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Fodder yield and quality assessment of different bajra napier hybrids in central Gujarat of India

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Abstract
A field experiment was conducted during 2013-15 at Fodder Demonstration Unit, National Dairy Development Board, Anand, Gujarat to compare growth, herbage yield and nutrient composition of eight notified bajra napier (BN) hybrids. On the basis of pooled data of two years, highest green fodder yield (GFY) 94.2 t/ha and dry matter yield (DMY) 20.9 t/ha was recorded in BN hybrids BNH 10 and DHN 6, respectively. Significantly higher dry matter content of 22.7 per cent was observed in DHN 6. At 90 days harvesting interval, green fodder and dry matter yields varied significantly at 5% level of significance from 77.8 to 94.2 t/ha and 16.8 to 20.9 t/ha, respectively, among different hybrids. APBN 1 recorded higher crude protein content and crude protein yield of 8.7 per cent and 1.64 t/ha. Among BN hybrids, crude protein, crude fat, crude fibre, silica and oxalic acid contents varied from 6.4 to 8.7, 0.8 to 1.1, 31.1 to 34.1, 6.0 to 7.2 and 2.3 to 2.8 per cent, respectively. Whereas calcium, phosphorus, potassium, magnesium and sulphur contents ranged from 0.31 to 0.49, 0.32 to 0.44, 1.59 to 2.06, 0.63 to 0.89 and 0.14 to 0.20 per cent among hybrids. On the basis of the study conducted over a period of two years, newly notified BN hybrid DHN 6 was found significantly better than local checks CO 3 and APBN 1 for dry matter yield.

Keywords: BN hybrid, Chemical composition, Mineral content, Oxalic acid content, Yields

Introduction

To meet green fodder requirement of animals round the year, cultivation of perennial grasses in forage based cropping sequences have become popular among dairy farmers in India. It is gaining importance as they provide year round supply of fodder to cattle (Dwivedi *et al.,* 2007). Among various perennial grasses, interspecific hybrid between bajra and napier grass called as BN hybrid (*Pennisetum glaucum* x *Pennisetum purpureum*) is most popular in irrigated areas due to its wider adaptability under different agro-climatic condition, low cost of cultivation, resistance to insect-pest-disease, tolerance to grazing/damages by wild animals, propagation by vegetative materials (rooted slips or stem cuttings) and high response towards manure/fertilizer applications along with timely irrigations/rainfall. During last few decades many bajra napier (BN) hybrids were notified due to systematic research work done by ICAR institutes and state agricultural universities. These BN hybrids in comparison to napier grass have been found to be superior in quality, more acceptable to cattle (palatable), nutritious, high yielding, quick growing, less hairy and with better regeneration capacity (Gupta, 1975). Presently in different parts of the country, BN hybrids are being cultivated by farmers and livestock farms on arable lands, field bunds and improved common grazing lands for fodder production and conservation except temperate areas in high hills. The information regarding the performance of newly notified BN hybrids CO 4, DHN 6 and BNH 10 under central Gujarat condition is, however, limited. The present study was, therefore, undertaken to identify the best new BN hybrid for fodder production in comparison to presently recommended BN hybrids.

Materials and Methods

Plant materials and experimental design: The field experiment was conducted during two consecutive years 2013-14 and 2014-15 at Fodder Demonstration Unit of National Dairy Development Board, Anand, India. The experiment was laid out in a randomized block design with three replications consisting of eight treatments of different BN hybrids (IGFRI 6, IGFRI 10, CO 3, CO 4, APBN 1, PBN 233, DHN 6 and BNH 10). The soil of the experimental site was loam in texture with EC - 0.30, pH –7.80, total nitrogen- 810.76 kg/ha, available P_2O_5- 50.82 kg/ha and available K_2O-240.65 kg/ha. The soil contained DTPA-extractable iron (Fe)- 15.31 ppm, manganese (Mn)- 20.51 ppm, zinc (Zn)- 2.09 ppm, available sulphur (S)- 5.70 ppm and copper (Cu)- 2.21 ppm. The crop was cultivated following the standard package of agronomic practices. During 2013-14 and 2014-15 eight harvestings

were done at 15 cm height from ground level at regular interval of 90 days. Forage yield, yield attributes and quality components were measured at harvest during both the years. After harvest, fresh biomass yield of every treatment was determined and 300 gram of chopped fodder samples were dried in oven separately at 70° C to a constant weight for dry matter content. At each harvest, observations regarding yield attributes were recorded and calculated from two selected bunches from net plot area in each plot. Oven dry weight (at 70° C to a constant weight) after partitioning of whole tiller into leaf and stem was recorded and leaf to stem ratio (LSR) was worked out by applying the following formula.

$$LSR = \frac{\text{Leaf dry weight (g)}}{\text{Stem dry weight (g)}}$$

Laboratory and statistical analysis: Dried samples were grinded (1 mm) for chemical analysis and N was determined by using micro-Kjeldahl method (Jackson, 1973). Crude protein content was calculated multiplying N amount of each sample by 6.25. Proximate analysis of fodder samples was carried out following the standard laboratory procedures recommended by (AOAC, 2005). Concentrations of minerals were determined according to Inductively Coupled Plasma-Optical Emission Spectroscopy, Perkin Elmer, OPTIMA-3300 RL (ICP-OES) test method. Nutrients uptake was calculated based on typical nutrient concentrations and dry matter yield. Data were analysed statistically at 5% level of significance as per Snedecor and Cochran (1994).

