



GLOBAL JOURNAL OF SCIENCE FRONTIER RESEARCH: D  
AGRICULTURE AND VETERINARY  
Volume 19 Issue 6 Version 1.0 Year 2019  
Type: Double Blind Peer Reviewed International Research Journal  
Publisher: Global Journals  
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

# Effect of Nitrogen and Variety on Agronomic Performance of Rhodes Grass (*Chloris gayana* Kunth) in the Sudan

By Hussein H. A. M, Dagash Y. M. I & Maarouf I. Mohammed

*University of Sudan for Science and Technology*

**Abstract-** An experiment was conducted in Shambat (2016-2017) in the demonstration farm of the College of Agricultural Studies, Sudan University for Science and Technology, to study the effect of variety and nitrogen fertilization on the agronomic performance of Rhodes grass. Two Rhodess grass varieties (Fine cut and Reclaimer) and 2 nitrogen doses plus control were studied across seven cuts. The treatments were replicated four times in split plot experiment with fertilizer doses assigned to the main plots and the varieties to the sub-plots. The data collected included forage yield, plant height and days to 50% flowering.

**Keywords:** *fine cut, reclaimer, tetraploid, diploid.*

**GJSFR-D Classification:** FOR Code: 070302



*Strictly as per the compliance and regulations of:*



# Effect of Nitrogen and Variety on Agronomic Performance of Rhodes Grass (*Chloris gayana* Kunth) in the Sudan

Hussein H. A. M<sup>α</sup>, Dagash Y. M. I<sup>σ</sup> & Maarouf I. Mohammed<sup>ρ</sup>

**Abstract-** An experiment was conducted in Shambat (2016-2017) in the demonstration farm of the College of Agricultural Studies, Sudan University for Science and Technology, to study the effect of variety and nitrogen fertilization on the agronomic performance of Rhodes grass. Two Rhodess grass varieties (Fine cut and Reclaimer) and 2 nitrogen doses plus control were studied across seven cuts. The treatments were replicated four times in split plot experiment with fertilizer doses assigned to the main plots and the varieties to the sub-plots. The data collected included forage yield, plant height and days to 50% flowering.

Differences between varieties and their interaction with cuts were not significant for forage yield. Differences between fertilizer doses for forage yield and their interaction with cuts were highly significant. The nitrogen dose 120kgN/ha significantly increased for age yield and plant height over 60kgN/ha and the control with yield increment of 118%. The dose 60kgN/ha failed to give significant increase in yield over the control. The highest forage yield was obtained in the first cut after establishment then started to decrease. The nitrogen dose 120kgN/ha maintained comparatively high yield throughout the subsequent cuts.

It was concluded that nitrogen application has significant positive impact on productivity of Rhodes grass. Future research should focus on optimizing management of nitrogen dose across cuts. Lack of differences between Rhodes grass varieties in forage yield was attributed to the narrow genetic base of the diploid group. More attention should be given to Tetraploid varieties (Callide, Samford) to enhance productivity of the dairy farms.

**Keywords:** fine cut, reclaimer, tetraploid, diploid.

## I. INTRODUCTION

Rhodes grass (*Chlorisgayana*) is an important forage crop originated in East Africa. It had been widely cultivated in the tropical and sub-tropical regions of the world (Ubei *et al.*, 2001). Rhodes grass is a perennial plant primarily used as forage. It can be grazed, cut for hay or used as deferred feed, with moderate to high feed quality. Many Rhodes cultivars have been developed to suit specific conditions or end-uses (Cook *et al.*, 2005). The crop is grown in a wide

**Author α:** Ministry of Agriculture, National Seed Administration, Khartoum, Sudan.

**Author σ:** Department of Agronomy, College of Agricultural Studies, University of Sudan for Science and Technology, Khartoum North, Shambat, Sudan.

**Author ρ:** Agricultural Research Cooperation (ARC), Shambat, Khartoum North, Sudan. e-mail: maaroufibrahim@gmail.com

range of soils; from clays to sandy loam. It does not do well on very heavy clays. The crop responds well to irrigation, moderately tolerant to flooding and has good salt tolerance (Loch *et al.*, 2004).

