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Effect of Integrated Nutrients Management on Nutrients Content and Uptake of Forage Sorghum

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The field study was "Effect of integrated nutrients management on nutrients content and uptake of forage sorghum'' was carried out during summer season at Main Forage Research Station, Anand Agricultural University, Anand, Gujarat. Result showed that treatment T6 (100-40 N-P kg ha-1 + *Azospirillum*) recorded higher N, P and K content and uptake in plants. Significantly higher content N (1.56 %) and P (0.25 %) and was remained at par with treatment T3 N (1.39 %) and P T_5 (0.24 %) T_9 (0.24%), T_{11} (0.22 %) and T_{12} (0.23%). Significantly higher N uptake (205.7 kg ha^{-1}) recorded in T6 and was at par with treatments T_3 (179.6 kg ha^{-1}) and T_9 (184.2 kg ha^{-1}) and P uptake (33.3 kg ha^{-1}) recorded in T6 and was remained at par with treatments T_9 (32.2 kg ha^{-1}), T_3 (31.8 kg ha^{-1}), T_5 (28.5 kg ha^{-1}) and T_5 (27.9 kg ha^{-1}). The INM effect on potash content and uptake was found non-significant.

Keywords: Sorghum; INM; Azospirillum; PSB; content; uptake; N, P and K.

1. INTRODUCTION

Sorghum (*Sorghum bicolor*) is the major millet of India. It belongs to the poaceae family; sorghum genus is having 25 species of flowering plants as grass. It is domesticated in Africa and spread throughout the world. Sorghum being a cereal crop exhausts more nutrients than other forage crops and it requires high amount of nitrogen [1]. According to Anonymous [2]. it is grown for the

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human consumption and pastures for the cattle's. Sorghum is the fourth most important cereal crops of India, next to rice, wheat and maize. In India, the area under sorghum is approximately 7.38 million hectares with an annual production of 61.88 million tonnes [3]. Integrated use of all potential sources of plant nutrients seems to be the only option to maintain soil fertility and crop productivity. At present, the country faces net deficit of 61.1 per cent green fodder and 21.9 per cent dry fodder. This situation indicates green forage supply has to grow at 3.2 per cent to meet the deficit [4,5] and [6]. Gujarat state has total animal population of 18.44 million heads and their total fodder requirement worked out is 42.2 million tons, whereas only 20.0 million tons of fodder is made available in normal year [4,5] and [6].

Integrated nutrient management play an important role in growth as well as quality of fodder crop production. Nitrogen is the most important nutrient for plant growth and is the most limiting nutrient in our soils. Nitrogen application increases crude protein and metabolizable energy, besides improving succulence and palatability of fodder crops. It is the important constituent of chlorophyll and protein. It imparts dark green color 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. Ram and Singh [7] also noted that nitrogen application to forage sorghum significantly increased the nitrogen uptake, leaf: stem ratio, crop growth rate, relative growth rate as well as the forage and crude protein yields of forage sorghum.

Bio fertilizers like *Azosprillum* and phosphate solubilizing bacteria (PSB). *Azosprillum* has the capacity to increase the dry fodder and green fodder yield from 7.8 to11.3 percent [8]. Sharma et al. [9] said that in case, the nutrient requirement will not have fulfilled by these sources then inorganic fertilizers were applied to the crops. Appropriate application of chemical fertilizers with FYM improves the soil biological, chemical and physical properties and improves the soil productivity. In this article focus has given on effect of nutrient management on different aspects of sorghum crop growth and development including soil health. Indian soils are characterized as medium status of available nitrogen, available phosphorus and organic carbon and deficient for many micronutrients. Bio-fertilizers play an important role in the increasing availability of nitrogen and phosphorus [10]. They increase the biological fixation of atmospheric nitrogen and enhance the availability to crop. *Azosprillum* and phosphate solubilizing bacteria being essential components of organic farming are the preparations containing live or latent cell of efficient strain of nitrogen fixing, phosphate solubilizing or cellulolytic microorganisms used for application of seed, soil or composting areas with the objectives of increasing number of such microorganisms and very significant role in improving soil fertility by fixing atmospheric nitrogen [11]. Therefore, introduction of efficient strain of "*Azotobacter* and *Azospirillum*" in the soil which is poor in nitrogen, may be helpful in boosting up production and consequently more nitrogen fixation.

