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Effect of nitrogen fertilizer on productivity of rhodes grass (*Chloris Gayana* L. Kunth) cultivars

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Abstract
A field experiment was conducted in the Demonstration Farm of the Faculty of Agricultural Studies, Sudan University of Science and Technology, during the season to evaluate the different doses of nitrogen on Rhodes grass (*Chloris gayana* L.) cultivars. Rhodes grass cultivars sown were Katambora, Callide, Boma and Fine cut. Nitrogen (Urea, 46% N) levels used were 0, 40, 60 and 80 kg N/ha. The treatments were arranged in a split-plot trial with four replications. The results showed that all nitrogen levels significantly (P≤0.05) increased plant height, forage fresh and dry weight in all cultivars. The results showed that the best cultivars in terms of forage dry weight were Fine cut, Callide, Katambora and Boma respectively with added fertilizer 80 kg N /ha.

Keywords: Rhodes grass, nitrogen, forage, fertilization

Introduction

Forage production is gaining more attention in both developed and developing countries. New species and cultivars of forage and pastures plants have been introduced from areas and countries rich in forage and pastures plant to areas where they are scarce. In Sudan forage production is very important because it's the basic source of energy for both growth and maintenance of livestock and increase of their products. Additionally, Sudan has a huge number of animals which was estimated to about 143 million heads in 1998 (Mohammed, 2000) [18].

Rhodess grass (*Chloris gayana* L. Kunth) is a member of the family Poaceae and subfamily Chloridoideae (Luna *et al*., 2002) [16]. Rhodes grass has been a popular perennial grass in the tropics and the subtropics of east and southern Africa, Australia and Central of America. The crop is originated in eastern and southern Africa, and it is valued for its ability to cover ground surface. Rhodes grass is one of the best grasses for rotations grasslands in tropical and subtropical areas, useful for establishment of pastures leys. It's suitable for silage and hay, as well as for fodder. Liked by all kinds of stock, but it may cause skin troubles in horses. Its ability to establish rapidly makes it valuable for soil conservation (Reed, 1976) [21]. The establishment of Rhodes grass experienced several problems. One major problem is the tiny grain size (Ibrahim, 1992) [12]. Nitrogen fertilizer is recommended to use directly after every cut to increase stand, maximize yields and minimum weed competition (Ibrahim, 1999) [13]. Rhodes grass is excellent for soil erosion control, weeds suppression, well for quick growth, tolerates drought and saline conditions. It has a fair forage production, nutritional, quality and palatability as described by Valenzuela and Smith (2002) [23], but the farmers are not aware of most of Rhodes grass cultural practices such as nitrogen fertilizer requirements and the difference between cultivars on yield quantity and quality.

Nitrogen plays an important role in plant growth and physiological processes as it enters in all enzymes composition. It enhances vegetative growth and yield (Burhan and Hago, 2000) [8]. Rhodes grass responds well to nitrogen and phosphorus fertilization. High yields are obtained only when nitrogen is given after a basic application of phosphorus. Nitrogen fertilizer increases the proportion of leaf in the herbage, but when applied after flowering it can increase the proportion of the stem (Bogdan, 1977) [6]. The objective of this work was to study the performance of Rhodes grass cultivars under different nitrogen doses and to suggest the best dose and cultivar.

Materials and Methods

An experiment was carried out during season to demonstration farm of the Faculty of Agricultural studies, Sudan University of Science and Technology, Shambat (Latitude 15^0 40` N and Longitude $32^0$ 32` E). Where the soil is clay, alkaline with pH 7.5-8 (Saeed, 1968) [22] Land preparation from tillage to leveling was done as it is recommended to the crop in the area. Phosphorus fertilizer was applied to all experiment before disc harrowing at a dose of 119.05 kg/ha. Four Rhodes grass cultivars *viz*. Katambora, Callide, Boma and Fine cut were sown on mid-march, a seed rate of 19.05 kg/ha. Four levels of nitrogen in the form of Urea were used (0, 40, 60, 80 kg/ha) marked after that by the letter (N0, N1, N2, N3) respectively.

The experimental method used was Split plot with four replications. The cultivars were assigned as the main plot in a Randomized Complete Block Design (RCBD) and the nitrogen levels as the sub-plot. The area was divided to plots of 16 $m^{2.}$ After sowing the field was uniformly irrigated and the second and third irrigations were at 5 days interval to ensure optimum germination. Subsequently the crop was irrigated at 7 days interval till final cut. The first nitrogen dose was added at 33 days from sowing and then with first irrigation after every cut. Weeding was carried out by hand

hoe after 10 days from sowing at the first time and then whenever it was necessary.

