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Research Communication

Evaluation of sugargraze (*Sorghum bicolor*), fodder maize (*Zea mays*) and sorghum (*Sorghum bicolor*) under different sources of nitrogen

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ABSTRACT

The present study was carried out at Karnal, Haryana during rainy (*kharif*) season of 2014–15 to estimate green fodder yield, dry fodder yield and nitrogen uptake in fodder maize (*Zea mays* L.), fodder sorghum [*Sorghum bicolor* (L.) Moench] and sugargraze (*Sorghum bicolor*) in response to organic and inorganic sources of nitrogen. The highest green fodder yield (63.74 t/ha), N uptake (259.1 kg/ha) and crude protein (10.42%) was recorded in sugargraze crop and the percent dry-matter was the highest in fodder sorghum (23.83%). Among the fertilizer sources, 100% N through inorganic form recorded the highest green fodder (51.10 t/ha), N uptake (230.0 kg/ha) and crude protein (10.2%). The N content as well as its uptake was also significantly higher in sugargraze than fodder maize and fodder sorghum. The highest net income (₹75,986/ha) and benefit: cost ratio (4.87) were obtained in sugargraze. Among the nitrogen sources, inorganic source of nitrogen recorded maximum net income (₹56,505/ha) and benefit: cost ratio (3.78). The study demonstrated that the fodder sugargraze has a capacity to accumulate dry-matter and N rapidly especially under inorganic fertilization. It could be a better choice in well irrigated fertilized soils as a high yielding fodder crop.

Key words : Fodder maize, Fodder sorghum, Nitrogen sources, Sugargraze

Nitrogen is a vital plant nutrient and a major yield-determining factor in crops. It is very essential for plant growth and makes up 1 to 4% of dry-matter and is a component of protein and nucleic acids. Its availability in required quantity is necessary throughout the growing season for optimum plant growth. It is also an integral component of many other compounds essential for plant growth processes including chlorophyll and many enzymes in plant system. Cereal crops are mostly dependent on outside sources of nitrogen. Maize is one of the most important cereals in the world, next to wheat and rice. It has very high yield potential, which is expressed both by biomass production as well as grain yield. Maize is an exhaustive crop having higher nutrient requirements than other cereals and absorbs large quantity of nutrients from the soil during different growth stages. Sorghum is the world's fifth most important cereal in terms of production and area planted. Sorghum can grow under infertile soils but it is responsive to fertilizers. Mahdi *et al.* (2012) observed that application of N @ 120 kg/ha resulted in significantly higher nitrogen uptake and crude protein content. Sugargraze is a top quality 3-way cross (sorghum × sorgho × sudan-grass hybrid) designed for grazing, green chop or for hay purpose. Sugargraze has the highest yield potential among summer annuals. To enhance/sustain agricultural productivity of any crop and for maintenance of soil health, management of nutrients in integrated manner is inevitable in the present agricultural scenario.

A field experiment was conducted at Forage Research and Management Centre, ICAR-National Dairy Research Institute, Karnal, Haryana (India) during rainy (*kharif*) season of 2014–15 (June–September, 2014), to evaluate the nitrogen uptake among fodder maize, fodder sorghum and sugargraze. Maize variety 'African tall', fodder sorghum variety 'PC 9' and sugargraze variety Sugargraze, were sown by hand, at a 30 cm row to row spacing. The seed rates were 50 kg, 30 kg and 30 kg/ha, for fodder maize, fodder sorghum and sugargraze, respectively. The experiment was laid out in split-plot design with three crop species (sugargraze, fodder sorghum and fodder maize) as

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main-plot treatments and four levels of nitrogen fertilizers [no N fertilizer (control), 100% N through urea as inorganic source (N_{100}), 50% N through inorganic + 50% through FYM as organic source ($N_{50}F_{50}$) and 100% N through organic source (F_{100})] as sub-plot treatments with four replications. Prior to sowing of the crop, soil samples were taken from a depth of 0–15 cm from randomly selected spots with soil auger and a homogenous composite sample was drawn to analyze the physico-chemical properties of soil. Initial soil analysis data indicated that soil of the experimental field was clay loam (sand 44.36%, silt 20.55 % and clay 35.09 %) in texture, low in available N (211.8 kg/ha), medium in available P (34.6 kg/ha), high in available K (288.6 kg/ha) and neutral in reaction (*p*H 7.2).

The recommended dose of N was taken as 120 kg/ha and was applied as per the treatments in two splits. However, FYM was applied at the time of final land preparation of the sub-plot. Uniform dose of phosphorus (60 kg P_2O_5/ha) and potassium (40 kg K_2O/ha) were applied as basal through single superphosphate and potassium chloride (murate of potash) respectively. The plants were harvested at 60, 65 and 75 DAS for fodder maize, fodder sorghum and sugargraze, respectively at 50% flowering stage. The plant samples were dried and N content in the samples was estimated by Kjeldahl method (AOAC, 2005). The crude protein (CP) content was estimated by multiplying the total nitrogen content by a factor of 6.25, as it is assumed that protein contains about 16% N. Soil samples were collected from each plot and N content was determined by distilling the soil solution with alkaline $KMnO_4$ and determining the ammonia liberated (Subbiah and Asija, 1956). The prices of the inputs that were prevailing at the time of their use and market price of crop commodities were taken to work out the cost of cultivation and net returns. Benefit : cost ratio (B:C) was worked out by dividing gross returns (₹/ha) by total cost of cultivation (₹/ha). Statistical analysis was done using analysis of variance in split-plot design using IRRISTAT software (IRRI, 1999) and statistical mean differences were found by Fisher's protected least significant difference test.

