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Effect of Urea Fertilization on Growth and Yield
Of Rhodes Grass (*Chloris gayana* L. Knuth)

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الآية

قال تعالى:

بسم الله الرحمن الرحيم

وَأَيَّةٌ لَهُمُ الْأَرْضُ الْمَيْتَةُ أَحْيَيْنَاهَا وَأَخْرَجْنَا مِنْهَا حَبًّا فَمِنْهُ يَأْكُلُونَ ﴿٣٣﴾

صدق الله العظيم

سورة يس الآية 33

DEDICATION

To my dear family, my brother

And sisters, and to the spirit of

My father and mother

To my dear friends

Ismail Ali

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First I do thank ALLAH who supports me with ultimate help, strength and patience to complete this research successfully.

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ABSTRACT

The experiment was conducted at experimental farm season 2016/2017 at the Collage of Agricultural studies –shambat- Sudan University of Science and Technology. The objective of this research to investigate the effect of urea fertilizer on growth and yield of (*Chloris gayana* -Var. reclimer). The experiment was laid out using the design of Randomized Complete Block Design (RCBD) in three replication, The parameter of plant growth studied was as follows: traits are plant height(cm), 50% flowering and yield components were fresh yield t/ha and dry yield t/ha.

Analysis of variance showed significant difference of fertilizer on plant height, fresh yield and dry yield(t/ha), on the other hand no significant in 50% flowering; using N2 obtained the best result in tern of fresh and dry weight (26%-34%) respectively.

The range of fresh fodder productivity was 11.7-15.9 t/ha and the yield of dry fodder was 3.3-5 t/ha,

الخلاصة

أجريت التجربة بالمزرعة التجريبية بكلية الدراسات الزراعية - شمبات - جامعة السودان للعلوم و التكنولوجيا موسم 2016/2017م. الهدف من الدراسات معرفة أثر السماد النيتروجيني (اليوريا) علي نمو و انتاجية حشيشة الرودس صنف (ريكلايمر) ، وقد تم اجراء التجربة باستخدام تصميم القطاعات الكاملة العشوائية بثلاثة مكرارات. معايير النمو الخضري و الانتاجية :- قياس الصفات علي النبات ، و الصفات هي طول النبات (سم) ، 50% ازهار ، و الانتاجية الطازجة للعلف بالطن/الهكتار و الانتاجية الجافة للعلف بالطن/الهكتار.

واظهر تحليل التباين وجود فروقات معنوية السماد علي طول النبات (سم) ، انتاج العلف الطازج و انتاج العلف الجاف (طن/الهكتار) عدم وجود فروقات معنوية علي 50% ازهار ، مستوى النيتروجين اثنين اظهر افضل نتيجة

من العلف طازج و العلف الجاف (26%-34%) علي التوالي ، وكان المدى لانتاجية العلف الطازج 11.7-15.9 طن/الهكتار و انتاجية العلف الجاف 3.3-5 طن/الهكتار.

CHAPTER ONE

INTRODUCTION

Rhodes grass (*Chloris gayana* L. Knuth) belongs to the family poaceae (Gramineae) its perennial forage crop. It occurs naturally in most tropical and subtropical part of Africa including all of eastern and central Africa (Hassan, 2010).

Rhodes grass first cultivated in the native Africa more than 100 years ago. Sine that time becomes widely sown throughout the tropical and subtropical world where it remains one of the major C4 forage grasses (Loch, *et at*, 2004).

The crop is used primarily as pasture hay or lay crop. Also it has been extensively used to stabilize disturbed sites and new widely naturalized in areas where irrigation water are marginal (Hassan, *et, at*, 2010)

Sudan is the largest country in Africa its rangelands constitute about 46% of the total area and huge animals resource. It has more than 130 million heads of animals.

Forage production in Sudan is very important because forage is the basic source of energy for growth and maintenance of livestock and increases their products. Livestock production depends mainly on development of forage crop production (Hassan, 2010)

Rhodes grass was firstly introduced to Sudan by administration of forage and pastures ministry of Agriculture in the seventeen of the last country, it

Was also sown in the farm of Arab Authority for Agricultural development and investment (A.A.A.D.I) in the same period (Khair, 1999). Recently it is introduced from Australia by some commercial companies and it is sown at different parts of Khartoum state and Kenana sugar company at while Nile state (Khair, 1999). The crop usually varies in organic as follow, crude protein 4-13 percent, crude fiber 30-40 percent, other extract 0.8-1.5 percent, nitrogen-free extract 42-48 percent and digestibility is 40-60 percent, of dry matter , the crop is highly palatable to animals (Abu sowar, 2007).

