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QUALITY OF FORAGE SORGHUM AS INFLUENCED BY THE APPLICATION OF NITROGEN THROUGH DIFFERENT SOURCES

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SUMMARY

A field experiment was conducted at Forage Research Farm, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar (Haryana), India during summer season of 2020 to assess the influence of organic and inorganic sources of nitrogen application on quality, yield and productivity of single-cut forage sorghum. The experiment was laid out in randomized block design with nine treatments *viz*. T_1: Control, T_2: 100% RDN (Recommended Dose of Nitrogen) through inorganic source, T_3: 75% RDN through inorganic source+25% RDN through FYM, T_4: 75% RDN through inorganic source+25% RDN through vermicompost, T_5: 50% RDN through inorganic source +50% RDN through FYM , T_6: 50% RDN through inorganic source +50% RDN through vermicompost , T_7: 100% RDN through FYM, T_8: 100% RDN through vermicompost, T_9: 50% RDN through FYM+50% RDN through vermicompost were replicated thrice in the experiment. Among quality parameters, maximum crude protein content (8.91%) and *in-vitro* dry matter digestibility (51.8%) were estimated with T_2 [100% RDN (Recommended Dose of Nitrogen) through inorganic source (Urea)] which were on a par with T_3 (75% RDN through inorganic source + 25% N through FYM) and T_4 (75% RDN through inorganic source + 25% N through vermicompost) for CP and with T_3, T_4 and T_6 for IVDMD. HCN content (anti-nutritional constituent) estimated at 30 DAS was below critical limit (200 µg/g on fresh weight basis) in all the treatments. Maximum per day productivity of green fodder, dry matter, crude protein and digestible dry matter (45640, 11980, 1070 and 6200, respectively) recorded with the application of 100% RDN through inorganic source was on a par with 75% RDN through inorganic source+25% RDN through FYM/ vermicompost. Conclusively among different nitrogen management options integrated use of inorganic and organic sources of nitrogen (75% nitrogen through urea and 25% nitrogen through vermicompost or FYM) can be a better substitute to sole application of inorganic sources (100% nitrogen through inorganic sources) to obtain the comparative results of quality parameters and yield of single cut forage sorghum.

Key words : Forage sorghum, single-cut, FYM, vermicompost, quality, HCN, crude protein and IVDMD

India has 535.8 million livestock, with cattle accounting for 37% and goats for 21.23% (Anonymous, 2020). [*Sorghum bicolor* (L.) Moench] is the most widely planted cereal fodder crop in the country (2.6 mha), with single cut sorghums accounting for 23.1% (Prabhakar Babu, 2018). It has a short lifetime (60-80 days) and the ability to produce a lot of biomass (Satpal *et al*., 2020). Due to an increase in animal population, India nowadays has a net shortfall of 11.24 percent green fodder. This gap in green fodder can be narrowed down by growing high yielding fodder varieties. Proper fertilization is another important factor to realize the potential forage sorghum production. (Kaur and Satpal, 2019).

Sorghum (*Sorghum bicolor* L.) is a popular fodder, feed, food, and fuel crop. It is very adaptable to a wide range of edapho-climatic environments. Sorghum forage can be grazed, utilised as fresh fodder, processed into hay or used to make silage. The average productivity of green fodder from single-cut forage sorghum is to the tune of 400-500 q/ha (Satpal *et al*., 2020). In terms of quality, its green fodder contains 8-10% crude protein, 60-65%, NDF, 37-42% ADF, 32% cellulose and 21-23% hemi-cellulose on dry matter basis when harvested at 50% flowering stage (Kumar *et al*., 2012). Forage sorghum is grown on 5.6 million ha in India while sorghum is grown on 72,000 ha in Haryana (Anonymous, 2016). In terms of quality, when harvested at 50 percent flowering stage, it includes 8-10 percent crude protein, 60-65 percent NDF, 37-42 percent ADF, 32 percent cellulose, and 21-23 percent hemi-cellulose. (Sunil Kumar *et al*.,

2012). Beside this, sorghum is also a moderately salt tolerant crop (Devi *et al*., 2018). Better nutrient management improves the crude protein content, digestibility and other quality characteristics of fodder sorghum. Sorghum also produces HCN naturally, a poisonous and anti-nutritional substance the concentration of which is maximum in the plant at around 30 days after sowing. Toxicity from HCN can be controlled with careful irrigation and nutrient management. The nutrient demand of sorghum is comparatively higher than other fodder crops. To meet out this demand, higher doses of inorganic fertilizers are required for higher fodder production. Farmyard manure (FYM) and vermicompost are two important nutrient sources of organic matter in India, although their availability in large quantities is debatable.

