different Forage Crops evaluated under different levels of nitrogen fertilizer.

Sources of variation	**d.f**	**SS**	**EMS**	**F ratio**	**Sig**
Replications	2	774.845	387.422	1.0196	
Fertilizers	3	1423.714	474.571	1.2490	Ns
Cultivars	2	100.132	50.066	0.1318	Ns
F× C	6	2408.061	401.344	1.0563	Ns
Error	22	8359.135	379.961		

Table 4.2: Effect of nitrogen fertilizer levels on plant height of three forage cultivars:

Nitrogen dose	Plant High		
	Forage crops		
	Abo 70	Sudan grass	Maize
0 N	126.5	135.2	125.8
1 N	135.3	138.2	124.8
2 N	116.9	122.3	135.1
3 N	133.3	102.1	112.3
LSD	6.5		
C.V	15.3		

4.1.2 Number of leaves

The analysis of variance revealed that, there were significant differences among varieties as well as nitrogen levels treatments for this character. The variation due to the interaction between fertilizers*varieties was non significant difference (Table 4-3).

For Abu 70, the highest value of number of leaves (12) was recorded under nitrogen dose (1N) where as the lowest value (8.7) of plant height was detected under the nitrogen level (3N) (Table 4-4)

For maize, the highest value of number of leaves (12.7) was recorded under nitrogen fertilizer(2N) where as, the lowest value(10.3) of number of leaves was detected under the control(0N) (Table 4-4)

For Sudan grass, the highest value of number of leaves (13.3) was recorded under the control (0N) where as the lowest value(10) of number of leaves was detected under the nitrogen level(1N) (Table 4-4)

Table 4. 3 :Analysis Of Variance (ANOVA) For Number of leaves of different Forage Crops evaluated under different levels of nitrogen fertilizer.

Sources of variation	d.f	SS	EMS	F ratio	Sig
Replications	2	24.667	12.333	2.6601	
Nitrogen levels	3	5.639	1.880	0.4054	*
Cultivars	2	22.167	11.083	2.3905	Ns
F× C	6	42.278	7.046	1.5198	Ns
Error	22	102.000	4.636		

Table 4. 4: The means of number of leaves under effect of nitrogen of three forage cultivars

Nitrogen dose	Number of leaves/ plant		
	Forage crops		
	Abo 70	Sudan grass	Maize
0 N	11.3	13.3	10.3
1 N	12	10	11
2 N	9	12.6	12.7
3 N	8.7	12.7	10.6
LSD	1.8		
C.V	19.8		

4.1.3 Stem diameter:

The analysis of variance revealed that, there were non significant difference among vanities as well as fertilizers treatments for this characters. The variation due to the interaction between fertilizers*varieties was non significant difference (Table 4-5).

For Abu 70,the highest value of stem diameter (4.2) was recorded under nitrogen fertilizer(2N) where as the lowest value(3.3) of stem diameter was detected under the nitrogen level(1N) (Table 4-6)

For maize, the highest value of stem diameter (5.7) was recorded under nitrogen level (2N) where as the lowest value (3.9) of stem diameter was detected under the nitrogen level(1Nand 3N) (Table 4-6)

For Sudan grass, the highest value of stem diameter (4.6) was recorded under nitrogen dose (0N) where as the lowest value(3.8) of stem diameter was detected under the nitrogen level(3N) (Table 4-6)

Table 4. 5: Analysis Of Variance (ANOVA) For Stem diameter of different Forage Crops evaluated under different levels of nitrogen fertilizer.

Sources of variation	d.f	SS	EMS	F ratio	Sig
Replications	2	5.535	2.768	1.0555	
Fertilizers	3	6.367	2.122	0.8095	Ns
Cultivars	2	4.657	2.329	0.8881	Ns
F× C	6	1.950	0.325	0.1240	Ns
Error	22	57.684	2.622		

Table 4. 6: The means of stem diameter under effect of nitrogen of three forge cultivars

Nitrogen dose	Stem diameter		
	Forage crops		
	Abo 70	Sudan grass	Maize
0 N	3.7	4.1	4.6
1 N	3.3	4.3	3.9
2 N	4.2	4.6	5.7
3 N	3.4	3.8	3.9
LSD	1.3		
C.V	38.1		

4.1.4 Leaf area:

The analysis of variance revealed that, there were high significant difference among vanities as well as Nitrogen levels for this characters. The variation due to the interaction between fertilizers*varieties was high significant difference (Table 4-7).

