Effect Of Different Nitrogen Fertilization Levels On Yield Of Maize (Zea Mays L.) As Winter Forage

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Abstract: The study was conducted for two consecutive seasons 2010/2011 and 2011/2012 at the Demonstration Farm of the college of Forestry and Range Sciences, Sudan University of Science and Technology, Soba Khartoum .the aims of this study was to evaluate the effect of nitrogen fertilization levels on forage maize as a potential winter crop in central Sudan in terms on biomass yield. Three nitrogen fertilization levels were examined. The treatments were arranged in a Randomized Complete Block Design (RCBD) with four replicates. Parameters studied were plant density, plant fresh weight (g), plant dry weight (g), and forage yield (tons/ha). Results obtained reveal that application did not significant affect forage plant density. Application of nitrogen increase fresh and dry weight per plant in all counts .fresh forage yield in terms of fresh forage and dry matter production was significantly increased with application of nitrogen .It was concluded that application of nitrogen fertilizer increase yield of forage maze during the winter season in central Sudan.

Keywords: Forage Maze, Nitrogen Fertilizer, Winter Forage, Central Sudan

1 INTRODUCTION

Nitrogen is an essential element for both fodder quantity and quality as it is a component of protein and chlorophyll. It is thus, essential for photosynthesis, vegetative and reproductive growth and it often determines yield of maize (Igbal et al., 2006). Fodder sorghum (Sorghum bicolor L. Moench) cultivar Abu 70, the main cereal forage in the Sudan, is a warm season crop. Despite that it is grown untimely during the winter in Khartoum State (Abuswar,2005) and along the banks of the Blue Nile and the white Nile(Khair et al.,2003).Being a summer crop, forage yield of Abu70 is suboptimal when sown in winter in Khartoum (Kambal,1983). For maintenance ration dairy cattle around cities like Khartoum are fed either green forages or crop residues or both (Khair et al., 2003).Such feeding system necessitates all year round forage production. Maize fodders contain relatively high concentration of soluble carbohydrates and yield a high quality biomass within a short period, making it attractive as hay and silage crops for tropical areas (Coors and Lauer 2000, Sleugh et al 2001).Compared to other cereal forage crops maize was found to be a high forage yielder in winter with a high protein content and lower fiber content (Kambal, 1984). In Sudan, maize can be grown to produce forage in winter season to solve problems of livestock feed shortage during this period. The current study aims at studying nitrogen fertilization levels on yield of maize (Zea mays L.) as winter forage in the irrigated areas of central Sudan.

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2 MATERIAL AND METHODS

2.1 Description of the Study area:

The study was conducted in the winter season Dec –Feb for two consecutive seasons 2010/2011 and 2011/2012 at the Demonstration Farm of the college of Forestry and Range Sciences, Sudan University of Science and Technology, Soba Khartoum (latitude 15o 16/ N,and longitude. 31o 34/ E). The Climate is tropical semi-arid with rainfall about 150 mm temperature range (6- 46) oC.

2.2 Land preparation:

The experimental site was disc ploughed and left for 15 days exposed to the sun, then disc harrowed to crush clods, and leveled out to maintain a well leveled seed bed and then followed by ridging up to 0.7m between rows which were oriented in a north-south direction. Individual plot size was 4 × 5 meters consisting of 5 ridges and then plots were grouped to four blocks each with 12 plots.

2.3 Cultural practices:

The experiment was sown on the 24th of December 2010 and 27th of December 2011 in the first and second seasons respectively. Sowing was done manually on the two sides of the ridge, 3 Seeds of maize were drilled in each hole, intra row spacing was 10 cm apart, the seed rate used was 107 Kg/ha. The plots were irrigated immediately after sowing and thereafter at intervals of 10- 15 days according to need. The application of urea fertilizer was in the level of 0, 119 and 238 kg urea/ ha as one dose immediately before the second irrigation. Plots were hand weeded before and after the experiment was sown, till the crop gave a complete cover.

2.4 Treatments:

The fertilization treatments involved three levels of Nitrogen Fertilizer in form of urea:
Zero kg urea /ha = 0 kg N / ha (0N).
119 kg urea / ha = 54.7 kg N / ha (1N).
238 kg urea / ha = 109.5 kg N / ha (2N).