Results and Discussion

Fodder and growth parameters: On the basis of pooled data, significantly higher green fodder yield (GFY) was recorded in BNH 10 (94.2 t/ha) over CO 4 and IGFRI 6 hybrids (Table 1). However, mean GFY of BNH 10, DHN 6, PBN 233, ABPN 1, CO 3 and IGFRI 10 hybrids was found at par amongst themselves and ranged from 86.8 to 94.2 t/ha. Khadda *et al*. (2013) also reported similar mean green fodder yield of 97 t/ha in front line demonstrations of APBN 1 hybrid conducted under central Gujarat conditions. Differences were found to be significant among BN hybrids for plant height, ranged from134.2 to 212.8 cm (Table 1). Chellamuthu *et al.* (2000) also reported significant variations in BN hybrid CO-1 for plant height from 169.4 to 198.3 cm. BNH 10 hybrid at par with DHN 6 and PBN 233 at 5% level of significance produced significantly higher plant height (212.8 cm) in comparison to remaining hybrids and might be the possible reason for highest green fodder production. Zhang *et al.* (2010) and Ekemini *et al.* (2012) also reported positive correlation between plant height and fodder yield in napier grass.

Dry matter yield (DMY) is a more meaningful way of comparing fodder yield (Faridullah *et al*., 2010). On the basis of pooled data, DHN 6 hybrid at par with PBN 233 and BNH 10 at 5% level of significance recorded significantly higher dry matter yield (20.9 t/ha) over other hybrids (Table 1). In this study, mean DMY was recorded between 16.8 to 20.9 t/ha amongst different BN hybrids. Antony and Thomas (2014b) also reported similar variations in DMY of 11 hybrid napier grass cultivars between 15.0 to 23.9 t/ha. Higher DMY of DHN 6 hybrid may be attributed to combination of better plant height (207.4 cm) and dry matter content (22.7%). This result was in conformity with Zewdu (2005) study in which taller BN hybrids showed higher dry matter yields.

Pooled data (Table 1) showed that differences in crude protein (CP) yield among the hybrids were significant.

Table 1. Biomass yield and growth parameters of different BN hybrids (pooled)

Hybrids	Green fodder yield (GFY) (t/ha)	Dry matter yield (DMY) (t/ha)	Crude protein (CP) yield (t/ha)	Number of tillers / bunch	Plant height (cm)	Leaf stem ratio	Dry matter (DM) content (per cent)
IGFRI 6	77.8	16.8	1.39	18.8	134.2	1.2	21.4
IGFRI 10	88.9	18.8	1.50	17.3	182.0	1.1	20.7
CO 3	89.2	17.9	1.41	14.9	175.3	1.0	21.1
CO 4	86.8	18.8	1.45	18.1	185.1	0.9	21.6
APBN 1	91.3	18.0	1.64	17.5	180.3	1.2	19.7
PBN 233	91.2	20.2	1.50	18.5	196.9	1.0	22.2
DHN 6	91.9	20.9	1.46	16.9	207.4	1.0	22.7
BNH 10	94.2	19.1	1.49	15.7	212.8	1.0	19.9
SEm±	2.1	0.7	0.05	0.9	8.15	0.04	0.5
CD (P< 0.05)	6.5	2.0	0.15	NS	24.7	0.1	1.5

Mean CP yield varied from 1.39 to 1.64 t/ha in BN hybrids. Shashikanth *et al.* (2013) also reported similar variation in mean CP yield from 1.05 to 1.84 t/ha in ten BN hybrids. APBN 1 hybrid at par with IGFRI 10, BNH 10 and PBN 233 produced the highest CP yield (1.64 t/ha) over remaining hybrids. More CP yield in APBN 1 might be due to combination of higher leaf stem ratio (LSR) and CP content (Table 2). Shankar (1980) reported that the usefulness of LSR has been accepted in most of the studies which demonstrated that leafiness had a positive relationship with the total protein content in forages. LSR was observed higher (1.2) in APBN 1 and IGFRI 6 hybrids. Both these hybrids at par with IGFRI 10 (1.1) recorded significantly higher LSR (1.2) as compared to rest of the hybrids. Mean LSR varied from 0.9 to 1.2 among BN hybrids. Singh *et al.* (2000) also observed similar mean variations in LSR from 1.05 to 1.15 among treatments in two years study on BN hybrid cultivar NB 21.