For Abu 70,the highest values of leaf area (306.6) was recorded under nitrogen fertilizer(N2) where as the lowest value (122.3) of leaf area was detected under the nitrogen level(0N). (Table 4-8)

For maize, the highest values of leaf area (290.6) was recorded under nitrogen fertilizer(2N) where as the lowest value(119.3) of leaf area was detected under the nitrogen level(0N) . (Table 4-8)

For Sudan grass, the highest values of leaf area (153) was recorded under nitrogen fertilizer(2N) where as the lowest value(110.7) of leaf area was detected under the nitrogen level(0N) . (Table 4-8)

Table 4. 7: Analysis Of Variance (ANOVA) For Leaf area of different Forage Crops evaluated under different levels of nitrogen fertilizer.

Sources of variation	d.f	SS	EMS	F ratio	Sig
Replications	2	5988.667	2994.333	0.8789	
Fertilizers	3	88892.083	29630.694	8.6972	**
Cultivars	2	65859.500	32929.750	9.6656	**
F× C	6	22284.500	3714.083	1.0902	Ns
Error	22	74952.000	3406.909		

Table 4. 8: The means of leaf area under effect of nitrogen of three forge cultivars

Nitrogen dose	Leaf area		
	Forage crops		
	Abo 70	**Sudan grass**	**Maize**
0 N	122.3	110.7	119.3
1 N	238.6	128.3	184.3
2 N	306.6	153	290.6
3 N	280	148	236
LSD	49.4		
C.V	30.2		

4.1.5 Fresh weight:

The analysis of variance revealed that, there were high significant difference among vanities as well as fertilizers treatments for this characters. The variation due to the interaction between fertilizers*varieties was non significant difference (Table 4-9).

For Abu 70,the highest values of fresh weight (343) was recorded under nitrogen fertilizer(3N) where as the lowest value(132) of fresh weight was detected under the nitrogen level(0N) . (Table 4-10)

For maize, the highest values of fresh weight (234) was recorded under nitrogen fertilizer (2N) where as the lowest value(134) of fresh weight was detected under the nitrogen level(N0) . (Table 4-10)

For sudan grass, the highest values of fresh weight (216) was recorded under nitrogen fertilizer (2N) where as the lowest value(70) of fresh weight was detected under the nitrogen level(0N) . (Table 4-10)

Table 4. 9: Analysis of Variance (ANOVA) For Fresh weight of different Forage Crops evaluated under different levels of nitrogen fertilizer.

Sources of variation	d.f	SS	EMS	F ratio	Sig
Replications	2	1317.556	658.778	0.1662	
Nitrogen levels	3	110936.889	36978.963	9.3290	**
Cultivars	2	36026.889	18013.444	4.5444	*
F× C	6	24346.444	4057.741	1.0237	Ns
Error	22	87205.111	3963.869		

Table 4. 10: The means of fresh weight under effect of nitrogen of three forge cultivars

Nitrogen dose	Fresh weight		
	Forage crops		
	Abo 70	Sudan grass	Maize
0 N	132	70	134
1 N	196	134	179
2 N	271	216	234
3 N	343	194	205
LSD	49.4		
C.V	32.7		

4.1.6 Dry weight:

The analysis of variance revealed that, there were significant difference among vanities as well as fertilizers treatments for this characters. The variation due to the interaction between fertilizers*varieties was non significant difference (Table 4-11).

For Abu 70,the highest values of dry weight (144) was recorded under nitrogen fertilizer(3N) where as the lowest value(53.3) of dry weight was detected under the nitrogen level(0N) . (Table 4-12)

For maize, the highest values of dry weight (118) was recorded under nitrogen fertilizer (2N) where as the lowest value(60) of dry weight was detected under the nitrogen level(1N) . (Table 4-12)

For Sudan grass, the highest values of dry weight (99.3) was recorded under nitrogen fertilizer (3N) where as the lowest value(52.6) of dry weight was detected under the nitrogen level(0N) . (Table 4-12)

Table 4. 11: Analysis of variance (ANOVA) For Dry weight of different Forage Crops evaluated under different levels of nitrogen fertilizer.

