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Impact Of Varied Nitrogen Fertilizer Rates On Growth And Yield Of Local Sorghum (Sorghum Bicolor L.) Variety In Somalia

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Abstract:
This field experiment was conducted at the agriculture faculty of Zamzam University of Science and Technology in Somalia during the winter season of 2021 to observe the growth and yield of a local variety of sorghum under varying levels of nitrogen. A randomized complete block design with 4 replications was used, with three levels of nitrogen (0.0, 75.,0 and 150.0 kg of N/ha) as treatments. The aim of the study was to determine the response of sorghum growth and yield to nitrogen levels and identify the rate that produces the highest yield. Results showed that the number of panicles, grain yield, straw yield, and biological yield were significantly different among treatments. The highest grain yield (2.657 t/h) was recorded in the third treatment (150kg/ha) and the lowest grain yield (0.872 t/h) was found in the first treatment (control). The highest straw yield (16.750 t/h) and biological yield (19.408 t/h) were also recorded in the third treatment. Overall, the third treatment showed the most promising growth and yield performance. In conclusion, applying 150kg/ha of nitrogen fertilizer to the local variety of sorghum in Somalia can significantly increase yield and should be recommended to farmers.

Keywords:*Sorghum, Nitrogen fertilizer, Growth, and yield*

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I. INTRODUCTION

Sorghum (Sorghum bicolor (L.) Moench) holds great significance as one of the most crucial cereals globally, particularly in semiarid and subtropical regions. Its prominence stems from its adaptability to challenging environmental conditions and its ability to thrive in areas with limited water availability. This makes sorghum a vital crop for regions where other cereals may struggle to grow. It is considered the fourth cereal crop after maize, wheat, and rice. Such crops can yield reasonably well under adverse conditions of low soil moisture and high temperature, although it responses well to irrigation. It is grown in different parts of the tropical and subtropical regions in the world. [1] Nitrogen is the most nutrient required for high grain sorghum productivity.[2] Balanced fertilization can increase yields. Nitrogen fertilizer promotes sucrose content, protein percent and growth rate in sorghum. N has a significant role on plant growth through cell division.[3] Nitrogen is one of the major nutrients that support crop growth and is the most responsive nutrient required by sorghum. Application of fertilizers has a direct impact on crop productivity. Plant height, number of leaves per plant, stem diameter, leaf area index, fresh yield ton\ha, dry yield ton\ha, crude protein and juice sugar content of sorghum increased with increasing nitrogen fertilizer. In addition, timing and placement of N fertilizer have a major influence on the efficiency of N management system. There is a need to use the minimum amount of nitrogen required for the maximum growth rate at any time during the growing season [4]. Rates of nitrogen fertilizer vary with soils, rainfall and irrigation patterns, and local farming practices. Although fertilizer use for crops in Somalia is very low or nonexistence, there are no fertilizer rate recommendations for Sorghum crop in the different regions of Somalia. Thus, the objective of this study is to recommend use of fertilizer particularly the most limiting nutrient for crop production, which is nitrogen, by Somali farmers. Therefore, this research seeks the appropriate rate of nitrogen fertilizer for the highest maximum yield.