Growth parameters (plant heigh, forage fresh weight (gm) and forage dry weight (gm)) were recorded at 55 days from sowing (first cut) and then every 25 days till final cut (cut No.8). The data were statistically analyzed by Computer program (M STAT-C) (1989). Means separation was performed by Duncan's Multiple Range Test (DMRT) procedure.

Results

Effect of treatment on plant hight (cm)

Cultivar Katambora

The results showed that mean plant height increased with increase in nitrogen fertilizer levels added during all sampling occasions. The tallest plants heights were obtained at 4th cut with added fertilizer (N3). Mean plant height did not show consistent trends with cuts and increase till 4th cut and then tended to decrease (Table.1a).

Table 1a: The effect of treatments on plant height (cm)

Cultivars	Treatments	No. of Cuts							
		1	2	3	4	5	6	7	8
	N 0	74.05 A	87.50 A	78.54 A	76.83 A	68.38 A	60.67 A	69.50 A	59.21 A
Katambora	N 1	80.58 AB	94.58 AB	93.29 B	99.71 B	79.71 B	74.79 B	80.63 B	72.02 B
	N 2	90.67 AB	99.50 B	101.17 B	109.58 BC	98.63 C	88.88 C	90.38 C	73.36 B
	N 3	92.12 B	100.08 B	104.42 B	112.96 C	100.13 C	89.63 C	93.79 C	81.63 C
LSD		17.82	11.38	14.05	11.98	10.31	11.27	9.33	5.93
CV %		14.94	9.18	10.62	8.83	8.40	10.63	7.60	5.64
Callide	N 0	80.75 A	75.75 A	76.29 A	80.13 A	71.46 A	57.38 A	79.54 A	65.01 A
	N 1	81.36 A	80.00 A	88.29AB	92.08 AB	81.63 AB	72.17 AB	89.54 B	77.44 B
	N 2	87.00 A	83.25 A	94.13 B	98.00 B	91.42 B	81.13 B	98.67 BC	79.02 B
	N 3	93.05 A	85.08 A	97.54 B	102.50 B	91.75 B	76.00 B	104.75 C	82.88 B
LSD		17.82	11.38	14.05	11.98	10.31	11.27	9.33	5.93
CV %		14.94	9.18	10.62	8.83	8.40	10.63	7.60	5.64

Means followed with in each cultivar/cut by the same letter (s) are not significantly different according to (DMRT) at 5% level.

Cultivar Callide

The results showed that plant height increased with increase in nitrogen fertilizer levels added during all sampling occasions except the 6th cut with the greater plant height obtained with added fertilizer (N2). The tallest plants were obtained at 7th cut with added fertilizer (N3) but mean plant height did not show consistent trends with cuts (Table.1a).

Cultivar Boma

The results signed that mean plant height increased with the increase in nitrogen fertilizer levels added during all sampling occasions. The tallest plants were obtained at 3rd cut with added fertilizer (N3). Plant height mean did not show consistent trends with cuts. (Table.1b).

Table 1b: The effect of treatments on plant height (cm)

Cultivars	Treatments	No. of Cuts							
		1	2	3	4	5	6	7	8
	N 0	82.25 A	71.59 A	75.75 A	82.13 A	71.46 A	60.17 A	71.71 A	66.71 A
Boma	**N 1**	87.46 A	75.50 AB	86.92 AB	85.71 AB	81.88 B	63.17 A	85.17 B	75.79 B
	N 2	88.17 A	80.92 AB	94.17 BC	94.67 BC	90.54 BC	77.38 B	91.04 BC	82.36 C
	N 3	92.37 A	83.83 B	101.87 C	101.67 C	94.92 C	82.59 B	96.50 C	82.97 C
LSD		17.82	11.38	14.05	11.98	10.31	11.27	9.33	5.93
CV %		14.94	9.18	10.62	8.83	8.40	10.63	7.60	5.64
Fine cut	**N 0**	73.66 A	92.42 A	86.75 A	80.71 A	72.50 A	62.21 A	68.50 A	59.57 A
	N 1	76.25 A	93.00 A	97.13 AB	99.04 B	87.59 B	75.11 B	83.33 B	71.19 B
	N 2	77.31 A	94.42 A	104.21 B	102.42 B	98.08 C	83.79 B	86.63 B	75.63 B
	N 3	83.16 A	94.92 A	106.42 B	105.63 B	99.00 C	86.37 B	88.71 B	76.17 B
LSD		17.82	11.38	14.05	11.98	10.31	11.27	9.33	5.93
CV %		14.94	9.18	10.62	8.83	8.40	10.63	7.60	5.64

Means followed with in each cultivar/cut by the same letter(s) are not significantly different according to (DMRT) at 5% level.