Based on seed importation record kept by the National Seed Administration of Sudan in 2018, the area cropped to Rhodes grass increased steadily from few hectares in 2012 to about 32000 ha by 2017. The crop is essentially grown for export to the Gulf States where it can fetch high prices justifying the huge initial costs incurred by the fully mechanized pivot irrigation system. Another low cost production system employing surface (Border) irrigation has also been attempted under the problematic low permeable soils.

Sudan is endowed with huge animal wealth ranking first in the Arab World and second in Africa (Mohammed and Zakaria, 2014). Rhodes grass may contribute effectively in alleviating fodder bottlenecks as it allows production of huge quantities of fodder under irrigation throughout the year. Research works carried on Rhodes grass are not coping with its growing importance in the Sudan. Some works on the husbandry practices (Abuswar, 2005; Abdelrahman, 2007; Elnazier, 2010) and variety performance (Maarouf, 2008) have been made. However, research works following the wide adoption of Rhodes cultivation in the Sudan (i.e. 2012 onwards) are very few or lacking. The Sudan Soils are known to be inherently low in nitrogen. The requirement of Rhodes grass to nitrogen fertilization is known to increase under irrigation (Fair, 1989; Dannhauser, 1991). The objectives of this study were to study the effect of variety, nitrogen fertilization and their interaction on the agronomic performance of irrigated Rhodes grass in Sudan.

## II. MATERIALS AND METHODS

### a) The field experiment

**The experimental site:** The experiment was conducted at Shambat, during (2016-2017) in the demonstration farm of the College of Agricultural Studies, Sudan University for Science and Technology, latitude 15°39' N, Longitude 32°3'E, 280 meter above sea level. The location is in the semi-arid tropical region with very hot summer and short rainy season between July and September. Temperature, rain fall and relative humidity

of the growing season are presented in Appendix I. The soil of the site is moderately clay, non-saline, non-sodic with pH of 7.8. The chemical and physical properties of the experimental site are presented in Appendices II and III.

**Management and Cultural practices:** The seeds of the Rhodes grass were sown in the 28<sup>th</sup> of August 2016. The individual plot size was two ridge 7m long spaced at 0.75m. The seeds were drilled manually in furrows opened in one side of the ridge using seed rate of 20 kg/ha Phosphate fertilizer (TSP) was added before sowing at a rate of 50 Kg P<sub>2</sub>O<sub>5</sub>/ha. The first irrigation was given immediately after sowing; irrigation water was applied after that at intervals of 7-10 days. However, the experiment was sporadically subjected to shortage of irrigation water leading to partial infestation with termite. Weeds were kept at minimum using hand tools. The zero cut (cut of the seed-crop) commenced after 65 days from sowing, a time at which all entries in each plot were in 25% to 50% bloom. Thereafter, succeeding cuttings throughout the age of the experiment were approximately maintained at intervals of 35 to 40 days or when 10%-25% of plants in each plot have flowered. Forage yield continued to be taken up to the ninth cut after which the experiment was terminated. However, the data of cut 8 and cut 9 will not be reported due to severe termite infestation.

#### b) *Treatments and experimental design*

Two Rhodes grass (*Chlorisgayana* Kunth) cultivars were used in this study, namely: Fine cut and Reclaimer. The seeds were received from Selected Seed Co. of Australia via a local agent in the Sudan. Three levels of nitrogen fertilizer in a form of urea were studied viz.: 60kg N /ha, 120kg N /ha and 0.0kg N /ha (Control). Randomized Complete Block design in split plot experiment was used with fertilizer treatments assigned to the main plots and the varieties to the sub-plots. The treatments were replicated four times, however, due to termite damage, the data of one of the replicates was deemed unreliable

#### c) *Data collection*

**Green matter yield (GMY) (t/ha):** Estimated from the center of the plot excluding one meter from each side of the two ridges. Plants were cut at a height of 6 cm and the green matter yield (GMY) was immediately recorded using spring balance.

**Dry matter yield (DMY) (t/ha):** Estimated from a sample of one kg randomly taken from each harvested plot and oven dried at 80°C for 48 hours

**Plant height (cm):** Five Plants from the whole plot were randomly chosen and the height was measured from the soil surface to the tip of the plant.

