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EFFECT OF NITROGEN LEVELS ON GROWTH AND YIELD OF FORAGE SORGHUM [*SORGHUM BICOLOR* (L.) MOENCH] VARIETIES

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Abstract: The application of 125 % N level of RDF ha^{-1} significantly increased the growth attributes *viz.,* plant height, number of leaves plant^{-1}, dry matter plant^{-1}, number of internodes plant^{-1} at harvest as compared to rest of the nitrogen levels and it was remained at par with the application of 100 % N of RDF ha^{-1}.The application of 125 % N level of RDF ha^{-1} significantly increased forage weight (g) plant^{-1}, forage production kg day^{-1} and forage yield t ha^{-1} (60.6 t ha^{-1}) compared to other treatments.

Keywords: Nitrogen fertilizer, growth and yield characters.

INTRODUCTION

Indian economy is primarily agricultural based, where animal health is very important. To establish and improve the animal production, a critical factor in sustainable agriculture is the availability of quality forage and grasses of which production needs urgent attention. The status of forage and fodder in India indicates the availability of 390 and 443 m tons respectively as against the requirement of 1025 and 570 m tons. It creates the deficit of 62 and 22 per cent respectively (Hegde, 2006). The higher adaptability and greater biomass production potential of sorghum makes it the most popular forage crop across the country. Maharashtra has about 4 crore livestock population which needs about 12 crore tonnes of fodder. However, only 7 crore tonnes fodder is available from all sources, it means about 42 per cent fodder is deficit for livestock feeding in Maharashtra (Anonymous, 2014).

Kharif fodders are comparatively poor yielder having low nutritive value and poor rationing ability, for improving this condition it is essential to determine its fertilizer requirements. Different varieties might respond differently to fertilizer application under changing soil and

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environmental conditions. The plant nutrition may not only affect the forage production but also improve the quality forage from view point of its protein contents. Fertilizers are the king pin in the present system of agriculture. Scientific use of fertilizer assumes vital importance in sustainable agriculture. Fertilizers pay back more profit per unit investment. Judicious use of fertilizer is an important management practice to increase single cut sorghum forage production. Nitrogen is the most important plant nutrient required for forage crop production and is required in large quantities (Balasubramanian *et al.,* 2010).

The current study aims to study nitrogen fertilization levels on growth and yield of forage sorghum [*Sorghum bicolor* (L). Moench] cultivars.

MATERIALS AND METHODS

A field experiment was conducted on the Research farm of Sorghum Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S) during the *kharif*, 2015 to study the response of forage sorghum [Sorghum *bicolor* (L). Moench] cultivars to different nitrogen levels. The experiment was laid out in factorial randomized block design with three cultivars of forage sorghum (**V_1**- Phule Godhan,**V_2**- Phule Amruta,**V_3**- Phule Ruchira) and four levels of nitrogen in percentage (**N_1**- 50 %, **N_2**-75 %, **N_3**- 100 % and **N_4**-125 % N of RDF) replicated thrice. The soil of the experimental field was clay in texture, low in available nitrogen (248 kg ha^{-1}), low in available phosphorus (11.62 kg ha^{-1}) and very high in potassium (314 kg ha^{-1}).The soil was slightly alkaline in reaction (pH 8.23) with low in electrical conductivity 0.38 dSm^{-1}. The moisture at field capacity and permanent wilting point were 32.16 and 16.02 per cent, respectively, with bulk density 1.38 Mg m^{-3}. As per the treatment split dose of nitrogen and entire dose of phosphorus and potassium was applied by placement method, through straight fertilizers. The total rainfall received during the crop growth period was 180.7 mm. The experimental plot was irrigated at regular intervals depending on the moisture condition of the soil.

RESULTS AND DISCUSSION

Effect of nitrogen levels

The data presented in table 1 revealed that, significantly more plant height at harvest was recorded in treatment where 125% N level of RDF ha^{-1} was applied (N_4) which was remained at par with application of 100 % N level of RDF (N_3). The increase in the plant height might be due to the positive effect of nitrogen element on plant growth that leads to progressive increase in inter nodal length and consequently plant height. Similar results were reported by Agarwal *et.al.* (2005) and Gupta *et al.* (2008). The effect of nitrogen levels on number of

leaves (Table 1) revealed that, significantly maximum number of leaves plant^{-1} (13.40) at harvest was recorded at 125 % N level of RDF ha^{-1} than the other levels of nitrogen, however, it was at par with application of 100% N of RDF ha^{-1} at harvest. Increase in number of leaves plant^{-1} in forage sorghum with application of nitrogen has also been reported by Patil *et al.* (2014), Ahmad *et al.* (2011) and Backiyavathy *et al.* (2007). The dry matter accumulation plant^{-1} with application of 125% N level of RDF ha^{-1} was higher (68.7 g plant^{-1}) and it was significantly more than the other percentage levels of nitrogen applications. However, it was at par with application of 100% N level of RDF ha^{-1} (63.2 g plant^{-1}). Increase in nitrogen level might have resulted in more active plant growth, which consecutively resulted in more dry matter partitioning. Similar results were reported by Yadav *et al.* (2007), Singh *et al.* (2005) and Mahmud *et al.* (2003) who found that there is significant increase in dry matter accumulation plant^{-1} with increase in nitrogen application. The number of internodes (11.67) of forage sorghum was significantly increased under application of 125 % N level of RDF ha^{-1} as compared to other percentage of nitrogen levels. These results are in conformity with the findings of Patil *et al.* (2014) that, there is significant increase in number and length of internodes plant^{-1} with increase in nitrogen levels. The forage weight (g) plant^{-1}, forage production day^{-1} (kg ha^{-1}) and forage yield (t ha^{-1}) of forage sorghum were significantly increased linearly with increased nitrogen levels. Forage sorghum received with 125 % N level of RDF ha^{-1} has significantly maximum forage weight (488 g plant^{-1}), forage production kg day^{-1} (887.3 kg) and forage yield t ha^{-1} (60.6 t ha^{-1}) followed by 100% N level of RDF ha^{-1} (460.0 g plant^{-1} and 843.3 kg production day^{-1} and forage yield 56.5 t ha^{-1} respectively). The reason for higher forage yield was that, the higher N received by plants may be attributed to the most lucrative consumption of applied nitrogen and other allied environmental resources by the forage sorghum crop which resulted in maximum biomass yield. Increase in forage yield with increased nitrogen was mainly associated with greater plant height, higher number of leaves plant^{-1} and stem diameter. The lower application of N level (50 % of RDF ha^{-1}) significantly decreased forage weight (g) plant^{-1}, forage production day^{-1} and forage yield (t ha^{-1}) because of significant reduction in yield attributes.