The results indicated that sugargraze produced significantly higher green fodder yield (63.74 t/ha) than fodder maize (35.02 t/ha) and fodder sorghum (38.10 t/ha) (Table 1). Sugargraze recorded the highest fresh weight, but the dry matter percentage was numerically higher in fodder sorghum (23.8%), and both were statistically at par. This may be due to more fiber content in the stover of sorghum than sugargraze and maize. Among the fodder crops, total dry fodder yield was the highest for sugargraze (15.13 t/ha). Among N treatments, highest dry matter (25.83%) was obtained at N_{100} level of fertilization as the dry matter accumulation is dependent on the availability of nitrogen in easily extractable form. Average per day accumulation of green fodder and dry fodder were also the highest in sugargraze (827 and 196 kg/ha/day, respectively) followed by fodder sorghum (583 and 139 kg/ha/day, respectively) and minimum in fodder maize (568 and 125 kg/ha/day, respectively). Across N sources the highest N uptake was by sugargraze followed by fodder sorghum and lowest in fodder maize, however N uptake were statistically similar between fodder sorghum and fodder maize (Table 1). Interaction between fodder crops and sources of nitrogen for

Table 1. Effect of N sources on fodder yield, N content and its uptake in fodder crops

Treatment	Green fodder yield (t/ha)	Dry matter (%)	Dry fodder yield (t/ha)	N content in fodder (%)	N uptake (kg/ha)	Crude protein (%)	Net income (× 10^3 ₹/ha)	Benefit: cost ratio
Fodder crops								
Sugargraze	63.74	23.50	15.13	1.67	259.1	10.42	75.9	4.87
Sorghum	35.02	23.83	8.34	1.31	110.0	8.18	34.1	2.85
Maize	38.10	21.66	8.38	1.14	100.2	7.15	37.5	2.90
SEm±	2.54	0.24	0.69	0.02	11.0	0.12	3.8	0.21
CD (P=0.05)	6.22	0.59	1.69	0.05	26.8	0.3	9.3	0.51
N-Sources								
Control	37.96	20.74	7.92	1.15	95.3	7.17	38.5	3.11
N_{100}	51.10	25.83	13.36	1.63	230.0	10.2	56.5	3.78
$N_{50}F_{50}$	47.07	23.36	10.96	1.42	162.1	8.9	51.1	3.63
F_{100}	46.35	22.07	10.23	1.29	138.2	8.07	50.5	3.65
SEm±	2.00	0.31	0.52	0.02	8.6	0.12	2.9	0.15
CD (P=0.05)	4.11	0.65	1.06	0.04	17.7	0.25	6.1	0.32

N_{100}, Recommended dose of N through inorganic (urea); $N_{50}F_{50}$, 50% recommended dose of N through inorganic (urea); and F_{100}, recommended dose of N through organic (FYM) nitrogen uptake was found to be non-significant. The N content was also significantly higher in sugargraze than fodder maize and fodder sorghum. This can be attributed to the fact that sugargraze is a rapid growing crop, needing higher amount of N for meeting its demand. Among nitrogen sources, N content and its uptake was significantly higher in N_{100} treatment (1.63% and 230.0 kg/ha). Almodares *et al*. (2009) and Ramos *et al.* (2012) reported similar results on sugargraze and Afzal *et al.* (2012) on sorghum. As crude protein (CP) content is a factor of total N content in the dry biomass, its estimation was highest in sugargraze (10.42%) and among nitrogen sources, inorganic treatment resulted in highest CP value (10.2%) (Table 1). Kar *et al.* 2016 reported the details of fodder quality parameters for the same study. Similar observations have also been made by Mahdi *et al.* (2012) on maize.

Among fodder crops, highest net income (₹75,986/ha) and benefit: cost ratio (4.87) were obtained from sugargraze (Table 1), while, among nitrogen sources, inorganic treatment (N_{100}) gave the highest net income (₹56,505/ha) and benefit: cost ratio (3.78), although other treatments were statistically at par. This was due to higher yield of sugargraze fodder than fodder maize and fodder sorghum. Rasheed *et al.* (2004) and Gabir *et al.* (2014) also reported similar findings on maize and sorghum respectively.

Based on the current study, it may be concluded that sugargraze produced the highest green fodder yield, dry fodder yield and crude protein with 100% recommended dose of NPK applied through inorganic sources. Highest net income (₹75,986/ha) and benefit: cost ratio (4.87) was also recorded with cultivation of sugargraze followed by fodder maize and lowest with fodder sorghum.

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