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RESEARCH PAPER

Effect of nitrogen and zinc on growth and yield of fodder sorghum [*Sorghum bicolor* (L.) Moench] varieties

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Abstract : A field experiment was conducted on loamy sand soil of the Agronomy Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar to study the, effect of nitrogen and zinc on growth and yield of fodder sorghum [*Sorghum bicolor* (L.) Moench] varieties during summer season of 2011. Eighteen treatment combinations consisted of two varieties, *viz*., GFS 4 and GFS 5; three levels of nitrogen *viz*., 40, 80 and 120 kg N ha^{-1} and three levels of zinc *viz*., 0, 2 and 4 kg Zn ha^{-1} were tried in Factorial Randomized Block Design with three replications. The results indicated that among the variety of fodder sorghum GFS 5 performed better in respect to growth parameters and green forage (257 q ha^{-1}) as well as dry matter (119 q ha^{-1}) yield than variety GFS 4. Application of 120 kg N ha^{-1} increasing green forage (262.00 q ha^{-1}) as well as dry matter yields (120.00 q ha^{-1}) over 40 kg N ha^{-1} and 80 kg N ha^{-1}. Application of zinc @ 4 kg Zn ha^{-1} was found significantly superior and produced highest green forage (254 q ha^{-1}) and dry matter yield (120 q ha^{-1}) than 2 kg Zn ha^{-1}.

Key Words : Varieties, Nitrogen, Zinc, Fodder sorghum

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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 the availability of quality forage crops and grasses and their production needs urgent attention. Gujarat state has a total animal population of 18.44 million heads and the total forage production is 20.0 million tonnes against the requirement of 49.2 million tonnes (Anonymous,2006). Thus, a gap of 29.2 million tonnes exists between the demand and supply of fodder, which is ought to further widen due to further steady rise in the livestock population and diversion of more area to grain and cash crops. The total area under forage crops in the state is 0.8 million hectares (*i.e.*, 6.4 % of the total cultivated area). Thus, the state is not only short of quantity but good quality of fodder too (Patel, 2005). Dairy farming is a back bone of the farmers and economy in North Gujarat area owing to poor land holding and uncertain climatic conditions (Anonymous, 1987). Under the circumstances, it is rather difficult to supply green fodder to mulching cattle round the year. In this area, farmers mainly grow sorghum as a fodder crop. Sorghum is an important cereal fodder crop. Due to its excellent growing habit, high potential, better nutritive value and quick regrowth, it is extensively grown in Northern, Central and North- West regions of the country. It can withstand heat, drought and also tolerate water logging better than other forage crops. In order to importance, fertilizer is the single most important input for securing higher production. Nitrogen is the most important nutrient for plant growth and is the most limiting nutrient in our soils. Nitrogen application increase crude protein and metabolizable energy, besides improving succulency and palatability of fodder crops. It is the important constituent of chlorophyll and protein. It imparts

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dark green colour to the plants, promotes vegetative growth and rapid early growth. It improves the quality by increasing the protein content of fodder crops and governs to a considerable degree, the utilization of protein, phosphorus and other elements. A comparative study made for the assessment of zinc status of Gujarat soils has clearly indicated that Banaskantha district with study soil has recorded the highest per cent of zinc deficient soils(4.4%) with less than 0.5 ppm DTPA extractable zinc. The total content of zinc in soils of Gujarat varied between 20-95 ppm. The delineation work revealed overall per cent deficiency of available zinc is 24.0 per cent ranging from 2 to10 per cent, respectively in different pockets of state (Dangerwala *et al.*, 1996). The decline in deficiency could be ascribed mainly due to use of micronutrient fertilizers and organic manures by the farmers.

MATERIAL AND METHODS

The field experiment was conducted at S.D. Agricultural University, Sadarkrushinagar, during summer 2011. The soil of experimental field was loamy sand in texture, low in organic carbon and available nitrogen, medium in available phosphorus and rich in available potassium. Eighteen treatment combinations consisted of two varieties *viz.*,V_1: (GFS 4), V_2: (GFS 5), three levels of nitrogen *viz*., N_1: 40 kg N ha^{-1}, N_2: 80 kg N ha^{-1} and N_3: 120 kg N ha^{-1} and three levels of zinc *viz*., Zn_0: 0 kg Zn ha^{-1}, Zn_1: 2 kg Zn ha^{-1} and Zn_2: 4 kg Zn ha^{-1} were tested under factorial randomized block design with four replications. The furrow was opened manually in each plot at a distance 45 cm. Before sowing the seed, half dose of nitrogen and full dose of zinc fertilizer according to calculated quantities as per treatment was applied in the opened furrow at a depth of about 8-10 cm. The nutrient N and Zn were applied in the form of urea and zinc sulphate, respectively. The recommended dose of phosphorus (40 kg P_2O_5 ha^{-1}) in the form of diammonium phosphate was applied before sowing in all the plots. The fertilizers were covered with a 4-5 cm layer of soil. The remaining half dose of nitrogen in the form of urea was applied at 35 days after sowing as per treatment. In the previously opened furrows, seed were sown manually and covered with a thin layer of soil. The irrigations were given as and when required. The experimental field was kept weed free through one inter cultivating by hand hoe and hand weeding.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under

Table 1 : Growth and yield of fodder sorghum varieties as influenced by different nitrogen and zinc levels

