www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(10): 1443-1446

www.thepharmajournal.com
Received: 28-08-2022
Accepted: 02-10-2022

KP Bhuriya
Main Sugarcane Research Station, Junagadh Agricultural University, Kodinar, Gujarat, India

VL Nagar
Main Sugarcane Research Station, Junagadh Agricultural University, Kodinar, Gujarat, India

PD Kumawat
Main Sugarcane Research Station, Junagadh Agricultural University, Kodinar, Gujarat, India

VP Bamaniya
Main Sugarcane Research Station, Junagadh Agricultural University, Kodinar, Gujarat, India

Corresponding Author:
KP Bhuriya
Main Sugarcane Research Station, Junagadh Agricultural University, Kodinar, Gujarat, India

Effect of integrated nutrients management on yield and quality of forage sorghum

KP Bhuriya, VL Nagar, PD Kumawat and VP Bamaniya

Abstract
The field study forage sorghum during summer season at Main Forage Research Station, Anand Agricultural University, Gujarat. Application of 100-40 (N-P kg ha^{-1}) + *Azospirillum* recorded significantly higher green forage yield (394 q ha^{-1}) and at par with T3 (371 q ha^{-1}), T12 (364 q ha^{-1}) and T9 (363 q ha^{-1}). Significantly higher dry matter content (38.9%) was recorded by T6 (100-40 N-P kg ha^{-1} + *Azospirillum*). Higher neutral detergent fiber (NDF) content 68.98 per cent was recorded T1 (60-40 (N-P kg ha^{-1}). The effect of integrated nutrient management on acid detergent fiber (ADF) content and hemicellulose content was non-significant.

Keywords: Sorghum, INM, Azospirillum, PSB, yield, DM, CP, ADF, NDF, hemicellulose content

Introduction
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 (Patel *et al.*, 2018) [7]. 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 (Dodiya and Bhuriya, 2016) [3] and (Bhuriya *et al.*, 2015) [1]. 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 (Dodiya and Bhuriya, 2016) [3] and (Bhuriya *et al.*, 2015) [1].
Integrated nutrient management plays an important role in growth as well as quality of fodder crop production. Nutrient interactions have a role to play in determining the course and outcome of two major issues of interest in fertilizer management-namely, balanced fertilizer input and efficient fertilizer use. The N and P interaction can be termed the single most important nutrient interaction of practical significance. In addition to nitrogen, potassium is the major plant nutrient absorbed and removed by crops in the largest amounts among all essential nutrients. High levels of nitrogen fertilizer or manure will increase the likelihood of prussic acid poisoning as well as nitrate poisoning. Very dark green plant often contains higher levels of prussic acid (Bhuriya *et al.*, 2019) [2]. Phosphorus is one of the major essential plant nutrients after nitrogen and is the second most deficient plant nutrients (Bhuriya *et al.*, 2019) [2]. Application of phosphorus fertilizer gradually increased plant height, stem diameter, number of leaves per plant, leaf area per plant and fodder yield (Bhuriya *et al.*, 2019) [2].
Use of bio-fertilizers in increasing availability of nutrients, fertilizer use efficiency and microbial biomass. Indian soils are characterized as medium status of available nitrogen, available phosphorus and organic carbon and deficient for many micronutrients (Bhuriya *et al.*, 2019) [2]. Bio-fertilizers play an important role in the increasing availability of nitrogen and phosphorus. *Azospirillum* and *PSB* being essential components of organic farming are the preparations contain live or latent cell of efficient strain of nitrogen fixing, phosphate solubilizing or cellulolytic microorganisms used 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 (Bhuriya *et al.*, 2015) [1] and (Dodiya and Bhuriya, 2016) [3]. *Azospirillum* has increased the green and dry fodder yield of from 7.8 to 11.3 per cent, (Bhuriya *et al*., 2015) [1] and (Dodiya and Bhuriya, 2016) [3].