#### d) *Statistical analysis*

The data collected for forage yield and plant height were subjected to analysis of variance (ANOVA)

following the standard procedure of analyzing split plot in RCB design (Cochran and Cox, 1957). The Least Significant Difference (LSD) procedure was used to separate the means. The statistical package GenStat (2009) was used to run the analysis

### III. RESULTS

**Variation among treatments:** Table 1 shows mean squares of Rhodes grass cultivars and nitrogen treatments evaluated for forage yield across 7 cuts. Differences between varieties were not significant for forage yield. Interaction of varieties with cuts was also insignificant. Differences between fertilizer doses for dry yield and their interaction with variety were highly significant. Variation among cuts and their interaction with nitrogen doses were also highly significant. The greatest magnitude of mean squares for forage yield was obtained by the nitrogen dose, cut and their interaction.

**Forage yield and related traits:** The effect of variety on forage yield and related traits was depicted in Table 2. Reclaimer and Fine cut gave comparable yields of 3.62 and 3.60 t/ha, respectively. Comparable GMYs have been also obtained with respective yields of 14.4 and 14.3 t/ha. Both varieties showed comparable performance for plant height and days to flower averaging 88 cm and 32.1 day, respectively.

Effect of nitrogen dose on forage yield and some related traits are presented in Table 3. The nitrogen dose 120kgN/ha significantly increased the dry (DMY) and green (GMY) matter yields over 60kgN/ha and the control. The dose 60kgN/ha gave higher DMY and GMY than the control but the difference in yield was not statistically significant. The plant height obtained by the nitrogen dose 120kgN/ha (92 cm) was significantly higher than that of 60kgN/ha (83 cm). It was also higher than that of the control (88 cm) but the difference was not statistically significant.

Table 4 shows that the nitrogen dose 120kg/ha has increased DMY and GMY by 118.5% and 96.7%, respectively, whereas the respective increases for the dose 60kg/ha were 16.3% and 15.1%.

**Interaction effects:** The effects of dose x variety interaction on forage yield are depicted in Fig. 1. The highest yields were obtained when using the dose 120kgN/ha with Reclaimer (DMY = 6.23 t/ha) whereas the lowest ones were obtained by the control with Reclaimer (DMY = 2.62 t/ha). Fine cut gave the highest yields under the dose 60kgN/ha (DMY = 3.26 t/ha).

The effect of dose x cut interaction on dry forage yield was shown by Fig. 2. For all doses, forage yield was the highest in the first cut then started to decrease. The dry matter yield obtained by 60kgN/ha decreased from 6.59 to 0.81 t/ha in the first and the 7<sup>th</sup> cut, respectively. Similar trend was observed for the

control treatment. However, the dose 120kgN/ha, that gave 9.27 t/ha in the first cut, maintained comparatively high DMY in the subsequent cuts (i.e. cut6 = 7.15, cut5 = 6.18 t/ha) before decreasing sharply to .81 t/ha in cut7. The total DMY from 7 cuts was 38.3, 22.0 and 18.9 for 120kgN/ha, 60kgN/ha and the control, respectively.

Fig. 3 shows the effect of dose x variety x cut interaction on dry (DMY) matter yields. The highest yield (10.14 t/ha) was obtained by the interaction of cut1, variety Reclaimer and the dose 120kgN/ha, whereas the lowest DMY (0.80 t/ha) was shown by the interaction of cut7 with both varieties and doses. Similar trend was kept by GMY (data not shown) where the highest yield (35.4 t/ha) was shown by the interaction of cut1, variety Reclaimer and the dose 120kgN/ha. The lowest GMY (4.0 t/ha) was shown by the interaction of cut7, variety Reclaimer and the dose 60kgN/ha. The total DMY from 7 cuts across variety and nitrogen dose ranged from 18.4 t/h (Reclaimer with control) to 43.6 t/ha (Reclaimer with 120kgN/ha)

The effect of cut x dose interaction on plant height is depicted in Fig. 4. The tallest plant stature (104 cm) was obtained by cut1 with 120kgN/ha whereas the shortest one (52 cm) was shown by cut7 with 60kgN/ha. Generally plant heights obtained by 120kgN/ha are taller across different cuts than those shown by 60kgN/ha and the control.