Cultivar Fine cut

The results showed that mean plant height increased with increase in nitrogen fertilizer levels during all sampling occasions. The tallest plant height was obtained at 3rd cut with added fertilizer (N3). Plant height did not show consistent trends with cuts. (Table.1b).

Effect of treatment on forage fresh weight (gm)

Cultivar Katambora

The results showed that forage mean fresh weight increased with increase in nitrogen fertilizer level added during all sampling occasions except the 1st and 3rd cuts which were higher in fresh weight in the 1st cut with added fertilizer (N1), and in the 3rd cut with added fertilizer (N2). Mean fresh weight did not show consistent trend with cuts but it increase till 4th cut and then tended to decrease with cuts and the highest fresh weight was obtained at 4th cut with added fertilizer (N3) although not significantly different for (N1) and (N2) (Table.2a).

Table 2a: The effect of treatments on fresh weight (gm).

Cultivars	Treatments	No. of Cuts							
		1	2	3	4	5	6	7	8
	N 0	907.75 ^{A}	1562.50 ^{A}	1348.75 ^{A}	2182.50 ^{A}	706.25 ^{A}	615.00 ^{A}	906.25 ^{A}	451.25 ^{A}
Katambora	N 1	1304.75 ^{A}	2987.50 ^{B}	2471.25 ^{AB}	2987.50 ^{AB}	1760.00 ^{B}	1515.00 ^{B}	2026.25 ^{B}	2057.50 ^{B}
	N 2	1200.00 ^{A}	3112.50 ^{B}	3246.25 ^{B}	3878.75 ^{B}	3056.25 ^{C}	2202.50 ^{C}	2627.50 ^{BC}	2318.75 ^{B}
	N 3	1023.25 ^{A}	3405.00 ^{B}	3003.75 ^{B}	3912.50 ^{B}	3162.50 ^{C}	2320.00 ^{C}	3105.00 ^{C}	2565.00 ^{B}
LSD		578.10	1059.00	1160.00	1358.00	802.10	553.90	715.70	629.50
CV %		33.84	30.10	33.11	31.31	24.87	23.31	22.86	23.38
Callide	N 0	1130.75 ^{A}	2125.00 ^{A}	1740.00 ^{A}	2418.75 ^{A}	1373.75 ^{A}	728.75 ^{A}	1161.25 ^{A}	896.25 ^{A}
	N 1	1489.75 ^{A}	2237.50 ^{A}	2335.00 ^{AB}	2977.50 ^{A}	2085.00 ^{A}	1616.25 ^{B}	2423.75 ^{B}	1767.50 ^{B}
	N 2	1536.25 ^{A}	2612.50 ^{A}	2903.75 ^{B}	3365.00 ^{A}	2975.00 ^{B}	2261.25 ^{C}	2911.25 ^{BC}	2428.75 ^{C}
	N 3	1331.50 ^{A}	2862.50 ^{A}	3212.50 ^{B}	3241.25 ^{A}	3611.25 ^{B}	2201.25 ^{C}	3441.25 ^{C}	2747.50 ^{C}
LSD		578.10	1059.00	1160.00	1358.00	802.10	553.90	715.70	629.50
CV %		33.84	30.10	33.11	31.31	24.87	23.31	22.86	23.38

Means followed with in each cultivar/cut by the same letter(s) are not significantly different according to (DMRT) at 5% level.

Cultivar Callide

The results showed that forage fresh weight increased with increase in nitrogen fertilizer levels added during all sampling occasions except the 1st, 4th and 6th cuts which had the higher fresh weight in the sampling obtained from plots with added fertilizer (N2). Fresh weight mean did not show consistent trends towards subsequent cuts but it increased till 5th cut and then tended to decrease with cuts in all nitrogen levels added and highest fresh weight mean was obtained at 5th cut with added fertilizer (N3) (Table.2a).