Materials Method

The experiment was laid out in Randomized Block Design (RBD) with four replications, measuring a net plot size of 4.4 m x 2.4 m. A composite sample of 0-15 cm deep soil was used for physical and chemical analysis method described by Bhuriya *et al*. (2019) [2]. The seed of the fodder sorghum cv. GFS – 4 (single cut) was sown 30 cm between row and seed rate 60 kg/ha (Dodiya and Bhuriya, 2016) [3]. The experimental plot was prepared as per the method described by Bhuriya *et al*. (2015) [1]. 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.*

Result and Discussion

Green forage yield (q ha^{-1})

Green forage yield was significantly affected influence by integrated nutrient management (Table 1.1). Application of 100-40 (N-P kg ha^{-1}) + *Azospirillum* (T_6) recorded significantly highest green forage yield (394 q ha^{-1}) and was at par with T_3 100-40 (N-P kg ha^{-1}) (371 q ha^{-1}), T_{12} 100-20(N-P kg ha^{-1}) +*Azospirillum* + *PSB* (364 q ha^{-1}) and T_9 100-20 (N-P kg ha^{-1}) + *PSB* (363 q ha^{-1}). The increase in green fodder under T_6 was to the tune of 5.83, 7.61 and 7.86 per cent over T_3, T_{12}, and T_9, respectively. The tune of per cent increased due to T_6 treatment was 14.21 per cent over T_2 treatment. Significantly lower green forage yield (313 q ha^{-1}) was recorded under the treatment T_1 (60-40 N-P kg ha^{-1}).

Significantly highest green forage yield recording in T_6 with *Azospirillum* application might be due to that *Azospirillum* application promoted root growth and thereby more nitrogen fixation in soil for luxuriant crop growth. The remarkable increase in yields with higher levels of nitrogen might be attributed to favorable effect on yield attributes *viz.,* plant height and number of tillers per meter row. The increase in leafy part due to nitrogen application might have promoted higher photosynthetic activities and assimilate translocation to growing parts might have helped in improvement of growth and yield attributes like plant height, number of tillers per meter row. In case of forage sorghum, linear response to nitrogen has been reported by Bhuriya *et al.* (2015) [1].

Dry matter content (%)

Dry matter content varied significantly affected by integrated nutrient management (Table 1.1). Application of 100-40 (N-P kg ha^{-1}) + *Azospirillum* (T_6) recorded significantly highest dry matter content (38.9) and was at par with T_3 (35.5%), T_{12} (35.6%) and T_9 (35.8%). Significantly lower dry matter content (33.89%) was recorded under the treatment T_1 (60-40 N-P kg ha^{-1}).

Dry matter yield (q ha^{-1})

The data presented in Table 1.1 indicated that dry matter yield was significantly influenced by integrated nutrient management. Application of 100-40 (N-P kg ha^{-1}) + *Azospirillum* (T_6) recorded significantly highest dry matter yield (134.7 q ha^{-1}) and was at par with T_3 (132.0 q ha^{-1}), T_{12} (129.6 q ha^{-1}) and T_9 (122.9 q ha^{-1}). The increase in dry fodder yield under T_6 was to the tune of 2.02, 3.79 and 8.28 per cent over T_3, T_{12} and T_9 treatments respectively. The tune of per cent increase due to T_6 treatment was 13.96 over T_2 treatment. Significantly lower dry matter yield (106.1 q ha^{-1}) was recorded under T_1 treatment (60-40 N-P kg ha^{-1}). The dry matter yield followed the same trend as that of green forage yield due to application of nitrogen. Nitrogen is used largely in synthesis of protein, but structurally it is a constituent of chlorophyll molecule combined with carbohydrates and fatty acids. It helps in formation of protoplasm, which is the physical base of plant life. Phosphate solubilizing bacteria converts insoluble P compounds by the production of organic acids, accompanied by acidification of the medium and enhanced higher dry matter yield with higher nitrogen application (Bhuriya *et al.* 2015) [1].

Crude protein content (%)

The data presented in Table 1.1 indicated significant increase in highest crude protein content (10.02%) by T_6 (100-40 N-P kg ha^{-1} + *Azospirillum)* and it was at par with T_3 (9.86%), T_{12} (9.82%), T_9 (9.59%), T_{11} (9.33%), T_5 (9.28%) and T_{10} treatments (8.98%). The increase in the per cent of crude protein content was 14.47 per cent under T_6 treatment over T_2 treatment. Significantly lower crude protein content T_1 (8.30%) was recorded under treatment T_1 (60-40 N-P kg ha^{-1}). The increase in crude protein content of forage sorghum with increasing level of nitrogen content of forage could be attributed to the increase in nitrogen content in plant along with increase in nitrogen level which might have helped in synthesis of more protein as nitrogen is chief constitute of various metabolites including protein and amino acid. Increase in crude protein with increase of level of nitrogen in forage oat has also been reported by Patel *et al*. (2010) [6]. Higher protein yield might be as a result of increased crude protein content and higher dry matter accumulation by crops as the protein yield is a function of dry matter yield and protein content in dry matter. This is in close conformity with the findings of Singh *et al*. (2014) [8].