Sources of variation	d.f	SS	EMS	F ratio	Sig
Replications	2	267.556	133.778	0.0587	
Fertilizers	3	29076.444	9692.148	4.2533	*
Cultivars	2	5144.222	2572.111	1.1287	Ns
F× C	6	4569.556	761.593	0.3342	Ns
Error	22	50132.444	2278.747		

Table 4. 12: The means of dry weight under effect of nitrogen of three forge cultivars

Nitrogen dose	Dry weight		
	Forage crops		
	Abo 70	Sudan grass	Maize
0 N	53.3	52.6	62.6
1 N	81.3	73.3	60
2 N	152.6	91.3	118
3 N	144	99.3	112.6
LSD	40.4		
C.V	52		

CHAPTER FIVE

DISCUSSION

In present study, there were no significant different between genotypes for all characters. This result was different with Grzesiak (2001) who observed that considerable genotypic variability among various maize genotypes for different traits. Ihsan *et al.* (2005) also reported significant genetic differences for morphological parameters for maize genotypes. This variability is a key to crop improvement (Welsh, 1981). The most important factor influencing selection gains is the amount of available genetic variation for general adaptation and traits necessary for improved production under specific constraints (Vasal *et al.*, 1997). In agreement with this report, others also indicated that selection cannot create variability but can act on heritable variability already existing in the population (Singh and Chaudhary, 1985, Hallauer and Miranda, 1988).

5.1 Effect of nitrogen rate and application method:

In this study, nitrogen non significantly enhanced agronomic traits of maize. Maximum leaves area/ plant-1, stem diameter and dry weight were found with the application of 129 kg N ha-1 through fertilization. Moreover, In this study, maize plant height, stem diameter, green fodder yield increased by increasing nitrogen levels and excessive application of nitrogen reduced leaf area, stalk thickness, leaf number of fodder crop (Reid *et al.*, 1992).

In this study, application of 129 kg N ha-1 was found to be optimum dose of Nitrogen as suitable dose for obtaining maximum maize fodder production. Further increase in N rates showed no significant increases in maize traits except plant height, number of leaves/plant and fresh weight, both increased as N rate changed from 129 to 172 kg ha-1.

In the present study, dry weight was positive significant correlation with fresh weight and leaf area but was negative and non signifanct different with plant heightandnumberofleaves/plant.

Similarly, Hallauer and Miranda (1988) summarized available estimates of genetic correlations in literature among 13 traits of maize of different populations under normal environmental conditions. Average genetic correlations with yield were larger for ear traits than for plant and ear height, days to flowering and tiller number. Plant height and ear height had the highest association (r = 0.81) and some of the ear traits showed moderate correlations. Unlike the results mentioned for groups of populations, days to flowering were negatively correlated (r = -0.52) with yield for Iowa Stiff Stalk Synthetic. Inbreeding that delays flowering has been considered as the main reason for this trend because it was estimated from two sets of unselected inbred progenies.

CHAPTER SIX

CONCLUSIONS

The present investigation was aimed at evaluating the performance of different genotypes of forages under different level of nitrogen fertilizers. The field experiments were executed during season 2012/013 at Shambat location. Factorial experiment with three replications was used. During the investigation, on different growth and yield were recorded. The results obtained can be summarized as follows:

1. The genotypes expressed different degree of relative response to Nitrogen levels with respect to leaf area, date to maturity and yield and its components.
2. Vegetative characters were more sensitive to nitrogen fertilizers than yield characters.
3. Most of the characters under study showed positive significant association with dry weight/plant. Therefore, these traits could be used as, selection criteria for improvement of yield in forages.

It can be concluded that, the evaluated forages genotypes showed high genetic variability for most of the characters. Also the forages genotypes exhibited different responses to nitrogen fertilizer. The characters which exhibited positive association with dry weight (kg/ha) could be used as selection criteria for forage genotypes improvement. The N2 (129N kg/ha) was most favorable dose of nitrogen fertilizers for cultivars.

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Appendices

APPENDIX 1.Chemical and physical properties of the field soil:

PH phaste	8.2
Ece (ms/m^2)	1.05
CEC(meq/100 g)	43.78
Sar	5.59
O.M(%)	0.46
Available P (ppm)	2.58
$CaCo_3$(%)	4.00
Ca (meq/L)	2.00
Mg (meq/L)	1.50
Na (meq/L)	7.39
K (meq/L)	0.0213
Co_3 (meq/L)	NA
HCO_3 (meq/L)	5.80
Cl (meq/L)	7.50
Fe (meq/L)	4.742
Zn (meq/L)	0.085
Cu (meq/L)	0.077
Co (meq/L)	0.305
Sand (%)	32.7
Silt (%)	24.5
Clay (%)	42.8