Treatments	Plant height (cm) at harvest	No. of leaves per plant at harvest	No. of days to 100% flowering	No. of internodes per plant	Stem thickness (cm)	length of internode (cm)	Leaf: stem ratio	Green forage yield (q ha^{-1})	Dry matter yield (q ha^{-1})
Varieties (V)									
V_1 : GFS 4	150.56	6.62	50	5.82	0.56	15.02	0.32	232	103
V_2 : GFS 5	159.00	6.90	58	6.00	0.72	21.43	0.45	257	119
S.E.±	2.63	0.11	1.23	0.09	0.01	0.38	0.01	4.24	1.61
C.D. (P=0.05)	7.58	NS	3.53	NS	0.03	1.10	0.03	12.19	4.63
Nitrogen levels (kg ha^{-1})									
N_1 : 40 kg N ha^{-1}	146.67	6.23	58	5.75	0.63	17.38	0.35	224	102
N_2 : 80 kg N ha^{-1}	155.67	6.69	53	5.94	0.64	18.10	0.38	248	111
N_3 : 120 kg N ha^{-1}	162.00	7.35	52	6.03	0.66	19.19	0.41	262	120
S.E.±	3.23	0.14	1.50	0.11	0.01	0.47	0.01	5.19	1.97
C.D. (P=0.05)	9.28	0.40	4.33	NS	NS	1.35	0.03	14.93	5.68
Zinc levels (Zn)									
Zn_0 : 0 kg Zn ha^{-1}	152.61	6.59	55	5.83	0.63	17.62	0.36	235	101
Zn_1 : 2 kg Zn ha^{-1}	155.72	6.79	54	5.90	0.64	18.21	0.39	245	112
Zn_2 : 4 kg Zn ha^{-1}	156.00	6.89	53	5.99	0.65	18.84	0.40	254	120
S.E.±	3.23	0.14	1.50	0.11	0.01	0.47	0.01	5.19	1.97
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	14.93	5.68
C.V. %	8.85	8.89	12	8.05	8.91	10.90	12.99	9.00	7.53
Interaction									
V X N	NS	NS	NS	NS	NS	NS	NS	NS	Sig
V X Zn	NS	NS	NS	NS	NS	NS	NS	NS	NS
N X Zn	NS	NS	NS	NS	NS	NS	NS	NS	NS
V X N X Zn	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS=Non-significant

Table 2 : Dry matter yield (q ha^{-1}) as influenced by interaction of varieties and nitrogen

Treatments	Levels of nitrogen		
Varieties (V)	N_1 (40 kg Nha^{-1})	N_2 (80 kg Nha^{-1})	N_3 (120 kg Nha^{-1})
V_1 (GFS 4)	93.89	107.00	109.00
V_2 (GFS 5)	110.22	115.00	131.56
S.E..±		4.71	
C.D. (P=0.05)		13.56	
C.V.%		7.53	

following heads :

Effect of varieties:

The outcome of the investigation among the varieties GFS 5 recorded significantly higher plant height, stem thickness, length of internodes and leaf: stem than variety GFS 4.The differences in growth attributes such as, number of leaves per plant and number of internodes per plant were non- significant (Table 1). The lowest days to 100% flowering was observed under V_2 (GFS 5). Variety GFS 5 produced significantly the highest green forage yield (257 q ha^{-1}) and dry matter yield (119.00 q ha^{-1}).

Effect of nitrogen:

The results show that the application of 120 kg N ha^{-1} was found significantly superior to 80 kg and 40 kg N ha^{-1} as it enhanced the plant height, number of leaves per plant at harvest as well as leaf: stem ratio and length of internode. The growth attributes such as number of internodes per plant, stem thickness were not affected significantly. Days for 100% flowering decreased with the increase in nitrogen level from 40 to 120 kg ha^{-1}. Green forage (262q ha^{-1}) and dry matter (120q ha^{-1}) were found significantly higher under treatment N_3 (120 kg N ha^{-1}).Whereas, the lowest green forage and dry matter yield were recorded under treatment N_1 (40 kg N ha^{-1}) (Table 1). This might have accelerated the meristematic activity, vegetative growth and photosynthetic activity, consequently resulting in to increased plant height, number of leaves per plant, internode length which had eventually increased green forage and dry matter yields. Similar trend was also observed by Sumeriya *et al.* (2007), Gupta *et al.* (2008) and Azam *et al.* (2010).

Effect of zinc:

Fertilizing the fodder sorghum with different levels of zinc failed to show significant increase in plant height, number of leaves per plant, number of internodes per plant, stem thickness, length of internode, days to 100% flowering and leaf: stem ratio (Table 1). Application of zinc @ 4 kg Zn ha^{-1} was found significantly superior and produced highest green forage (254 q ha^{-1}) and dry matter yield (120 q ha^{-1}). These results are in close conformity with those reported by Patel and Patel (1994) and Verma *et al.* (2005).

Interaction effect:

Interaction between variety and nitrogen (VxN) was found to be significant in respect of dry matter yield of forage sorghum only (Table 1). The treatment combination V_2N_3 (GFS 5 fertilized with 120 kg N ha^{-1}) gave the highest dry matter yield (Table 2). These results are in accordance with those reported by Ammaji and Surynarayana (2003).

Conclusion:

Based on the results from one year experimentation it is concluded that higher production of fodder sorghum crop grown in summer season loamy sand soil of North Gujarat by growing the variety GFS 5 and fertilized with 120 kg N ha^{-1} and 4 kg Zn ha^{-1}.

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