II. MATERIAL AND METHODS

This experiment was conducted during the Jiilaal season (February-April 2021) at the experimental farm at Zamzam University of Science and Technology, which locates around Garasbaaley area. Garasbaaleyis situated about 11 kilometers west of Mogadishu, the nation's capital, and administratively comes under the Benaadir region. Garasbaaley lies on latitude 2.04°N and longitude 45.16°E. The soil of the experimental site is Sand loam in texture with pH (7.31), Total Nitrogen (66 mg/kg), Phosphorus (0.50 mg/kg), Potassium (28 mg/kg), and Organic Matter (0.43 mg/kg). The experiment comprised three treatments in a Randomized Complete Block Design (RCBD) with four replications, the overall size of the field was in 15 m length and 14 m of width which brings total area of 210 m² with spacing between replications of 1 m. Each replication consists of 3 plots which generally makes 12 plots in all replications. Each plot consists of 4 rows with a row length of 4 m and width of 2.5 m, which brings a plot area of 10 m² with Spacing between plots of 1 m. The experiment evaluated the sorghum local variety (Masago Gaduud) with spacing of 60cm x 20cm between rows and plants. Three to five seeds were sown per hill. Missing hills were sown with seeds to maintain desired plant population. Di Ammonium Phosphate DAP (P2O5/ha) at the rate of 75 kg/ha was added before sowing. The required nitrogen was provided by the urea source. The following growth and yield attributes were recorded after the final harvest was done; Plant height, number of panicles per plant, Panicle length, Panicle weight, Grain per panicle, thousand-grain weight, Grain yield, Straw yield, biological yield, Harvest index. Data was collected from Average of ten plants^{-1} plot, Sample plants were collected from the second and third rows. The first rows were avoided from sampling for a border effect. The mean comparisons of the treatments were evaluated by LDS (Least Significant Differences). The analysis of variance (ANOVA) for different parameters was done by a computer package program 'MSTATC' Master of Statistics.

III. RESULT AND DISCUSSION

Table 1: Morphological Parameters

Treatments	**PH**	**NP**	**PL**	**PW**
Control	224.675 b	1.125 b	8.650 a	24.863 b
75kg/ha	246.875 a	1.775 a	8.990 a	40.338 a
150kg/ha	251.575 a	1.950 a	9.957 a	44.603 a
Level of significance	*	**	NS	*
CV (%)	4.74	11.71	8.66	19.21

Values having the same letter (s) do not significantly differ.
**= highly significant at P<0.01
*= significant at a 5% level
NS= not significance
CV= Coefficient Variation

Treatments have shown a big effect on plant height (Table 1). The tallest plant height (251.575 cm) was found in treatment 3 (150kg/ha), followed insignificantly by treatment 2 (75kg/ha) (246.875 cm) while the lowest plant height (224.675 cm) was recorded in treatment 1 (Control). These results are in accordance with the findings of (Melaku, N. D., et al 2018) who reported that theplant height in the control plot was significantly ($P < 0.05$) shorter by 27–45 cm from sorghum that received nitrogen fertilizer. Nitrogen levels Increase in plant height with increased nitrogen rates is not unexpected and might be more possibly due to the direct effect of nitrogen for vegetative growth.[5]The number of panicles plant $^{-1}$ was significantly influenced by treatments (Table 1). The greatest number of panicle (1.950) was observed from treatment 3 (150kg/ha) while the smallest number of panicles per plant (1.125) was found in treatment 1 (Control). These results are in line with those of (Joseph, S. B. D., Boubacar, et al 2020) who demonstrated that treatment difference in number of panicles plant^{-1} was significant. [6]

There was no significant difference in treatments in terms of panicle length, the length of panicle increased with the increased levels of nitrogen application, the longest panicle length among the treatments (9.957 cm) was recorded from the treatment 3 (150kg/ha), followed by treatment 2 (75kg/ha) (8.990 cm) while the shortest panicle length (8.650 cm) was found in treatment 1 (Control). Gebremariam, G., & Assefa, D. (2015) revealed that panicle length plant $^{-1}$ was influenced by treatments. [7] Panicle weight was significantly different among varieties (Table 1). the largest panicle weight among the treatments (44.603 g) was found the treatment 3 (150kg/ha), followed insignificantly by treatment 2 (75kg/ha) (40.338 g) while the smallest panicle weight (24.863 g) was found in treatment 1 (Control).