2.5 Parameters measured:

2.5.1 Plant density (plant /ha):
An area of one-meter row (0.7m2) was permanently marked. The numbers of plants were counted randomly five times in each treatment. The mean numbers of plants per meter square were calculated then per ha.

2.5.2 Fresh and dry weight (g)/ Plant
Five plants were selected randomly and taken from each plot then weighted to determine the mean fresh weight per plant. Fresh samples were dried at 60°C for 48 h in a fan-assisted oven until a constant weight was reached and weighted to obtain the mean dry weight per plant.

2.6 Yield parameters:
Yield parameters (Fresh forage yield (tons/ha) and dry forage yield (tons/ha)) were measured at the harvest (milk stage). In each plot middle ridge was used for sampling.

2.6.1 Fresh forage yield (tons/ha):
The measurement of fresh yield was conducted by harvesting green forage in an area of (0.7m2) chosen from the middle ridge as destructive samples. A sickle was used for clipping plants around five cm above the soil surface. The samples were weighed using a spring balance immediately in the field to get the fresh weight. Final fresh yield was calculated in tons per ha.

2.6.2 Dry matter production (tons/ha):
Dry forage production was determined using the same samples used for fresh yield and the dry matter of each treatment calculated as done earlier. Final dry matter yield was calculated in tons per ha.

3 RESULT AND DISCUSSION

3.1 Plant density
The effect of nitrogen levels on plant density of forage maize is illustrated in Table 1. Application of nitrogen fertilization showed non-significant differences at (P> 0.05), in all three growth stages among treatments at both seasons. This finding is with Bebawi (1987) who revealed that nitrogen application had no effect on plant density. Also Afzal et al (2012) found that plant density showed non-significant behavior in second and third cutting .On the other hand Abusuwar and Mohammed (1997) reported that nitrogen fertilization had a significant effect on plant density of fodder sorghum.

Table 1: *Effect of different nitrogen fertilization levels on plant density (plant/ ha) of maize during 2010/11 and 2011/12 seasons.*

Treatments	2010- 2011			2011- 2012		
	DAS			DAS		
	45	**60**	**75**	**45**	**60**	**75**
Nitrogen levels						
0N	350584 a	317349 b	329109 a	373445 a	349526 a	309281 a
1N	351985 a	349146 a	337427 a	382765 a	351568 a	323049 a
2N	358868 a	342299 ab	322516 a	376182 a	337443 a	311768 a
S. L	NS	NS	NS	NS	NS	NS
C.V%	9.01	11.60	10.03	10.17	11.82	14.91

C.V = coefficient of variation.
S.L = significant level.
DAS= days after sowing.

3.2 Fresh weight per plant (gm):
The effect of nitrogen application on the fresh weight per plant (g) is presented in Table 2. Results revealed that nitrogen application had significant effects on treatments in all three growth stages at the two seasons. By increasing nitrogen levels fresh weight per plant was increased. While the second and third counts had maximum fresh weight per plant at 75.06 and 116.16 in 1st season, respectively and 40.02, 63.29 and 89.28 in the first, second and third count, respectively on 2nd season. The variation in green forage yield per plant among nitrogen levels can be attributed to more availability of nitrogen with the increase in nitrogen fertilizer rate. These results confirm the findings of Ayub et al. (2013), Aslam et al. (2011) and Shehzad et al. (2012).

Table 2: *Effect of different nitrogen fertilization levels on fresh weight per plant (g) of maize during 2010/2011 and 2011/2012 seasons.*

Treatments	2010- 2011			2011- 2012		
	DAS			DAS		
	45	60	75	45	60	75
Nitrogen levels						
0N	30.465 c	62.88 b	79.18 b	29.19 b	48.88 b	69.86 b
1N	35.944 b	71.21 a	91.30 b	36.95 a	56.55 ab	75.85 b
2N	41.674 a	75.06 a	116.16 a	40.02 a	63.29 a	89.28 a
S. L	***	**	***	***	**	**
C.V%	21.11	15.22	21.44	20.67	19.50	22.15

C.V = coefficient of variation.
S.L = significant level.
DAS= days after sowing.