These results are in full conformity with those reported by Shahin *et al.* (2013), Karwasra and Anil Kumar (2006), Verma *et al.* (2005) and Sunil Kumar *et al.* (2004) in case of forage sorghum.

Effect of forage sorghum cultivars

A significant difference in plant height of forage sorghum was recorded among the different forage sorghum cultivars at harvest. Among the forage sorghum cultivars, Phule Godhan showed significantly higher plant height (292.4 cm), functional leaves plant^{-1} (12.65) and dry matter accumulation plant^{-1} (64.6 g plant^{-1}) than the other forage sorghum cultivars. Agarwal *et al.* (2005) also reported that, plant height of forage sorghum varieties were significantly affected due to different levels of nitrogen application and exhibited increasing trend with the increasing levels of nitrogen from 0 to 150 kg ha^{-1}.

The forage weight (g) plant^{-1}, forage production day^{-1} (kg ha^{-1}) and forage yield (t ha^{-1}) were significantly increased by Phule Godhan forage sorghum cultivar as compared to Phule Amruta and Phule Ruchira. This might be due to photosynthetic efficiency of that cultiver to convert its photosynthates into production by integrated effects of genetic makeup of cultivars and growing condition of a crop.

INTERACTIONS

Number of internodes of forage sorghum were significantly affected due to interaction effects between forage sorghum cultivars and percentage levels of nitrogen as presented in table 1(a). The combination of 125% N level of RDF ha^{-1} and Phule Godhan forage sorghum produced significantly highest number of internodes (11.93) followed by 100% N level of RDF ha^{-1}.

CONCLUSIONS

On the basis of results obtained, it can be concluded that, the forage sorghum cultivar Phule Godhan with application of 125 % N level of RDF ha^{-1} found more profitable for forage yield and monetary returns.

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Table 1: Growth and yield of forage sorghum as influenced by different treatments.

Treatments	Plant height (cm)	No. of functional leaves plant^{-1}	Dry matter plant^{-1} (g)	Number of internodes plant^{-1}	Forage weight (g) plant^{-1}	Forage production day^{-1} (kg ha^{-1})	Forage yield (t ha^{-1})
Forage sorghum cultivars (V)							
V_1- Phule Godhan	292.4	12.65	64.6	10.67	486.5	852.5	60.1
V_2- Phule Amruta	269.7	12.53	57.5	10.08	453.5	863.6	55.7
V_3- Phule Ruchira	252.5	10.29	48.2	10.08	411.5	768.0	50.0
S.Em ±	4.5	0.23	1.5	0.06	12.5	19.3	1.7
C.D. at 5 %	13.4	0.67	4.5	0.18	31	45.8	4.2
Nitrogen levels (N)							
N_1- 50 % N of RDF	239.8	10.00	45.7	9.02	419.5	785.5	50.9
N_2 -75 % N of RDF	253.4	11.12	49.4	9.73	436.5	797.6	53.2
N_3 -100 % N of RDF	294.0	12.78	63.2	10.69	460	843.3	56.5
N_4 -125 % N of RDF	299.0	13.40	68.7	11.67	488	887.3	60.6
S.Em ±	5.2	0.26	1.8	0.07	11	21.4	1.6
C.D. at 5 %	15.5	0.78	5.3	0.21	26.5	41.2	3.5
Interaction (V x N)							
S.Em ±	9.04	0.45	3.1	0.12	31	50.9	3.7
C.D. at 5 %	NS	NS	NS	0.36	NS	NS	NS
General mean	**271.5**	**11.83**	**56.8**	**10.28**	**450.5**	**828**	**55.3**

Table 1(a): Interaction effects between forage sorghum cultivars and nitrogen levels on number of internodes plant^{-1} of forage sorghum at harvest.

Forage Cultivars / **Nitrogen levels**	**Number of internodes plant^{-1}**		
	V_1 Phule Godhan	**V_2** Phule Amruta	**V_3** Phule Ruchira
N_1- 50 % N level of RDF ha^{-1}	9.67	8.73	8.67
N_2 -75 % N level of RDF ha^{-1}	10.33	9.53	9.33
N_3 -100 % N level of RDF ha^{-1}	10.73	10.40	10.93
N_4 -125 % N level of RDF ha^{-1}	11.93	11.67	11.40

Source	S.Em ±	C.D. at 5 %
Interactions (V x N)	0.12	0.36