Source: Abdelhafeez (2001)

APPENDIX 2: Means Squares of nitrogen fertilizers, varieties and interaction between nitrogen and varieties for three forages varieties evaluated under three levels of nitrogen fertilizers

Characters	Fertilizers	Varieties	F*V
Plant height	474.57 ns	50.07 ns	401.34 ns
Number of leaves	1.88 *	11.08 ns	7.04 ns
Stem diameter	2.12 ns	2.32 ns	0.325 ns
Leaf area	29630.7 **	32929.7 **	3714.1 ns
Fresh weight	18013.4 **	4057.7 *	3963.8 ns
Dry weight	9692.1 *	2572.1 *	761.6 ns

Ns, no significant difference, * significant at 0.05 and ** significant at 0.01

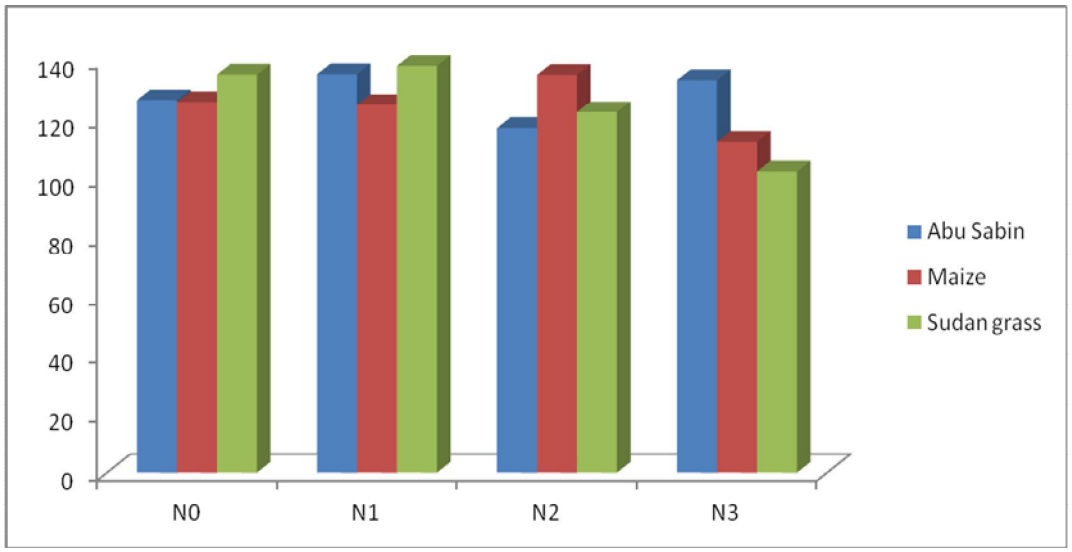

Fig1. Plant height (cm) of three cultivars forage affected by different level of nitrogen fertilizers.