#### IV. DISCUSSION

*Variation among treatments:* Most of the variability observed for agronomic performance in this study could be attributed to the effect of fertilizer doses, cuts and their interaction. The effect of variety seems to have little or no contribution to the variability observed specially for forage yield. The genotypic difference between varieties for forage yield might have been curtailed by the uncontrolled variations as evident by the high error mean square (residual) which was 50 times greater than the variety mean squares (Table 1). This might also explain the high coefficient of variations noticed for forage yield. The difficulties encountered in irrigation water coupled with termite infestation were some of the reasons behind the uncontrolled variations. However, lack of differences between Rhodes grass varieties may also be attributed to the narrow genetic base of the varieties used in this study as both of them selected from the diploid Katambora variety (Loch *et al.*, 2004). Insignificant differences among Katambora types has been reported (Maarouf, 2008).

*Forage yield and related traits:* The study revealed that nitrogen fertilization increased Rhodes grass yield irrespective of the variety effect. Yield increment amounting to 118% was obtained when a dose of 120kgN/ha was used. This result substantiates the previous findings reported by many workers (Skerman

and Riveros 1990; Valenzuela and Smith 2002; Loch *et al.*, 2004; ESGPIP, 2008; Abebe *et al.*, 2015). Loch *et al.*, 2004 reported that in most situations, nitrogen is the major element limiting growth. Increment in Rhodes grass yield up to sevenfold due to nitrogen application has been reported (Henzell, 1963). Research works conducted in Sudan also pointed to the significant effect of nitrogen on Rhodes grass yield (Abuswar, 2005; Abdelrahman, 2007). However, in the present study, the lower dose of nitrogen (60kgN/ha) failed to give significant increase in yield over the control.

The present study as well as many other studies (Koul, 1997; Gasim, 2001; Adam, 2004) showed that plant height is significantly increased by nitrogen fertilizer. Increased plant height could be one of the factors contributing to increased forage yield. Other yield components contributing to forage yield include population density resulting from plant coverage via stolons. However, this feature was not monitored in the present study since high level of seed rate (20 kg/ha) has been used.

The interaction of variety and the dose of nitrogen for dry matter yield is highly significant pointing to the differential performance of variety across different fertilization levels. Similarly, a differential performance of dose across cuts exists indicating that the response of Rhodes grass yield to nitrogen dose was influenced by cutting age.

The potential of dry matter yield of Rhodes grass shown by this study (18.4 - 43.6 t/ha/year) was within the range reported in the literature which varies from 8.7-9.1 (Abebe *et al.*, 2015) to 35-60 t/ha/year (Cook *et al.*, 2005). However, the yield levels showed by this study were lower than those reported in Sudan by Maarouf (2008) who presented data showing dry yield amounting to 3.9 t/ha/year.

#### V. CONCLUSIONS

The present study confirmed the importance of nitrogen fertilizer in increasing forage production of Rhodes grass. However, the soils of the Sudan are inherently low in nitrogen suggesting the need for more research to optimize nitrogen requirement across cuts i.e. to what extent we can skip applying nitrogen across cuts. Most if not all of Rhodes grass varieties grown in the Sudan belong to the diploid group with little or no variation among cultivars as showed by this study. Diploid varieties suit mainly hay production largely used for export in the Sudan. New research efforts must include Tetraploide.g. Samford, Callide, Masaba, Boma etc.. Such varieties are characterized by high productivity and palatability and suitable for grazing and green chopping systems specially in dairy farms.