Table 2: Yield Parameters

Treatments	G/P	TGW	GY	ST	BY	HI (%)
Control	538.800b	31.250 a	0.872 c	5.250 c	6.123 c	14.690 a
75kg N /ha	824.325 a	34.000 a	1.515 b	12.250 b	13.765 b	10.955 a
150kg N /ha	892.225a	33.500 a	2.657 a	16.750 a	19.408 a	13.605 a
Level of significance	*	NS	**	**	**	NS
CV (%)	18.68	8.49	19.62	8.76	8.01	18.43

Values having same letter (s) do not significantly differ.
**= highly significance at P<0.01
*= significant at 5% level
NS= not significance
CV= Coefficient Variation

Grain per panicle was significantly influenced by nitrogen treatments (Table 2). The maximum grain per panicle among the treatments (892.225) was found to be treatment 3 (150kg/ha), followed insignificantly by treatment 2 (75kg/ha), (824.325), whereas the minimum grain per panicle (538.800) was verified from treatment 1 (Control). Similar studies have indicated that treatments have significant impact on Grain per panicle Gebremariam, G., & Assefa, D. (2015) [7] The analysis of variance showed that the thousand seed weight was not significantly influenced by the treatments. The results showed that the sorghum grain yield was highly significantly influenced by the nitrogen rates, the highest grain yield among the treatments (2.657 t/h) was found treatment 3 (150kg/ha), followed by treatment 2 (75kg/ha) (1.515 t/h), and the lowest grain yield (0.872 t/h) was documented from the control with no nitrogen application. The results of this study are consistent with the results of (Shamme, S. K., &Raghavaiah, C. V. 2016) who reported that sorghum grain yield was significantly influenced by the nitrogen rates. [8]

However, there is highly significant variation among increased straw yield over the control, among all levels, 150kg N /ha rate gave the highest straw yield (16.750 t/h), followed by treatment 2 (75kg/ha) (12.250 t/h), while the lowest straw yield (5.250 t/h) was verified from control treatments. It was observed that third treatment (150kg/ha) showed the highest biological yield which was highly significantly different from treatment 2 (75kg/ha) (13.765 t/h), as well as treatment 1 (Control) (6.123 t/h). Moghimi, N., & Emam, Y. (2015) noted that responses of biological yield to nitrogen in sorghum cultivars were different and showed a positive reaction to nitrogen fertilization rate. [9]

Finally, there was not significant variation among treatments in accordance to harvest index (Table 2). The highest harvest index among the treatments (14.690 %) was found at treatment 1 (Control), while the lowest harvest index (10.955 %) among the treatments was observed at treatment 2 (75kg/ha). Comparable results were found by (Mahama, G. Y et al 2014) who stated that the Harvest index ranged from 0.28 to 0.43 among the genotypes. [10]

IV. CONCLUSION

The study was conducted to evaluate the response of sorghum for growth and yield. Sorghum crop investigated in the current study differed highly significantly in various growth and yield parameters such as Number of panicles, Grain yield, Straw yield, and biological yield, while plant height, Panicle weight, and Grain per panicle were statistically significant, whereas Panicle length, thousand grain weight, and Harvest index were not statistically significant. The highest number of panicle per plant (1.950) was observed in response to nitrogen applied at the rate of 150kg/ha while the lowest number of panicle per plant (1.125) was recorded from Control treatment, while the highest plant height (251.575 cm) was recorded from treatment 3 (150kg/ha). The effects of nitrogen fertilization rates on biological yield were highly significant. Biological yield (BY) is a function of photosynthetic rate and proportion of the assimilatory surface area. The increase in biological yield with increase in rate of N might be due to better crop growth rate. Panicle weight and grain per panicle were also significantly affected by the nitrogen rates. The sorghum was recorded longest panicle length when plants were supplied with 150kg N /ha, and the lowest panicle length was resulted from control treatments. The

application of the highest level of N resulted in less thousand grain weight compared to 75 kg N /ha. This might be because of birds, which targeted the longest plots in terms of height and panicle. Both grain yield and straw yield were highly significantly increased with increase in the rate of nitrogen application. Harvest index was not significantly influenced by nitrogen rates. It was observed that the third treatment (150kg/ha) would be the most promising treatment. Finally, the study is recommending that farmers use the third treatment (150kg/ha).

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