MATERIALS AND METHODS

A field experiment was conducted at Forage Section Research Area, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar Haryana (India) during the summer season of 2020. Hisar is situated at 29°10' N latitude and 75° 46' E longitude at an altitude of 215.2 m above mean sea level having semi-arid and sub-tropical climate with hot dry summer and severe cold winters and receives 450 mm precipitation per annum. Weekly weather parameters *i.e*. temperature (°C), relative humidity (%) and rainfall (mm) during the season are given Fig. 1. The experimental soil was sandy loam with pH 7.7 has 0.48% organic carbon, 140.2 -12.0 - 240.5 kg/ha of available N-P-K at the start of study in plough layer. Nine treatment *viz*. T_1: Control, T_2: 100% RDN (Recommended Dose of Nitrogen) through inorganic source, T_3: 75% RDN through inorganic source+25% RDN through FYM, T_4: 75% RDN through inorganic source+25% RDN through vermicompost, T_5: 50% RDN through inorganic source +50% RDN through FYM , T_6: 50% RDN through inorganic source +50% RDN through vermicompost , T_7: 100% RDN through FYM, T_8: 100% RDN through vermicompost, T_9: 50% RDN through FYM+50% RDN through vermicompost were replicated thrice in the experiment. Single cut variety of forage sorghum 'HJ 541' was used in the experiment. The experiment was sown manually with the row spacing of 25 cm on April 5, 2020. RDF (Recommended Dose of Nitrogen) used was 75 kg nitrogen + 15 kg P_2O_5 per ha. All the other standard agronomic practices were followed uniformly in all the treatments as per the package of practices for *kharif* crops of CCS Haryana Agricultural University, Hisar, India (Anonymous, 2017). The samples for estimation of HCN were taken at 30 DAS from the portion of the plant immediately below the uppermost leaf collar and HCN content was determined as per Hogg and Ahlgren (1942). The amount of HCN on fresh weight basis was calculated by calibrating the absorbance with HCN (5-40×10-3 g/l) in water as standard. Crude protein content (CPC) was calculated by multiplying the nitrogen content (%) with 6.25, estimated by conventional micro-kjeldal method (AOAC, 1995). IVDMD was determined as per Barnes *et al.* (1971). Crude protein and digestible dry matter yield (q/ha) were calculated by multiplication of CPC and IVDMD with dry matter yield (q/ha), respectively. Data were analyzed by using OPSTAT software available at CCS Haryana Agricultural University website (Sheoran *et al*., 1998). The results are presented at five per cent level of significance (P=0.05) for making comparison between treatments. The data were analyzed using appropriate analysis of variance (ANOVA). Data were analyzed by using OPSTAT software available at CCS Haryana Agricultural University website (Sheoran *et al*., 1998). The results are presented at five per cent level of significance (P=0.05) for making comparison between treatments.

RESULTS AND DISCUSSION

A perusal of data (Table 1) on HCN content exhibited that significantly higher HCN content (94.77) was estimated with the application of (T_2) 100% RDN through inorganic source which was at par with 75% RDN through inorganic source+25% RDN through vermicompost only. It was mainly due to increase in nitrogen absorption by plants which was used for the synthesis of HCN. Satpal *et al*. (2018) also observed increase in HCN content with higher level of nitrogen fertilizer. However, HCN content remained below critical limit (200 µg/g at 30 DAS) in all the treatments. A perusal of data exhibited that highest crude protein content (CP) was estimated with the application of (T_2) 100% RDN through inorganic source which was at par with 75% RDN through inorganic source+25% RDN through FYM and 75% RDN through inorganic source+25% RDN through vermicompost. Highest *in vitro* dry matter digestibility (IVDMD) was also estimated with (T_2) which was at par with 75% RDN through inorganic source+25% RDN through FYM, 75% RDN through inorganic source+25% RDN through vermicompost and 50% RDN through inorganic source+50% RDN through vermicompost.