## REFERENCES RÉFÉRENCES REFERENCIAS

- Abdelrahman, F.I. (2007). Effect of seed rate and NPK fertilization on growth, yield and for age quality of Rhodes grass (*Chlorisgayana L. kunth*). Msc thesis, Faculty of Agriculture, University of Khartoum.
- Abebe, Y., Tafere, M., Dagneu, S., Tolla, M., G.Selassie, Y., Amane, A. and Molla, D. (2015). Best fit practice manual for Rhodes grass (*Chlorisgayana*) production. BDU-CASCAPE working paper 10.
- Abuswar, A.O. (2005). Forage production in the Sudan. University of Khartoum Printing Press. (In Arabic), Pp 54-58.
- Adam, M.Y. (2004). Effect of seed rate and nitrogen on growth and yield of Teff grass (*Eragrostisteff, zucc.*) Msc thesis, Faculty of Agriculture, University of Khartoum.
- Cochran, W. G. and Cox, G. M. (1957). Experimental designs. 2<sup>nd</sup>edn. John Wiley and Sons, Inc. New York. Pp 293-316.
- Cook, B. G.; Pengelly, B. C.; Brown, S. D.; Donnelly, J. L.; Eagles, D. A.; Franco, M. A. ; Hanson, J.; Mullen, B. F.; Partridge, I. J.; Peters, M.; Schultze-Kraft, R., (2005). Tropical forages. CSIRO, DPI&F (Qld), CIAT and ILRI, Brisbane, Australia.
- Dannhauser, C. S. (1991). The management of cultivated pasture in the summer rainfall areas. C. S. Dannhauser, (self published). Warmbths, S. Africa.
- Elnazier.S.G. (2010). Effects Of Irrigation Intervals And Seed Rate On Growth, Yield And Quality Of Rhodes Grass (*chloris Gayana L. Kunth*) M.Sc. Thesis, Faculty of Agriculture, University of Khartoum.
- ESGPIP (Ethiopia Sheep and Goat Productivity Improvement Program). (2008). Technical Bulletin No. 17. Fodder establishment, management and utilization techniques for the smallholder.
- Fair, J. (1989). Guide to profitable pastures. M & J Publ., Harrismith, S. Africa.
- Gasim, S.A. (2001). Effect of nitrogen, phosphorus and seed rate on growth, yield and quality of forage maize (*Zea mays L.*). M.Sc. Thesis. Faculty of Agriculture, University of Khartoum.
- Genstat. (2009). Ninth edition, Version – 9.1.0.174. Lawes Agricultural Trust (Rothamsted Experimental Station) VSN International, Hertfordshire.UK.
- Henzell, E.F. (1963). Nitrogen fertilizer responses of pasture grasses in south-eastern Queensland. Aust. J. Exp. Agric. Anim. Husb. 3:290-299.
- Koul, B.G. (1997). Effect of Sowing Methods, Nitrogen Level and Seed Rates on Yield and Quality of Fodder Maize (*Zea mays L.*). M.Sc Thesis. Faculty of Agriculture, University of Khartoum, Sudan.
- Loch, D. S., Rethman, N.F.G. and Van Niekerk W. A. (2004). Rhodesgrass. Warm-Season (C4) Grasses, Agronomy Monograph no 45. Page 833-872. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, 677 S. Sege Rd., Madison, WI53711, USA.
- Maarouf I. Mohammed (2008). Annual Scientific Research Report. Shambat Research Station. ARC, Wad Medani.
- Mohammed, Maarouf I. and Zakaria, Z. A. (2014). Quality Attributes in Sudanese Sorghums Improved for Forage Yield. American Journal of Experimental Agriculture, 4: 171-182.
- Skerman, P. J. and F. Riveros, (1990). Tropical grasses. FAO. Plant Prod. Ser. 23. FAO Rome Pp283-288.
- Ubei, B.E., M. Fujimori. M. Ebina, and T. Komatsu. (2001). Amplified fragment length polymorphism analysis in diploid cultivars of Rhodes grass plant breeder .120:85.87.
- Valenzuela, H. and Smith, J. (2002). Rhodes grass, sustainable Agriculture, cover crops/SA-CC-3. Cooperative Extension Service, Collage of Tropical Agriculture and Human Resources. University of Hawaii at Manoa web site. www.ctahr.hawaii.ed

**Table 1:** Mean squares for green (GMY), dry (DMY) matter yields and related traits of 2 Rhodes grass cultivars evaluated across 7 cuts (2016-2017)