Cultivation of the crop is relatively limited in Sudan and research works is scanty. More studies needed, in addition, the farmers are not a ware of most its cultural practices such as plant population and fertilizer requirements thus the objective of this research to investigate i) the effect of Urea fertilizer on growth and forage yield of crop and ii)to chose the best dose of Urea fertilizer.

CHAPTER TWO

LITERATURE REVIEW

2-1 Origin and geographic distribution:

Rhodes grass is native to east, central and eastern part of Africa.(Bogdan, 1977).at the beginning of the 20 century it was introduced to wide regions of Africa , united state ,Australia, central and south America and soviet union. It is also grown in the Indonesia, the Philippines and Thailand. (Hassan, 2010).

2-2 Morphology of the plant:

Root system of Rhodes is fibrous to surface of the soil. The stem made up and cylindrical, many leaves range from 0.9-1.2 m blade lengths range 3-5 mm blade widths (Alsayad, 1993). The inflorescence is adigitate subdigitate panicle with 3-20 spikes, each 40-150 mm long (Bogdan, 1977) flowering of the crop in tropic is apparently not influenced by day length. Changes of day length from 10 h 20 min to 13 h 40 min did not affect flowering, but under photoperiod of 7-10 h it was delayed up to 15 days of 14-17 h up to 125 days, flowering begins from 15 days (Bogdan, 1977).

2-3 Environmental requirements:

2-3-1 Temperature:

Rhodes grass has optimum temperature of 35⁰c for photosynthesis but is tolerant of wide temperature range (0-50⁰c). It is more tolerant of lower than other subtropical grasses (Hassan, *et, at, 2010*)

2-3-2 Rainfall:

The crop has optimum annual rainfall between 600-1000 mm. it can't with stand on dry season up to six months. Responds well to irrigation and is moderately tolerant of flooding (Hassan, *et at*, 2010)

2-3-3 Soil:

The crop grow well on a wide range of soil, from clays to sandy loams, it done not fare well on very heavy clays, crop grow well on loose texture soils such as volcanic ash.(Bogdan,1977). Optimum pH for Rhodes grass is between 4-5.7 .The crop has high sold tolerance and con accumulates large amounts of Na_2 in the leaves without harm the plant, it con not tolerate Mgcl_2 and relatively high concentrations of Mg_2 in the leaves con be toxic to grass.(Dagash,2005).

2-4 Cultural practices:

2-4-1 Land preparation:

The ground preparation process begins with the plow, reverse tillage. Then follow by harrowing and leveling. (Dagash, 2005).

2-4-2 Cultivars:

There is a large number of cultivars with local names or the introduction number only but only after better know ones are given below:

There have been developed mainly in Australia, Kenya and Rhodesia Pioneer Diploid registered under name in Australia in 1973 being previously know as commercial cultivar of unknown probably south Africa origin an early flowering, middle leaves productive which requires fertile soil and relatively high rainfall .(Abu sowar, *et at*,2007).

Katambora Diploid originates from Katambora Zambia where it grown on the banks of the Zambezi river stolons thin and long valued for its fast growth and drought resistance .A late, maturing cultivar frost and thick leaves. (Abu sowar, *et at*, 2007).

Samford Developed in Australia at Samford where it was introduced from Kenya via Sierra Leone. In Australia it gives high herbage yield and its palatability is outstanding maturity. (Dagash, 2005)

Callide A late maturing

Maseba and mbrara at them thick leaves. (Dagash, 2005)

Rongai its drought resistance and high yield

Top cut an early maturing and high yield

Fine cut (Abu sowar, 2007).

2-4-3 Sowing date:

March –April optimum temperature 27-38⁰C

October –November Attributed to the calm winds in this period. (Dagash, 2005).

2-4-4 Seed rate:

Seed rate of 0.5-1 kg/ha of pure live seeds is recommended. Seed purity is usually not more than 25-35% with germination of 30-55 minimum seeding rates (Hassan, *et at*, 2010). At also seed rate recommended vary from 5-20 kg seeds/ha. About they are usually given for seed of unknown quality and are there for of not much significance a better recommended is to sow 0.5-1 kg/ha pure germinating seed (PGS) e.g. seed containing 10% PGS should be sown at 5-10 kg/ha (Bogdan,1977).