3.3 Dry weight per plant (gm)

Data presented in table3 showed significant difference in the three DAS counted. Maximum dry weight per plant of 10.15, 19.48 and 28.91 in 1st season and 9.73, 15.25 and 21.05 in 2secd season was observed in 2N treatment which is 46 kg N/fed in first, second and third DAS respectively. The variation in dry matter yield among nitrogen levels can be attributed to the differences in uptake and availability of Nutrients for crop plants. This result is in agreement with Khair and Salih (2007) and Eltelib (2004) for sorghum. They found that application of urea increased the dry weight of multicut sorghum. On the other hand, Adar (1999) reported non-significant effect of nitrogen fertilization on plant dry weight during two seasons on forage sorghum.

Table 3: *Effect of different nitrogen fertilization levels on dry weight per plant (g) of maize during 2010/2011 and 2011/2012 seasons.*

Treatments	2010- 2011			2011- 2012		
	DAS			DAS		
	45	60	75	45	60	75
Nitrogen levels						
0N	7.556 b	15.24 b	19.44 b	7.35 b	11.81 b	16.99 b
1N	8.955 ab	17.36 ab	22.68 b	8.94 a	13.74 a	18.16 b
2N	10.147 a	19.48 a	28.91 a	9.73 a	15.25 a	21.05 a
S. L	**	***	***	***	**	**
C.V%	24.11	17.46	21.79	18.48	19.63	20.51

C.V = coefficient of variation.
S.L = significant level.
DAS= days after sowing.

3.4 Fresh and dry forage yield:

Table 4 shows that the effect of different levels of nitrogen on forage yield was significant at P<0.001 in 1st season and P<0.01 in 2nd season. The highest green yields (49.43 ton/ha) and (38.77 ton/ha) in 1st and 2ed season, respectively were obtained by applying nitrogen at 2N (110 kg N/ ha). The lowest yield was obtained in the zero nitrogen application (31.56 ton/ha) and (26.61 ton/ha), at 1st and 2nd season, respectively. The increased yield of fresh forage of the present experiment is similar to that reported by many other workers (Sultana et al., 2005; Khan et al., 1996 and Kumar et al., 2001) who indicated that the green forage yield increased significantly with increased level of nitrogen fertilizer. The results summarized in table 4 revealed that, nitrogen application significantly influenced dry forage yields during the two seasons studied. Nitrogen fertilizer resulted in progressive (P< 0.001) and (P< 0.01) increase in dry matter maize forage yield. The highest dry yield (5.15 ton/fed) and (3.83 ton/fed) at 1st and 2nd season, respectively was obtained by applying nitrogen 2N (46 kg N/fed). The lowest dry yield were obtained (3.24 ton/fed) and (2.72) at 1st and 2nd season, respectively when the zero nitrogen application. Increasing the nitrogen levels of the fertilizers significantly increased the dry yield of forage. Similar results were reported by Sultana et al., (2005) and Khan et al. (1992) who found higher DM yield when extra N fertilizer was applied to the land. Forage yield is a function of growth parameters. As shown earlier in this study, all growth parameters were affected by nitrogen fertilization among different levels. These results are in full conformity with those reported by (El Amin, 2003) and Abdel Gader, (2007).

Table 4: *Effect of different nitrogen fertilization levels on fresh forage (ton/ha) and dry matter yield (ton/ fed) of maize during 2010/11 and 2011/12 seasons.*

Treatments	2010- 2011		2011- 2012	
	fresh forage	dry matter	fresh forage	dry matter
Nitrogen levels				
0N	31.56 c	7.71 c	26.61 b	6.47 b
1N	41.27 b	10.23 b	30.20 b	7.24 b
2N	49.43 a	12.26 a	38.77 a	9.12 a
S. L	***	***	**	**
C.V%	27.05	27.16	30.18	28.48

C.V = coefficient of variation.
S.L = significant level.
DAS= days after sowing.

4 CONCLUSION

The present study investigated the effect of nitrogen fertilizer on some growth and yield parameters of forage maze. The finding reveals that application of nitrogen increased plant fresh and dry forge yield. Nitrogen fertilizer resulted in progressive (P< 0.001) and (P< 0.01) increase in fresh and dry matter yield .It was concluded that the highest rate of nitrogen applied (109.5 Kg/N/ ha) produced the highest forage yield.

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