Cultivar Boma

The results showed that forage mean fresh weight increased with increase in nitrogen fertilizer levels added in half of sampling occasions 2nd, 4th, 5th and 7th cuts. The higher mean fresh weight obtained for cut No.1 with added fertilizer (N1), and in the 3rd, 6th and 8th cuts with added fertilizer (N2). Fresh weight mean did not show consistent trend with cuts but generally increased till 4th cut and then tended to decrease with cuts in all nitrogen levels added, with the highest fresh weight obtained at 4th cut with added fertilizer (N3) (Table. 2b).

Table 2b: The effect of treatments on fresh weight (gm).

Cultivars	Treatments	No. of Cuts							
		1	2	3	4	5	6	7	8
	N 0	1106.50 ^{A}	1377.50 ^{A}	1438.75 ^{A}	1992.50 ^{A}	1107.50 ^{A}	732.50 ^{A}	1040.00 ^{A}	638.75 ^{A}
Boma	N 1	1314.75 ^{A}	1625.00 ^{AB}	1997.50 ^{AB}	2400.00 ^{AB}	2025.00 ^{B}	1276.25 ^{A}	2220.00 ^{B}	1865.00 ^{B}
	N 2	1130.75 ^{A}	2375.00 ^{AB}	2903.75 ^{B}	3220.00 ^{AB}	2768.75 ^{BC}	2252.50 ^{B}	2527.50 ^{B}	2707.50 ^{C}
	N 3	1281.25 ^{A}	2675.00 ^{B}	2838.75 ^{B}	3411.25 ^{B}	3235.00 ^{C}	2052.50 ^{B}	2808.75 ^{B}	2411.25 ^{BC}
LSD		578.10	1059.00	1160.00	1358.00	802.10	553.90	715.70	629.50
CV %		33.84	30.10	33.11	31.31	24.87	23.31	22.86	23.38
Fine cut	N 0	772.00 ^{A}	2025.00 ^{A}	1492.50 ^{A}	2481.25 ^{A}	781.25 ^{A}	641.25 ^{A}	860.00 ^{A}	472.50 ^{A}
	N 1	1055.75 ^{AB}	2550.00 ^{AB}	2490.00 ^{AB}	2723.75 ^{AB}	2075.00 ^{B}	1553.75 ^{B}	1738.75 ^{B}	1777.50 ^{B}
	N 2	1420.00 ^{B}	2912.50 ^{AB}	2606.25 ^{AB}	3533.75 ^{AB}	2737.50 ^{B}	2222.50 ^{C}	2548.75 ^{C}	2446.25 ^{C}
	N 3	1202.75 ^{AB}	3100.00 ^{B}	3346.25 ^{B}	4025.00 ^{B}	2773.75 ^{B}	2507.50 ^{C}	2828.75 ^{C}	2695.00 ^{C}
LSD		578.10	1059.00	1160.00	1358.00	802.10	553.90	715.70	629.50
CV %		33.84	30.10	33.11	31.31	24.87	23.31	22.86	23.38

Means followed with in each cultivar/cut by the same letter(s) are not significantly different according to (DMRT) at 5% level.

Cultivar Fine cut

The results showed that forage mean fresh weight increased with increase in nitrogen fertilizer levels added in all sampling occasions except the 1st sampling with the higher fresh weight mean obtained with added fertilizer (N2). Fresh weight mean did not show consistent trends with cuts but generally increased till 4th cut and then tended to decrease with cuts in all nitrogen levels. The highest fresh weight obtained at 4th cut with added fertilizer (N3) (Table. 2b).

Effect of treatment on forage dry weight (gm)

Cultivar Katambora

The results revealed that forage mean dry weight increased with increase in nitrogen fertilizer level during all sampling occasions except the 1st and 3rd cuts which were higher in dry weight in the 1st cut with added fertilizer (N1), and in the 3rd cut with added fertilizer (N2). Dry weight mean did not show consistent trend with cuts but it increase till 4th cut and then tended to decrease with cuts and the highest dry weight mean was obtained at 4th cut with added fertilizer (N3) (Table. 3a).