2. MATERIALS AND METHODS

The experiment was conducted during the summer season at Main Forage Research Station, Anand Agricultural University, Anand, Gujarat. Total twelve treatments comprising of three N and P treatments and nine bio-fertilizers treatments. The treatments detail includes, that is, T1 : 60-40 (N-P kg ha-1), T2 : 80- 40 (Recommended dose of N-P kg ha-1), T3 : 100-40 (N-P kg ha-1), T4 : 60-40 (N-P kg ha-1) + *Azospirillum*, T5 : 80-40 (N-P kg ha-1) + *Azospirillum*, T6 : 100-40 (N-P kg ha-1) + *Azospirillum*, T7 : 60-20 (N-P kg ha-1) + *PSB*, T8 : 80-20 (N-P kg ha-1) + *PSB*, T9 : 100-20 (N-P kg ha-1) + PSB, T10: 60-20 (N-P kg ha-1) + *Azospirillum* + PSB, T11: 80-20 (N-P kg ha-1) + *Azospirillum* + PSB and T12 : 100-20 (N-P kg ha-1) + *Azospirillum* + PSB. Nitrogen from plant sample was determined after cutting and recorded in percentage using Kjeldhal's method [12]. Phosphorus and potassium contents were estimated by using Vandomolybdo phosphoric acid yellow colour method in HNO_3 [12] and flame photometric method as described by Jackson [12], respectively. The nutrient uptake was worked out by employing the following formula,

Nutrient uptake = [Dry matter yield (q ha^{-1}) x Nutrient content (%)]/100

Statistically analysis was done using standard methodology of randomize block design. The statistical analysis of green and dry fodder yield was done by using statistical methods as per the procedure described by Steel and Torrie (1982).

3. RESULTS AND DISCUSSION

3.1 Effect of Integrated Nutrients Management on N, P and K Content (%) from Plant

The data on NPK content (%) of forage sorghum as influenced by integrated nutrient management treatments are summarized in Table 1. The data indicated that N and P content were significantly affected by integrated nutrient management. The effect on K content was non-significant. Significantly highest N content (1.56 %) recorded by T_6 (100-40 N-P kg ha^{-1} + *Azospirillum)* and was remained at par with treatment T_3 (1.39 %). The tune of per cent increase in N content (14.10 %) under T_6 treatment over treatment T_2 recommended dose of fertilizer. Significantly lower N content (1.17 %) was recorded under the treatment T_1 (60-40 N-P kg ha^{-1}). It may be due to addition of N through application of bio fertilizer (*Azospirillum*) increase N content in soil. The results reported are in conformity with the findings of Pankhaniya et al. [13].

Significantly higher P content (0.25 %) recorded by T_6 (100-40 N-P kg ha^{-1} + *Azospirillum)* and was at par with treatments T_3 (0.25 %), T_5 (0.24 %) T_9 (0.24%), T_{11} (0.22 %) and T_{12} (0.23%). The tune of per cent increase in P content (16.00 %) under T_6 treatment over treatment T_2 recommended dose of fertilizer. Significantly lower P content (0.20 %) was recorded under the treatment T_1 (60-40 N-P kg ha^{-1}). It may be due to addition of phosphorus through application of bio-fertilizer increase P content in soil. The results reported are in conformity with the findings of Pankhaniya et al. [13].