2-4-5 Irrigation:

Irrigation is often used as a sprinkler system, the actual a spraying

requirement is 600-1200 mm per year. (Dagash, 2005).

2-4-6 Fertilization:

The crop responds well N and P fertilization. High yield are obtained only when N is given after a basic application of P. fertilizer N increases the proportion of leaf in the herbage, but when applied after flowering it can increase the proportion of the stem (Bogdan, 1977). N is the major element limiting growth under rain-fed condition on moderate to low fertility soil. (Khair, 1999), More studied showed that when cultivating the crop with Philip Sara (intercropping) yield was 27.1 to 50.4 ton/ha green forage, 5.3 to 7.5 ton/ha dry forage production (Hassan,2010), also the average productivity of forage under united Arab Emirates UAE condition was 6-12 ton/ha per harvest (Dagash,2005). And the average productivity per harvest about 12 ton/fod of green forage, in Zimbabwe dry forage production was 5.8 ton/ha and the united state USA 15.8 ton/ha (Abu sowar, 2007)

2-4-7 Bests and disease:

The several fungus and virus disease recorded on Rhodes grass only two inflict major damage:

Helminthosporium diseases causing die-back of leaves and shoot bases, apparently inflicted by a species of *Fusarium gramineum* and *Cochliobolus* attacking spikelet's and causing considerable seed losses in wet years. The tow diseases appear to be genetically controlled and resistant types exist (Dagash, 2005, Bogdan.1977).

2-4-8 Grazing and cutting management:

The frequent cutting or grazing can reduce the dry matter yield of crop but at the same time are essential to maximize the nutritive value of the herbage produced for hay and silage production the compromise decision is to cut at

the early heading stage to maximize the mass of material harvested while
Minimize the inevitable decline in feeding value with age.
Recommendations that grazing be delayed until the plants have been
allowed seed (Hag babiker, 2010). In Sudan and study of Rhodes grass
forage khair (1999) reported that the forage yield of the crop was 6, 11, 11,
14 tons/ha when cutting was conducted every 50, 90,153 and 188 days,
respectively. He added Rhodes grass tolerant frequency cutting and cutting
every 28 days give more forage yield than cutting every 14 days.

2-4-9 Dry matter production:

As with other forage grasses productive potential of Rhodes grass is strongly
influenced by the soil and climatic condition at the particular site, dry matter
production is restricted by low soil fertility by low rainfall and by shorter
season for growth. The crop dry matter production also decreases as
frequency of cutting increases giving shorter cycle of growth for these
reason, dry matter yield of crop reported in the literature very widely. The
crop dry matter production ceases under very low winter temperature, but
where there are no frosts or minimal frost damage (e.g. southern Florida)
Rhodes grass continues to grow slowly during winter provided there is
sufficient moisture (Hag babiker,2010).

CHAPTER THREE

MATERIALS AND METHOD

3-1 Location of experiment:

The experiment were conducted at Sudan university of science and Technology SUST, collage of Agriculture studies –shambat, latitude 15, 40 N longitude 32, 35 E and 380 m above sea level.

3-2 The plant material:

Rhodes grass, (v. reclimer) obtained from Australia was used in this experiment with different dose of Urea fertilizer (0, 60, and 120 kg/ha).

3-3 Land preparation and experiment argument:

The land was ploughed using disc plough and then followed by harrowing, leveling and ridging up N-S, the spaces between ridges 70 cm, the size of plot was 1.4 m consisting of three ridges of 5 m Length, the experiment was laid out using a Randomized Completely Block Design (RCBD), with 3 replications.

3-4 Seed rate and sowing date:

Using in this experiment was 20 Kg/ha. Sowing date was done manually at 25/8/2016, irrigation was directly applied after sowing and subsequent were done every 7-10 days, first hand weeding was done after one week.

3-5 Harvest or cutting:

Harvest was done three times; the first cut was conducted at 27/10 /2016

after 60 days from sowing date, second cut at 4/12 /2016 and last cut 7/1/2017, second and last cuts were done after 35 days each cut.

3-6 Data collection (parameters):

Data was collected for three cut, the following growth parameters of Rhodes grass were estimated.