Days to flowering and yield

A perusal of data (Table 2) revealed that

TABLE 1
Effect of organic and inorganic sources of nitrogen application on quality of forage sorghum

Treatments	HCN (µg/g on fresh weight basis)	Crude protein (%)	IVDMD (%)
T_1 : Control	66.38	7.40	47.03
T_2 : 100% RDN (Recommended Dose of Nitrogen) through inorganic source	94.77	8.91	51.80
T_3 : 75% RDN through inorganic source+25% RDN through FYM	89.04	8.73	50.93
T_4 : 75% RDN through inorganic source+25% RDN through vermicompost	90.86	8.86	51.40
T_5 : 50% RDN through inorganic source +50% RDN through FYM	81.34	8.49	49.96
T_6 : 50% RDN through inorganic source +50% RDN through vermicompost	82.35	8.54	50.60
T_7 : 100% RDN through FYM	70.65	7.89	48.20
T_8 : 100% RDN through vermicompost	76.76	8.06	49.80
T_9 : 50% RDN through FYM+50% RDN through vermicompost	72.64	8.17	49.43
SEm ±	1.48	0.11	0.56
C.D. at 5%	4.48	0.33	1.70

maximum days to 50% flowering (stage of green fodder harvest) were taken by T_1 (Control) which were significantly higher over application of 100% RDN through inorganic source (T_2), 75% RDN through inorganic source+25% RDN through FYM (T_3), 75% RDN through inorganic source+25% RDN through vermicompost (T_4). Maximum crude protein and digestible dry matter yields (1070 and 6200 kg/ ha, respectively) were estimated with the application of 100% RDN through inorganic source (T_2) which were on a par with 75% RDN through inorganic source+25% RDN through FYM (T_3), 75% RDN through inorganic source+25% RDN through vermicompost (T_4).The CPY and DDMY estimated with the application of 100% RDN through inorganic source was 9.18 & 8.39, 4.90 & 4.73 and 132.61 & 112.32 per cent higher over 75% RDN through inorganic source+25% RDN through FYM, 75% RDN through inorganic source+25% RDN through vermicompost and control, respectively. The green fodder yield recorded with the application of 100% RDN through inorganic source was only 3.05 and 1.65 per cent higher as compared to 75% RDN through inorganic source+25% RDN through FYM and 75% RDN through inorganic source+25% RDN through vermicompost; however, it was 66.81% higher over control. The highest dry matter yield of 11980 kg/ha was recorded with the application of 100% RDN through inorganic source (T_2), which was found statistically at par with T_3 and T_4. Satpal *et al*., (2010) also recorded maximum straw yield of wheat with the application of 75% RDN through inorganic source+25% RDN through organic source which was at par with the application of 100% nitrogen through inorganic source based on soil test value.

Per day productivity

A perusal of data (Table 3) revealed that maximum per day productivity of green fodder, dry

TABLE 2
Effect of organic and inorganic sources of nitrogen application on days to 50% flowering and yield of forage sorghum

Treatment	Days to 50% flowering	Yield (kg/ha)			
		Green fodder	Dry matter	Crude protein	Digestible dry matter
T_1 : Control	86.0	27360	6220	460	2920
T_2 : 100% RDN (Recommended Dose of Nitrogen) through inorganic source	82.0	45640	11980	1070	6200
T_3 : 75% RDN through inorganic source+25% RDN through FYM	83.0	44290	11240	980	5720
T_4 : 75% RDN through inorganic source+25% RDN through vermicompost	82.7	44900	11530	1020	5920
T_5 : 50% RDN through inorganic source +50% RDN through FYM	85.0	38640	9570	820	4780
T_6 : 50% RDN through inorganic source +50% RDN through vermicompost	84.0	40450	10420	890	5270
T_7 : 100% RDN through FYM	85.0	33360	8010	630	3860
T_8 : 100% RDN through vermicompost	84.3	36000	9040	730	4500
T_9 : 50% RDN through FYM+50% RDN through vermicompost	85.0	34980	8650	710	4280
SEm ±	0.8	1410	360	30	190
C.D. at 5%	2.4	4270	1070	100	590

TABLE 3
Effect of organic and inorganic sources of nitrogen application on per day productivity of yield of forage sorghum