3.2 Effect of Integrated Nutrients Management on N, P and K Uptake (kg ha^{-1}) from Plant

The data on NPK uptake (kg ha^{-1}) of forage sorghum as influenced by integrated nutrient management treatments are summarized in Table 1. The data indicated that N and P uptake was significantly affected by integrated nutrient management. The effect on K uptake was non-significant. Significantly highest N uptake (205.7 kg ha^{-1}) recorded by T_6 (100-40 N-P kg ha^{-1} + *Azospirillum)* and was at par with treatments T_3 (179.6 kg ha^{-1}) and T_9 (184.2 kg ha^{-1}). The tune of per cent increase in N uptake (23.4 %) under T_6 treatment over treatment T_2 recommended dose of fertilizer. Significantly lower N uptake (125.6 kg ha^{-1}) was recorded under the treatment T_1 (60-40 N-P kg ha^{-1}). The results are in conformity with the findings of Pankhaniya et al. [13]. Nitrogen absorption by sorghum N is main constituent of protein and it is involved in the synthesis of amino acids and accumulation of protein in plants. These results are in accordance with those of Dadheech et al. [14] and Singh et al. [15].

Significantly highest P uptake (33.3 kg ha^{-1}) recorded by T_6 (100-40 N-P kg ha^{-1} + *Azospirillum)* and was remained at par with treatments T_9 (32.2 kg ha^{-1}), T_3 (31.8 kg ha^{-1}), T_5 (28.5 kg ha^{-1}) and T_5 (27.9 kg ha^{-1}). The tune of per cent increase in P uptake (18.2 %) under

Table 1. Effect of integrated nutrients management on NPK content and uptake of plant

Sr. no.	Treatments	Content (%)			Uptake (kg ha^{-1})		
		N	P	K	N	P	K
T_1	60-40 (N-P kg ha^{-1})	1.17	0.20	0.31	125.6	22.6	33.20
T_2	80-40(Recommended dose of N-P kg ha^{-1})	1.34	0.21	0.32	157.5	27.2	38.36
T_3	100-40 (N-P kg ha^{-1})	1.39	0.25	0.34	179.6	31.8	40.10
T_4	60-40 (N-P kg ha^{-1}) + *Azospirillum*	1.34	0.21	0.30	143.9	22.7	33.60
T_5	80-40 (N-P kg ha^{-1}) + *Azospirillum*	1.36	0.24	0.31	164.5	28.5	38.13
T_6	100-40 (N-P kg ha^{-1}) + *Azospirillum*	1.56	0.25	0.36	205.7	33.3	42.05
T_7	60-20 (N-P kg ha^{-1}) + PSB	1.19	0.21	0.29	133.2	24.0	33.50
T_8	80-20 (N-P kg ha^{-1}) + PSB	1.34	0.22	0.31	156.7	24.5	37.03
T_9	100-20 (N-P kg ha^{-1}) + PSB	1.37	0.24	0.37	184.2	32.2	43.24
T_{10}	60-20 (N-P kg ha^{-1}) + *Azospirillum* + PSB	1.24	0.20	0.31	143.1	23.4	36.14
T_{11}	80-20 (N-P kg ha^{-1}) + *Azospirillum* + PSB	1.25	0.22	0.32	144.1	25.2	37.24
T_{12}	100-20(N-P kg ha^{-1}) +*Azospirillum* + PSB	1.38	0.23	0.34	169.3	27.9	42.63
S. Em. ±		0.06	0.01	0.02	11.5	1.9	2.79
C.D. at 5 %		0.17	0.03	NS	33.3	5.6	NS
C.V. %		9.27	9.6	10.32	14.6	14.3	14.18

T_6 treatment over treatment T_2 recommended dose of fertilizer. Significantly lower P uptake (22.6 kg ha^{-1}) was recorded under the treatment T_1 (60-40 N-P kg ha^{-1}). Phosphorus compounds are the production of organic acids, accompanied by acidification of the medium. The results are in conformity with the findings of Pankhaniya et al. [13]. Moreover, increase in uptake of nutrients due to optimum release of nutrients besides mobilizing unavailable plant nutrients into available form by bio fertilizers that in turn gave higher green forage production. These results are supported by findings of Gopalan et al. [16] and Singh et al. [17].

4. CONCLUSION

Based on one-year study, it is concluded that application of 100-40 (N-P kg ha-1) + Azosprillum to obtain higher soil available N, P and nutrients uptake by sorghum as compared to other treatments in sandy loam soil of middle Gujarat, India.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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