Source of variation	df	GMY (t/h)	DMY (t/h)	Plant height(cm)	Days to flowering
Block	2	266.40	7.705	1351.1	30.77
Dose(D)	2	5282.85 *	298.361 **	1683.9 *	99.59 ns
Residual	4	359	12.188	323.6	129.70
Variety(V)	1	0.40ns	0.034 ns	94.3 n.s	25.19 **
D x V	2	63.47 n.s	5.817 **	14.2 n.s	2.04 ns
Residual	6	26.79	1.351	35.7	0.82
Cut	6	2021.13 **	200.126 **	5433.8 **	214.40 **
D x C	12	251.47 **	14.314 **	311.6 **	109.62 **
V x C	6	13.64 n.s	0.198 ns	30.8 n.s	4.37 n.s
D x V x C	12	5.32 n.s	0.605 ns	29.2 n.s	0.85 n.s
Residual	282	24.54	1.730	104.7	13.84

\*. \*\*: Significant at 5% and 1% probability level, respectively.

ns: Not significant at 5% probability level.

*Table 2:* Effect of variety on Rhodes grass yield and related traits

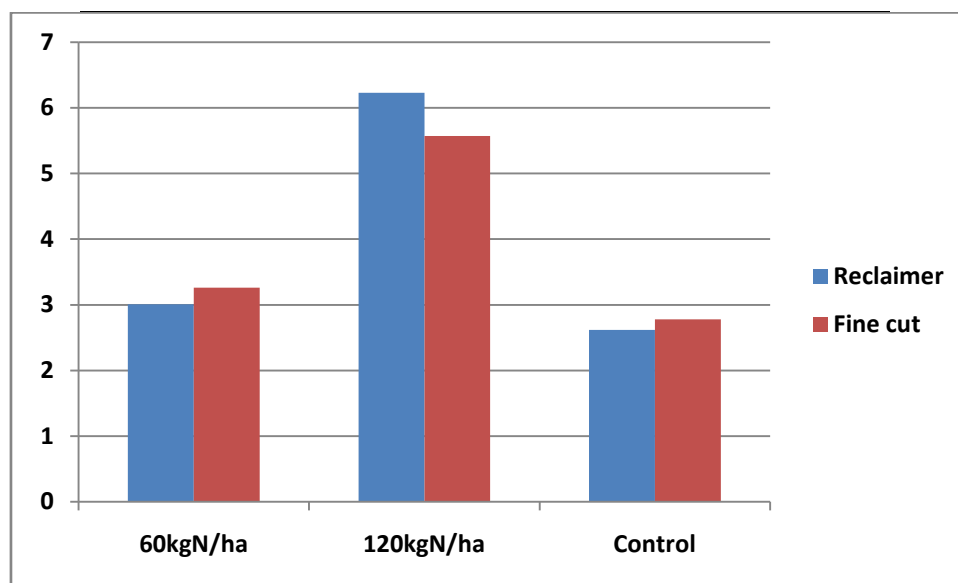
Variety	Reclaimer	Fine cut	Mean	SE±	CV%
Dry matter yield (t/h)	3.62	3.60	3.61	0.090	36.4
Green matter yield (t/h)	14.4	14.3	14.3	0.40	34.6
Plant height (cm)	87	88	88	0.5	11.7
Days to flowering	32.4	31.8	32.1	0.070	11.6

*Table 3:* Effect of nitrogen dose on Rhodes grass yield (t/h) and some related traits

Dose	60kgN/ha	120kgN/ha	N0 (control)	Mean	SE±	LSD (5%)	C.V(%)
Dry matter yield	3.14	5.90	2.70	3.61	0.269	1.295	36.4
Green matter yield	12.2	24	10.6	14.3	1.46	7.03	34.6
Plant height (cm)	83	92	88	88	1.4	6.7	11.7
Days to flowering	30.9	31.9	32.8	32.1	0.879	4.225	11.6

*Table 4:* Percent increase in Rhodes grass yield (t/ha) obtained by nitrogen dose over the control

Dose	Dry matter yield (DMY)	Green matter yield(GMY)	Increase over control (%)	
			DMY	GMY
120kgN/ha	5.90	24.0	118.5	96.7
60kgN/ha	3.14	12.2	16.3	15.1
Control	2.70	10.6	-	-



*Fig. 1:* Effect of dose x variety interaction on dry matter yield of Rhodes grass