Treatment	Per day productivity (kg/ha)			
	Green fodder	Dry matter	Crude protein	Digestible dry matter
T_1 : Control	316.7	70.0	5.4	34.0
T_2 : 100% RDN (Recommended Dose of Nitrogen) through inorganic source	556.7	146.7	13.0	75.7
T_3 : 75% RDN through inorganic source+25% RDN through FYM	533.3	133.3	11.8	69.0
T_4 : 75% RDN through inorganic source+25% RDN through vermicompost	543.3	140.0	12.4	71.7
T_5 : 50% RDN through inorganic source +50% RDN through FYM	453.3	113.3	9.6	56.3
T_6 : 50% RDN through inorganic source +50% RDN through vermicompost	483.3	126.7	10.6	62.8
T_7 : 100% RDN through FYM	393.3	93.3	7.5	45.4
T_8 : 100% RDN through vermicompost	426.7	106.7	8.6	53.4
T_9 : 50% RDN through FYM+50% RDN through vermicompost	413.3	103.3	8.3	50.4
SEm ±	19.0	4.9	0.4	2.5
C.D. at 5%	58.0	15.0	1.2	7.6

matter, crude protein and digestible dry matter (556.7, 146.7, 13.0 and 75.7, respectively) were recorded with the application of 100% RDN through inorganic source (T_2) which were on a par with 75% RDN through inorganic source+25% RDN through FYM (T_3), 75% RDN through inorganic source+25% RDN through vermicompost (T_4)

CONCLUSION

Based on one year research findings, it was concluded that among different nitrogen management options integrated use of inorganic and organic sources of nitrogen (75% nitrogen inorganic source and 25% nitrogen through vermicompost or FYM) can be a better substitute to sole application of inorganic sources (100% nitrogen through inorganic sources) to obtain the comparative results of quality parameters and yield of single cut forage sorghum. It is also concluded that vermicompost proved to be a better alternative nitrogen source than FYM in terms of yield, quality and per day productivity of green fodder, dry matter, crude protein and digestible dry matter of forage sorghum.

REFRENCES

Anonymous, 2016 : All-India Area, Production and Yield along with coverage under Irrigation. Agricultural Statistics at a Glance 2016. Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture, Government of India, New Delhi.

Anonymous, 2020 : 20th Livestock Census – 2019, All India Report. Department of Fisheries, Animal Husbandry & Dairying, Department of Animal Husbandry & Dairying, Statistics Division, Krishi Bhawan, New Delhi.

Kaur, M. and Satpal 2019 : Yield and economics of single cut sorghum genotypes as influenced by different fertilizer levels. *International Journal of Agriculture Sciences*, **11**(5): 7971-7973.

Kumar, S., R.K. Agrawal, A.K. Dixit, A.K. Rai J.B. Singh and S.K. Rai, 2012 : Forage production technology for arable lands. IGFRI (Indian Grassland and Fodder Research Institute), Jhansi, India.

PrabhakarBabu, 2018 : Forage crop research contribution to the Indian fodder production: Business opportunities for seed industry. https://www.millets.res.in/aicsip18/presentations/Stakeholders_interaction-Day1/Forage_Opportunities.pdf.

Satpal, B. Gangaiah, N. Kumar, S. Devi, N. Kharor, K.K. Bhardwaj, P. Kumari, D.S. Phogat and Neelam, 2020 : Performance of single-cut forage sorghum cultivars at different fertilizer levels. *Forage Res.,* **46**(2): 202-207.

Satpal, Gangaiah, B., Kumar, N., Devi, S., Kharor, N., Bhardwaj, K. K., Kumari, P., Phogat, D.S. and Neelam. 2020 : Performance of single-cut forage sorghum cultivars at different fertilizer levels. *Forage Research,* **46**(2): 202-207.

Satpal, R.A. Singh and R. Kathwal, 2010 : Effect of organic and inorganic sources of nitrogen application on wheat dry fodder production and its contributing traits. *Forage Res*., **36**(3): 161-165.

Satpal, Tokas, J., Duhan, B.S. and Neelam, 2018 : Fodder quality and nutrient uptake of sorghum as influenced by different fertilizer levels. *Multilogic in Science*, **8**(Special Issue C): 127-129.