Table 3a: The effect of treatments on dry weight (gm)

Cultivars	Treatments	No. of Cuts							
		1	2	3	4	5	6	7	8
	N 0	234.05 ^{A}	375.00 ^{A}	321.25 ^{A}	446.75 ^{A}	201.75 ^{A}	191.75 ^{A}	209.25 ^{A}	141.75 ^{A}
Katambora	N 1	317.83 ^{A}	525.00 ^{AB}	531.75 ^{B}	609.00 ^{AB}	468.50 ^{B}	407.25 ^{B}	529.75 ^{B}	492.25 ^{B}
	N 2	306.40 ^{A}	575.00 ^{B}	623.00 ^{B}	680.00 ^{AB}	630.00 ^{C}	537.50 ^{C}	561.75 ^{B}	510.00 ^{B}

	N 3	213.90 A	645.00 B	508.75 AB	707.75 B	644.00 C	541.00 C	658.50 B	531.75 B
LSD		135.50	199.70	190.70	236.20	145.90	129.90	147.30	177.80
CV %		40.18	31.05	26.56	30.11	20.97	21.48	21.92	29.24
Callide	N 0	247.05 A	342.50 A	353.00 A	491.25 A	223.75 A	235.00 A	274.75 A	275.50 A
	N 1	329.70 A	372.00 A	471.00 AB	500.00 A	456.25 B	412.00 B	508.25 AB	402.00 AB
	N 2	329.33 A	396.25 A	551.50 BC	539.50 A	578.50 BC	524.75 B	619.75 BC	472.25 B
	N 3	311.73 A	516.25 A	675.50 C	522.00 A	640.00 C	483.25 B	670.75 C	575.00 B
LSD		135.5	199.70	190.70	236.20	145.90	129.90	147.30	177.80
CV %		40.18	31.05	26.56	30.11	20.97	21.48	21.92	29.24

Means followed with in each cultivar/cut by the same letter(s) are not significantly different according to (DMRT) at 5% level.

Cultivar Callide

The results revealed that forage mean dry weight increased with increase in nitrogen fertilizer levels added during all sampling occasions except the 1st, 4th and 6th cuts and the higher mean dry weight in these sampling obtained with added fertilizer (N2). Dry weight mean did not show consistent trends with cuts in all nitrogen levels added but the highest mean dry weight was obtained at 3rd cut with added fertilizer (N3) (Table.3a).

Cultivar Boma

The results revealed that forage mean dry weight increased with increase in nitrogen fertilizer levels added in half of sampling occasions 2nd, 4th, 5th and 7th cuts. The 1st cut had the higher mean dry weight which was obtained with added fertilizer (N1), and the higher mean dry weight in sampling 3rd, 6th and 8th was obtained with added fertilizer (N2). Dry weight mean did not show consistent trends with cuts but it increased with cuts till 5th cut and then tended to decrease in all nitrogen levels added (Table.3b).

Table 3b: The effect of treatments on dry weight (gm).

Cultivars	Treatments	No. of Cuts							
		1	2	3	4	5	6	7	8
	N 0	217.30 A	288.75 A	338.75 A	381.00 A	277.00 A	233.75 A	253.75 A	180.00 A
Boma	N 1	272.93 A	360.00 A	438.75 AB	450.00 A	460.50 B	336.75 A	435.50 B	416.75 B
	N 2	226.83 A	411.25 A	573.75 B	522.50 A	597.50 BC	547.50 B	477.50 B	568.00 B
	N 3	235.15 A	423.75 A	518.50 AB	573.00 A	641.00 C	503.50 B	502.25 B	497.75 B
LSD		135.5	199.70	190.70	236.20	145.90	129.90	147.30	177.80
CV %		40.18	31.05	26.56	30.11	20.97	21.48	21.92	29.24
Fine cut	N 0	182.75 A	365.00 A	362.50 A	496.25 A	220.00 A	205.00 A	202.50 A	150.00 A
	N 1	243.00 A	528.75 A	538.75 AB	558.00 A	518.00 B	462.50 B	405.00 B	428.25 B
	N 2	317.78 A	538.75 A	553.00 AB	629.25 A	609.50 B	540.00 BC	562.25 C	536.00 B
	N 3	303.68 A	562.50 A	705.00 B	704.00 A	649.00 B	633.25 C	604.75 C	579.75 B
LSD		135.5	199.70	190.70	236.20	145.90	129.90	147.30	177.80
CV %		40.18	31.05	26.56	30.11	20.97	21.48	21.92	29.24

Means followed with in each cultivar/cut by the same letter (s) are not significantly different according to (DMRT) at 5% level

Cultivar Fine cut

The results revealed that forage mean dry weight increased with increase in nitrogen fertilizer levels in all sampling occasions except the 1st sampling which had the higher mean dry weight obtained with added fertilizer (N2). Dry weight mean did not show consistent trends with cuts but generally increased till 3rd cut and then tended to decrease with cuts in all nitrogen levels added. The highest mean dry weight was obtained at 3rd cut with added fertilizer (N3) (Table.3b).