3-6-1 Plant height (cm)

Five Plants randomly taken from each plot from ground level.

3-6-2 50% Flowering

Taken when %50 of the plots started to shed pollens

3-6-3 Green matter yield (ton/fod)

Fresh yield determent in metric ton/foddan by harvesting one meter² from each plot, cutting was done at 5-8 cm above ground level.

3-6-4 Dry matter yield (ton/fod)

We take one kg of green matter forage from each plot and then dried in the oven (temperature 80 C⁰, time 48 h).

3-7 Statistical analysis:

The data were analyzed using the statistical analysis program STATISTIDIX 8



Fig: 3-1 Rhodes grass establishment stage.



Fig: 3-2 Study area- shambat
Replications



Fig: 3-3 two plot non- fertilization.



Fig: 3-4 Two plot applied 2 doses in Urea.



Fig: 3-5 harvesting stage.

CHAPTER FOUR

RESULTS

4-1 Plant height (cm) and 50% flowering:

As showed in **Table (4-2)** the analysis of variance for the cuts showed that there were significant difference treatment of three doses of Urea fertilizer on plant height, the overall mean for plant height (cm) was 104.9, 100.9 and 108.5 respectively and application of dose N2 resulted high plant height 7% length, Also analysis of variance for three cuts showed that significant difference of urea fertilizer on cuts, the overall mean for 50% flowering was 20, 20 and 19 days respectively N2, N1 are resulted 50% flowering early **Table (4-2)** .

Table (4-1): ANOVA values of yield parameters

Sources of Variation	D .f	Plant height	50% flowering
Rep	2	0.10*	0.00 ^{NS}
Treat	2	1.06 *	0.00 ^{NS}
Error	22		
Total	26		

NS= no significant

*= Significant

Table (4-2): Table of means for the plant height and 50% flowering as affected by urea fertilizer

Sources of Variation	D .f	Plant height	50% flowering
Rep	2	N2 108.5 ^A	N2 20 ^A
Treat	2	N0 104.9 ^A	N1 20 ^A
Error	22	N1 100.9 ^A	N0 19 ^A
Total	26		

A the Sami letter in on color means no significant difference

4-2 Fresh and dry weight (t/ha):

The analysis of variance for cuts showed that there were significant differences in treatment for three doses of urea fertilizer for three cuts, the overall mean for fresh weight was 11.7, 12.9 and 15.9 t/ha respectively **Table (4-4)**.

Also overall mean for dry weight was 3.3, 3.8 and 5 t/ha respectively, **Table (4-4)** application of dose N2 investigated high yield in fresh and dry forage yield 26% fresh and 34% dry yield forage.

Table (4-3): ANOVA values of yield parameters

Sources of Variation	D .f	Fresh weight	Dry weight
Rep	2	0.01*	1.73*
Treat	2	1.04 *	1.35 *
Error	22		
Total	26		

*= Significant

Table (4-4): table of means for the yield (fresh –dry) of the Rhodes grass as affected by urea fertilizer

Sources of variation	D .f	Fresh weight	Dry weight
Rep	2	N2 15.9 ^A	N2 5 ^A
Treat	2	N1 12.9 ^A	N1 3.8 ^A
Error	22	N0 11.7 ^A	N0 3.3 ^A
Total	26		

A the Same letter in one color means no significant difference

CHAPTER FIVE

DISCUSSION

The results of the study showed that there was significant difference between doses of nitrogen fertilizer on growth of Rhodes grass, the plant height (cm) was 104.9, 100.9 and 108.5 cm respectively, and application of dose N2 resulted high plant height 7% length.

Some studies have shown that plant height increased when increases urea doses 120 cm (Dagash, 2005).

50% flowering (day) was 20, 20 and 19 days respectively.

More over treatment influence significant on fresh and dry weight production, fresh weight forage (t/ha) was 11.7, 12.9 and 15.9 t/ha respectively and dry weight forage (t/ha) production was 3.3, 3.9 and 5 t/ha respectively, application of urea N2 increases high yield in(fresh and dry forage yield) 26% fresh and 34% dry yield forage.

Some studied showed that yield was increases when fertilizer application used over the control (Hassan, 2010)

In other study showed yield was 6-12 t/ha under conditions United Arab Emirates (Dagash, 2005).

Abu sowar (2007) mention that in Zimbabwe dry forage production was 5.8 t/ha and USA 15.8 t/ha.

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