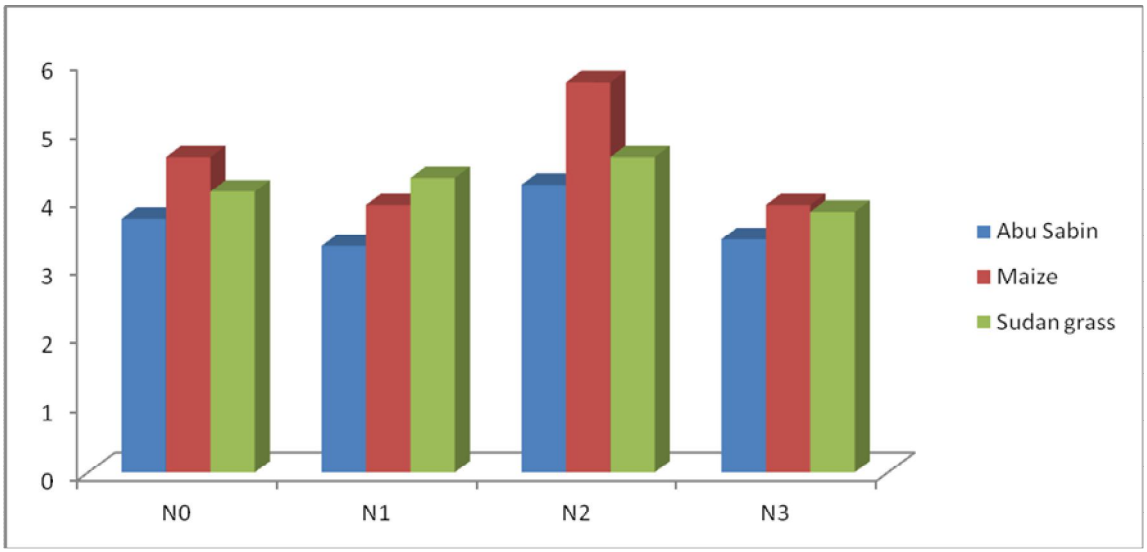

Fig 2. Number of leaves of three cultivars forage affected by different level of nitrogen fertilizers.

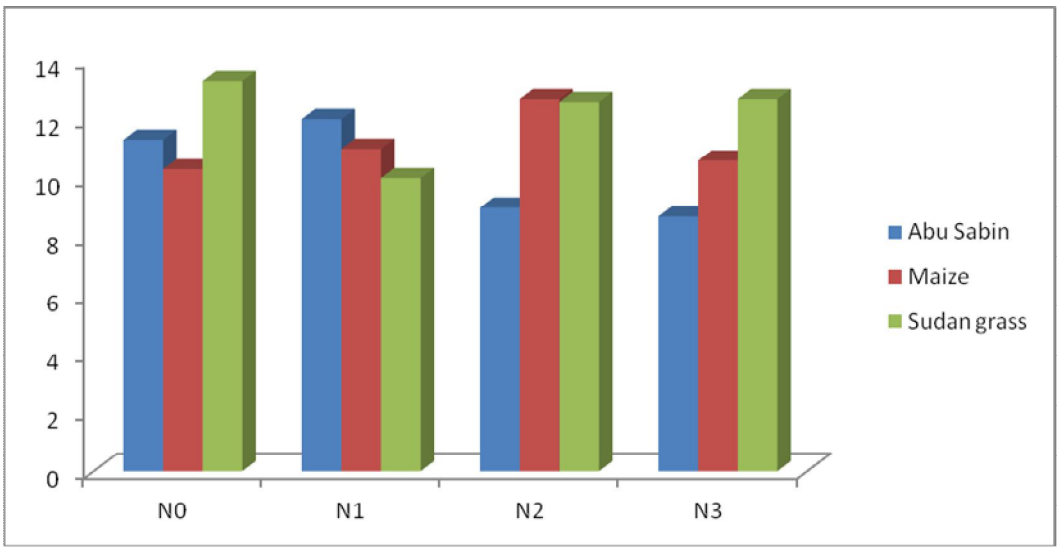

Fig .3 Stem diameter (cm) of three cultivars forage affected by different level of nitrogen fertilizers.

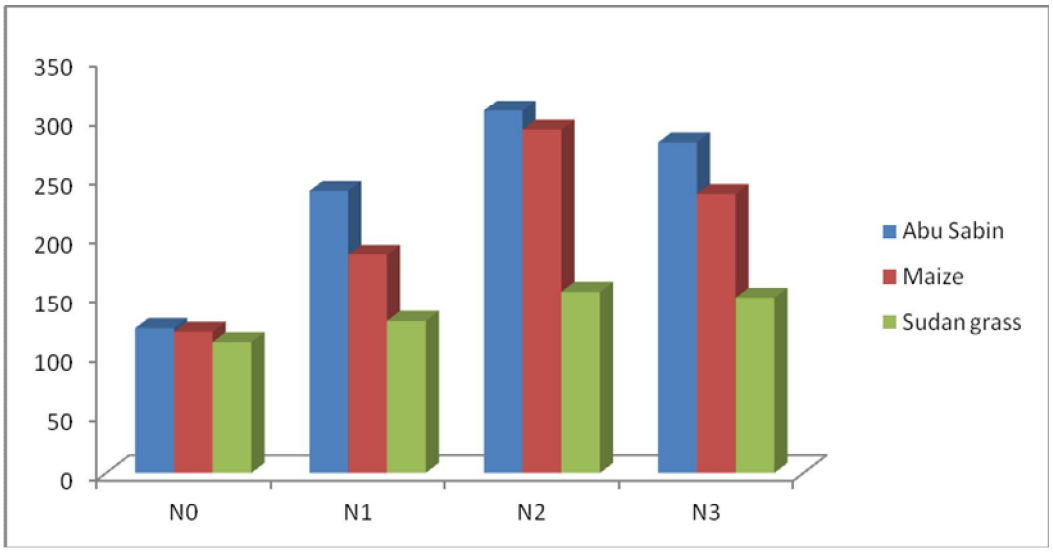

Fig 4. Leaf area (cm) of three cultivars forage affected by different level of nitrogen fertilizers.