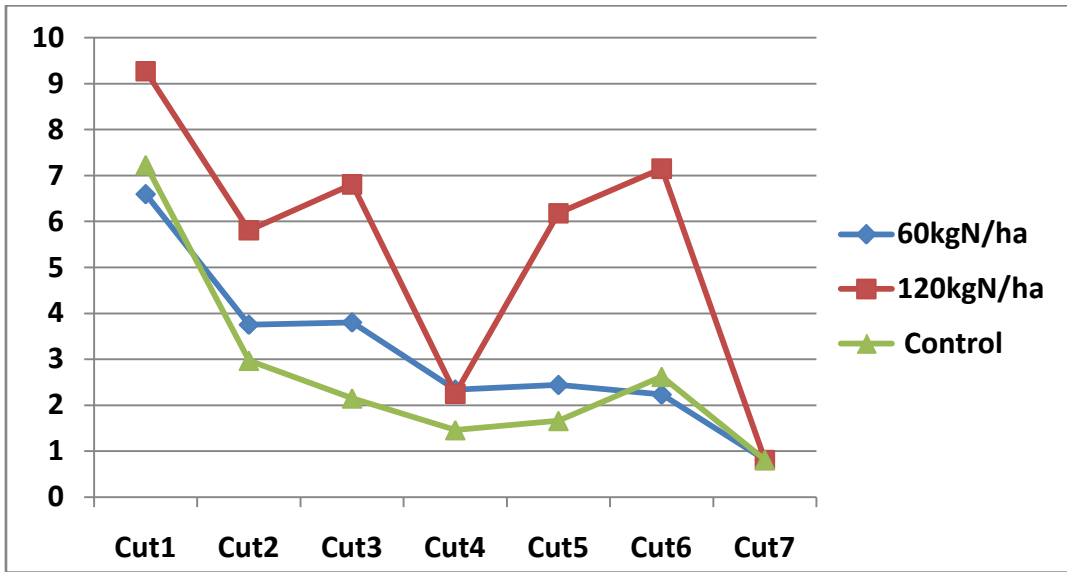


Fig. 2: Effect of dose x cut interaction on dry matter yield of Rhodes grass

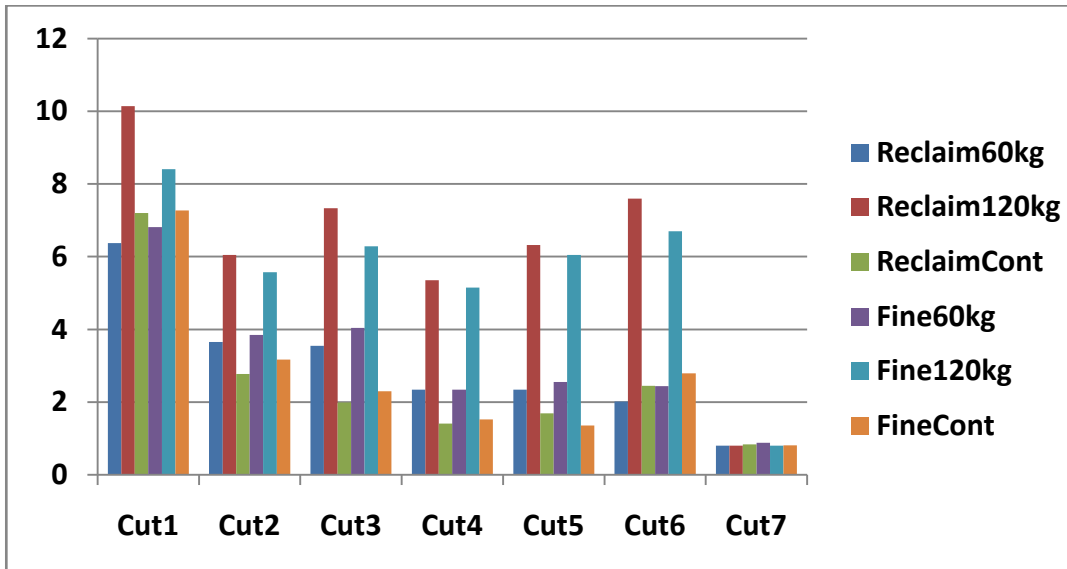


Fig. 3: Effect of dose x variety x cut interaction on dry matter yield of Rhodes grass