Crude protein yield (q ha^{-1})

The data on crude protein yield as influenced by integrated nutrient management is summarized in Table 1.1. The data revealed that the effect of integrated nutrient management on crude protein yield was significant. Significantly highest crude protein yield (14.49 q ha^{-1}) was recorded with T_6 (100-40 N-P kg ha^{-1} + *Azospirillum)* and it was at par with T_3 (13.01 q ha^{-1}), T_{12} (12.72 q ha^{-1}). The tune of per cent increase in crude protein yield was 15.24 under T_6 treatment over treatment T_2. Significantly lower crude protein yield (8.80 q ha^{-1}) was recorded under the treatment T_1 (60-40 N-P kg ha^{-1}). Nitrogen alone or in combination with organic nutrients increased protein content. Nitrogen is a basic constituent of protein and with increase in the rate of nitrogen application, nitrogen availability increased and resulted in increased seed protein content. The results are in conformity with Nagre, *et al.*, 1991 [5] who reported that supplementary application of organic manures and bio fertilizers increased nitrogen availability and nitrogen use efficiency and protein synthesis.

Neutral detergent fiber (NDF) content

The data on NDF influenced by integrated nutrient management treatments are summarized in Table 1.2. NDF content significantly decreased with an increase in nitrogen application from T_1 (60-40 (N-P kg ha^{-1}) to T_{12} (100-20 (N-P kg ha^{-1}) + *Azospirillum* + PSB). Higher NDF content 68.98 per cent was recorded under the treatment T_1 (60-40 (N-P kg ha^{-1}). Higher NDF content at harvest was due to lower leaf: stem ratio and more fibrous nature of stem than that of leaf. These results are in line with the findings of Kumar *et al.* (2010) [4].

Acid detergent fiber (ADF) content

The data pertaining to acid detergent fiber content in forage sorghum as influenced by integrated nutrient management treatments are presented in Table 1.2. The effect of integrated nutrient management treatments on Acid detergent fiber content was found to be not significant.

Hemicellulose content (%)

The data pertaining to hemicellulose content in forage sorghum as influenced by integrated nutrient management treatments are presented in Table 1.2. The data indicated that the effect of integrated nutrient management treatments on hemicellulose content was found non-significant.

Table 1: Effect of integrated nutrients management on yield of forage sorghum

Sr. no.	Treatments	Green forage yield (q ha^{-1})	Dry matter content (%)	Dry matter yield (q ha^{-1})	Crude protein content (%)
T_1	60-40 (N-P kg ha^{-1})	313	33.8	106.1	8.30
T_2	80-40(Recommended dose of N-P kg ha^{-1})	338	34.2	115.9	8.57
T_3	100-40 (N-P kg ha^{-1})	371	35.5	132.0	9.86
T_4	60-40 (N-P kg ha^{-1}) + *Azospirillum*	320	33.4	107.7	8.90
T_5	80-40 (N-P kg ha^{-1}) + *Azospirillum*	343	34.9	120.7	9.28
T_6	100-40 (N-P kg ha^{-1}) + *Azospirillum*	394	38.9	134.7	10.02
T_7	60-20 (N-P kg ha^{-1}) + PSB	314	35.5	111.6	8.96
T_8	80-20 (N-P kg ha^{-1}) + PSB	330	34.7	117.9	8.82
T_9	100-20 (N-P kg ha^{-1}) + PSB	363	35.8	122.9	9.59
T_{10}	60-20 (N-P kg ha^{-1}) + *Azospirillum* + PSB	326	35.3	115.1	8.98
T_{11}	80-20 (N-P kg ha^{-1}) + *Azospirillum* + PSB	346	33.4	115.9	9.33
T_{12}	100-20(N-P kg ha^{-1}) +*Azospirillum* + PSB	364	35.6	129.6	9.82
S.Em.$\pm$		16.4	1.3	6.3	0.37
C.D. at 5%		47	3.3	18.1	1.06
C.V. %		9.5	7.7	10.6	8.01