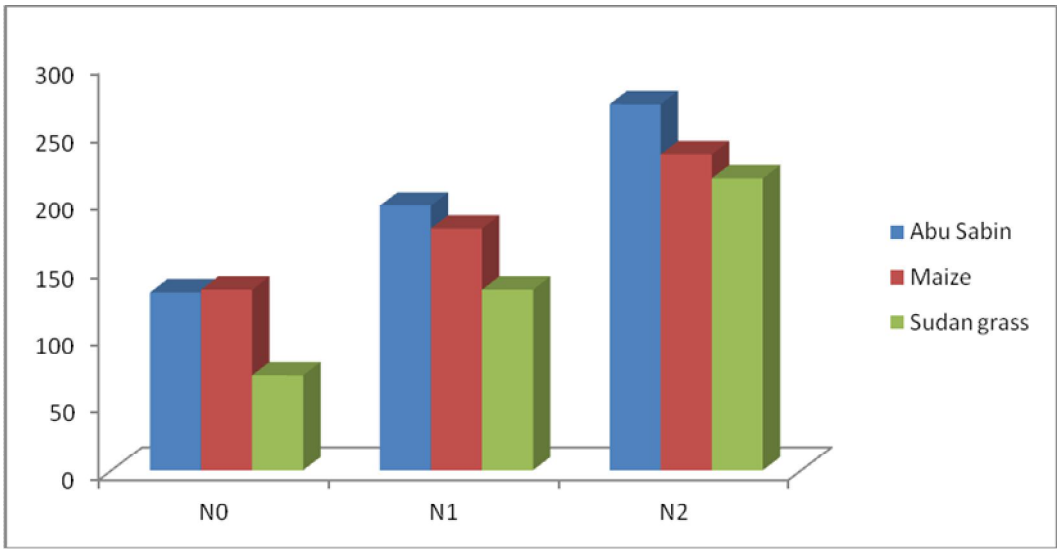

Fig 5. Fresh weigh (g) of three cultivars forage affected by different level of nitrogen fertilizers.

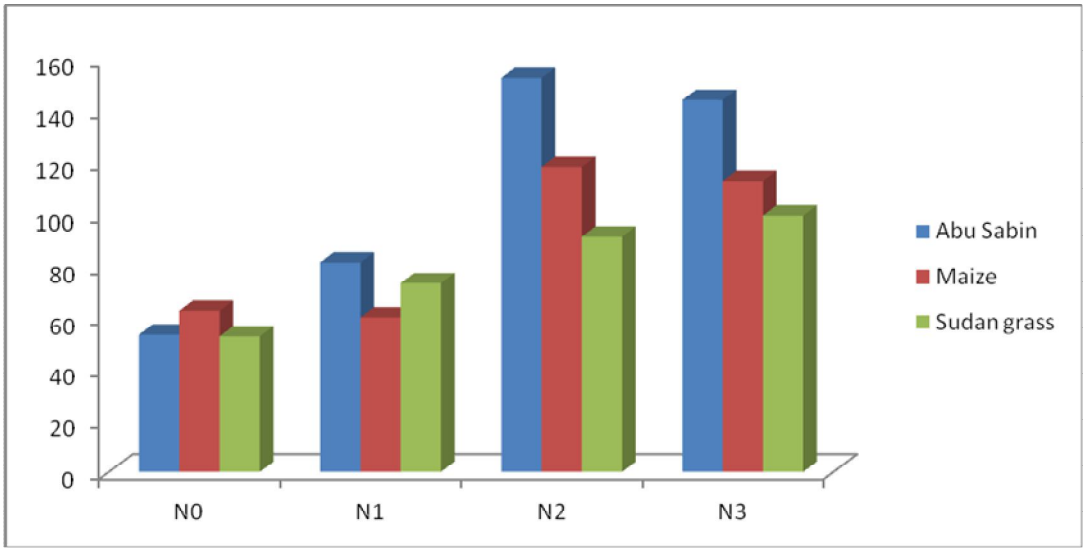

Fig 6. Dry weight (g) of three cultivars forage affected by different level of nitrogen fertilizers.