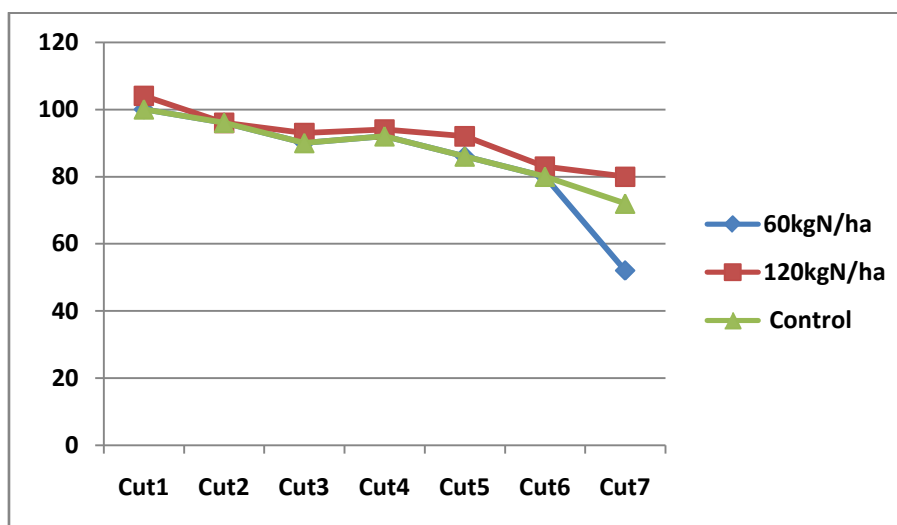


Fig. 4: Effect of cut x nitrogen dose interaction on plant height of Rhodes grass

Appendix I: Monthly average temperature of meteorological data for the experimental period at Shambat

Month	2016				2017			
	Max Temp. (°C)	Min Temp. (°C)	Rain Fall (mm)	Relative Humidity (%)	Max Temp. (°C)	Min Temp. (°C)	Rain Fall (mm)	Relative Humidity (%)
Jan	-	-	-	-	16.8	34.2	-	30
Feb	-	-	-	-	14.9	31.6	-	23
Mar	-	-	-	-	17.8	36.3	-	19
Apr	-	-	-	-	24	40.9	-	17
May	-	-	-	-	26.3	41.6	5.3	29
Jun	-	-	-	-	26.4	42.4	1.5	30
Jul	-	-	-	-	26.7	39.9	40.4	42
Aug	25.2	36.1	69.5	55	24.8	36.6	15	52
Sep	25.4	39.2	23	63	26.5	39.3	2.5	43
Oct	24.6	40.2	-	32	24.3	39.4	-	27
Nov	21.4	37	-	31	20.8	34.8	-	30
Dec	17.5	33.4	-	34	18.3	33.6	-	38

Source: Ministry of Environment, Natural Resources and Physical Development Metrological Authority.

Appendix II: Chemical and physical soil properties of the experimental site

Depth (cm)	pH	ECe (dm/m)	Ca+Mg (mmol+L)	Na (m mol+l)	SAR	CaCO <sub>3</sub>	Clay (%)	Silt (%)	Sand (%)
0-15	7.79	1.4	9.0	5.1	2.4	5.10	42.1	15.9	42.0
15-35	7.88	1.0	6.0	4.3	2.5	4.88	39.6	15.8	44.6
35-51	7.87	1.2	5.0	7.1	4.5	4.99	44.1	16.4	39.5
51-75	7.91	2.0	8.0	12.5	6.3	4.88	51.4	16.6	32.0
75-90	7.71	2.2	6.0	16.0	9.2	5.20	50.0	16.6	33.4



*Appendix III:* Soil analysis for Nitrogen (N), Phosphorus (P) and potassium (K)

Depth (cm)	N%	P (meg/kg)	K (meg/l)
0-20	0.084	0.53	0.195
0-20	0.140	0.79	0.096
0-20	0.140	0.46	0.070
Mean	0.121	0.59	0.120
20-40	0.112	0.54	0.079
20-40	0.098	0.54	0.066
20-40	0.098	0.51	0.084
Mean	0.103	0.53	0.076