Table 2: Effect of integrated nutrients management on quality of forage sorghum

Sr. no.	Treatments	Crude protein yield (q ha^{-1})	NDF content (%)	ADF content (%)	Hemicelluloses content (%)
T_1	60-40 (N-P kg ha^{-1})	8.80	68.98	40.18	28.81
T_2	80-40(Recommended dose of N-P kg ha^{-1})	9.93	67.95	41.13	26.82
T_3	100-40 (N-P kg ha^{-1})	13.01	66.54	40.78	25.76
T_4	60-40 (N-P kg ha^{-1}) + *Azospirillum*	9.58	66.29	43.70	22.59
T_5	80-40 (N-P kg ha^{-1}) + *Azospirillum*	11.20	65.03	37.94	27.09
T_6	100-40 (N-P kg ha^{-1}) + *Azospirillum*	14.49	58.71	39.75	18.97
T_7	60-20 (N-P kg ha^{-1}) + PSB	9.99	64.48	41.50	22.98
T_8	80-20 (N-P kg ha^{-1}) + PSB	10.39	63.30	40.22	23.09
T_9	100-20 (N-P kg ha^{-1}) + PSB	11.78	63.07	39.33	23.74
T_{10}	60-20 (N-P kg ha^{-1}) + *Azospirillum* + PSB	10.33	64.45	41.23	23.22
T_{11}	80-20 (N-P kg ha^{-1}) + *Azospirillum* + PSB	10.81	61.67	41.20	20.48
T_{12}	100-20(N-P kg ha^{-1}) +*Azospirillum* + PSB	12.72	61.36	38.06	23.30
S.Em.$\pm$		0.70	1.46	1.43	1.43
C.D. at 5%		2.02	NS	NS	NS
C.V. %		12.2	4.55	7.08	7.08

Conclusion

On the basis of the results of field experimentation, it can be concluded that application of 100-40 (N-P kg ha^{-1}) + *Azospirillum* to forage sorghum recorded significantly higher yield attributes (green forage yield, dry matter content, dry matter yield, crude protein content, crude protein yield), neutral detergent fiber (NDF) of sorghum as compared to other treatments in sandy loam soil of middle Gujarat, India.

Acknowledgement

The authors are thankful to Professor & Head, Department of Agriculture chemistry & Soil Science, B. A. College of Agriculture, AAU, Anand for providing necessary facilities and permission to conduct the study.

References

1. Bhuriya KP, Mistry GJ, Prajapati D. Effect of Integrated Nutrient Management on Growth and Yield of Forage Sorghum (*Sorghum bicolor* L. Moench) During Summer Season. Trends in Biosciences. 2015;8(17):4755-4758.
2. Bhuriya KP, Kharadi RR, Dodiya VC, Kumbhar MB. Effect of integrated nutrient management on HCN (Hydrocyanic acid) content of forage sorghum (*Sorghum bicolor L.* Moench) during summer season. International Journal of Chemical Studies. 2019;7(6):2007-2010.
3. Dodiya VC, Bhuriya KP. Effect of Integrated Nutrient

Management on Soil Properties of Forage Sorghum (*Sorghum bicolor* L. Moench) During Summer Season. Trends in Biosciences. 2016;9(4):283-285.
4. Kumar R, Singh P, Sumeriya HK. Effect of integrated nutrient management on growth and productivity of forage sorghum (*Sorghum bicolor* L. Moench). Forage Res. 2010;36(1):19-21.
5. Nagre KT, Deshmukh SB, Bhalerao PD, Thorve PV. Effect of sowing dates and fertilizers on growth, yield and quality of soybean varieties. P.K.V. Research Journal. 1991;15:81-84.
6. Patel MR, Meisheri TG, Sadhu AC. Effect of irrigation, nitrogen and bio-fertilizer on forage yield and quality of oat (*Avena sativa* L.). Forage Res. 2010;35(4):231-235.
7. Patel KM, Patel DM, Gelot DG, Patel IM. Effect of integrated nutrient management on green forage yield, quality and nutrient uptake of fodder sorghum (*Sorghum bicolor* L.). International Journal of Chemical Studies. 2018;6(1):173-176.
8. Singh Shyam, Kewalanand, Ramesh Chandra, Das Anchal. Effect of integrated nutrient sources on fodder yield and quality of sweet sorghum [*Sorghum bicolor* (L.) Moench.] and phillipesara (*Phaseolus trilobus*) intercropping system. Annals of Agriculture Research. 2014;35(2):193-199.