Discussion

Previous studies proved that nitrogen enhances vegetative growth and yield through its effect upon cell number and their rate of division. This was supported by the results of this study. Moreover, application of nitrogen fertilizer lead to significant increase in all growth parameters of the experiment, as indicated by Burhan and Hago (2000) [8], who stated that nitrogen plays an important role in plant growth and physiological processes, as it enters in all enzymes composition and enhances vegetative growth and yield.

The result revealed that plant height increased with increase in nitrogen fertilizer levels in all sampling occasions. Moreover, plant height was significantly affected by nitrogen fertilizer except on the first cut and other cultivars on the second cut also. This finding is in accordance with the results reported by Omer (1988) who stated that the application of urea fertilizer resulted in a significant difference in plant height, leaf number per plant and leaf area index of forage maize. Abdelrahman (2007) [5] reported that the non-significant effect of the nitrogen fertilizer on plant height in the first and second cuts may be due to the late application of (NPK) fertilizer to the plants in one dose, therefore the growing plants did not use fertilizer efficiently in the beginning of their growth when they were at age 10-15 days, this may explain the lack of response to added nitrogen at the first cut for all cultivars.

The results obtained revealed that forage fresh and dry weight generally increased with increase in nitrogen fertilizer levels. Moreover forage fresh and dry weight did not show consistent trend with cuts but they increased in the 4th cut and then tended to decrease with cuts. On the other hand, the effect of nitrogen fertilizer on fresh and dry weight was significant at all sampling occasions except on the first cut in all cultivars and sometimes on the second and third or fourth cut on other cultivars. Similar result were reported by Abdelrahman (2007) [5] who stated that forage fresh and dry weight were significantly influenced by increased in (NPK) fertilization levels. Also Mohammed (1990) reported that the nitrogen fertilizer increased the fresh weight in all crops, but it was pronounced on grasses compared to legumes.

Moreover, Koul (1997) [15] stated that forage fresh and dry weight increased when nitrogen rates increased. Also El-Hag and Ali (1988) [9] reported that DM percent of Rhodes grass tended to increase with advancing maturity. This was expected since young plants are generally succulent with higher moisture content compared to older plants which are woody and drier. Similar results were obtained by El-Hag *et al*. (1993) [10]. In addition Henzel (1971) [11] stated that nitrogen fertilization caused a significant increase in the nitrogen content of soil, roots and dry matter of Rhodes grass. El-Hag *et al*. (1993) [10] also stated that yield was relatively low during the first cut but it tends to increase with advancing maturity of Rhodes grass reaching maximum somewhere between the 3rd and 6th cuts. Similar results reported by Ibrahim (1999) [13] who stated that the yield of Rhodes grass increased gradually and reached the peak at fifth cut and the late cuts were better than earlier ones. This results also coincides with the findings obtained by Mohamed (2007) who reported that green yield was low during the first cut, and increased gradually, peaking in the fourth cut this might be due to its ability to spread naturally, and from the produced stolons, which spread over the ground, rooting at the nodes. Moreover during the fourth cut, the Rhodes grass reached the maximum population and biomass production per unit area. But the 5th, 6th and 7th cuts had shown fluctuations in yield. Therefore, this stage of growth can be interpreted as being not reflecting the inherent potential of the cultivar, because of the competing effect of the newly established plants searching for nutrients, Mohamed (2007).

The non-significant effect of nitrogen level observed in the result on 4th cut on both fresh and dry weight maybe due to the increase in rain rate, this period coincided with the peak of the rainy season (Appendix table.1). This result was in agreement with that reported by Keftasa (1990) [14] who stated that the average rates of increase in dry-matter yields were 121 and 65 kg/ha/day in the short rainy season with and without nitrogen fertilization respectively. Both yield and quality varied according to growing season and the short rainy season produced forage of high yield and quality. Forage fresh and dry weight increased with increase in nitrogen fertilizer level compared to the control which confirm the fact that nitrogen increase the photosynthetic capacity of growing plants and enhances growth to produce adequate dry matter. Consequently, higher yield could be expected at higher nitrogen fertilization level. This is in agreement with the finding of many researcher on the effect of nitrogen on yield of different forage grasses (Saeed, 1988; Skerman and Riveros, 1990; Geweifel, 1997; Buerkert *et al*. 2001 and Abbas, 2003) [7, 4].

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