Table 2. Chemical composition (% DM basis) of different BN hybrids (pooled)

Hybrids	Crude protein	Crude fat	Crude fibre	Silica	Oxalic acid
IGFRI 6	7.7	1.1	31.1	7.2	2.8
IGFRI 10	7.6	1.1	33.2	6.5	2.4
CO 3	7.6	1.1	32.4	6.0	2.3
CO 4	7.1	0.9	34.1	6.0	2.5
APBN 1	8.7	1.0	31.9	6.6	2.5
PBN 233	7.0	0.8	33.4	6.6	2.5
DHN 6	6.4	0.8	33.7	6.0	2.3
BNH 10	6.9	1.1	32.8	6.5	2.4
SEm±	0.3	0.1	0.7	0.3	0.1
CD (P< 0.05)	0.9	NS	NS	NS	NS

Chemical composition: APBN 1 hybrid recorded significantly higher mean crude protein (CP) content in comparison to remaining hybrids (Table 2). The lowest mean CP content (6.4 per cent) was observed in DHN 6 hybrid. Mean CP content varied from 6.4 to 8.7 per cent among BN hybrids. Results were in conformity with Singh *et al.* (2000) who observed CP contents ranged from 6.21 to 8.54 per cent in BN hybrids. Non-significant differences were observed among hybrids for crude fat, crude fibre, silica and oxalic acid contents (Table 2). However, mean crude fat, crude fibre, silica and oxalic acid content varied between 0.8 to 1.1, 31.1 to 34.1, 6.0 to 7.2 and 2.3 to 2.8 per cent, respectively among BN hybrids. Kaur *et al.* (2016) reported that total oxalate content varied with increasing doses of nitrogen fertilization and seasons, but effect was not consistent in all the cuttings. Murali Krishna and Riazuddin (2010) observed that oxalic acid content ranged between 2-3 per cent in fourteen BN hybrid genotypes which was under permissible tolerance limits. Pathan *et al*. (2014) reported that BN hybrid crop cut at an interval of 45 days registered significantly higher oxalic acid content (2.05 per cent). Antony and Thomas (2014a) reported oxalic acid content varied from 2.40 to 3.77 per cent in eleven BN hybrids, which was below 4 per cent of permissible limit.

Macro and micro nutrient concentration: Pooled data revealed that IGFRI 6 hybrid at par with PBN 233 recorded significantly highest calcium content (0.49 per cent) among all hybrids (Table 3). CO 4 and DHN 6 hybrids at par with each other significantly recorded lower mean calcium content among all hybrids. Mean calcium content ranged from 0.31 to 0.49% among hybrids. On the basis of pooled data, APBN 1 hybrid at par with IGFRI 10, CO 3 and BNH 10 hybrids recorded higher phosphorus content over remaining hybrids. Mean phosphorus content varied from 0.32 to 0.44 per cent among hybrids. Similarly APBN 1 hybrid at par with CO 3 and CO 4 recorded significantly higher potassium content (2.06%) as compared to other hybrids. Mean potassium content ranged from 1.59 to 2.06% in BN hybrids. NRC (2001) recommended dietary K levels ranging from 1.0 to 1.2% of the dry matter.

BNH 10 hybrid was at par with IGFRI 6 and PBN 233 hybrids which recorded significantly higher magnesium content (0.91 per cent) in comparison to other hybrids. Lowest mean magnesium content (0.63 per cent) was observed in DHN 6 hybrid. Antony and Thomas (2014a) reported that variations in BN hybrids for phosphorus, potassium, calcium and magnesium contents ranged from 0.14 to 0.25 per cent, 1.12 to 2.14 per cent, 0.10 to 0.26 per cent and 0.15 to 0.31 per cent, respectively. BNH 10 hybrid recorded significantly higher sulphur content than other hybrids. Mean sulphur content varied between 0.14 to 0.20 per cent among BN hybrids. Agronomists recommend a plant tissue level of 0.2 percent sulphur for optimum forage production (Blezinger, 2007). NRC (2001) also recommends milking cows should have 0.20% sulphur in their diets. On the basis of pooled data (Table 3), zinc content ranged from 30.3 to 37.6 ppm among BN hybrids. Anonymous (1980) suggested that 30 ppm zinc is a critical dietary level, although it has been recommended that concentrations of 12-20 ppm are adequate for growing ruminants.

Table 3. Macro and micro nutrient content of different BN hybrids (pooled)

Hybrids	Calcium	Phosphorus	Potassium	Magnesium	Sulphur	Zinc	Manganese	Iron	Copper
	(%)					(ppm)			
IGFRI 6	0.49	0.36	1.73	0.89	0.14	32.3	57.7	602.5	11.4
IGFRI 10	0.41	0.39	1.90	0.74	0.17	33.5	45.5	372.3	10.0
CO 3	0.41	0.43	1.91	0.80	0.17	32.9	46.6	342.2	8.6
CO 4	0.34	0.32	1.80	0.76	0.17	32.4	45.7	325.8	9.9
APBN 1	0.42	0.44	2.06	0.77	0.17	32.7	51.6	481.0	10.1
PBN 233	0.44	0.34	1.59	0.89	0.17	35.3	42.1	398.3	11.1
DHN 6	0.31	0.32	1.59	0.63	0.15	30.3	48.6	354.1	17.4
BNH 10	0.40	0.40	1.78	0.91	0.20	37.6	50.1	492.2	12.0
SEm±	0.02	0.02	0.07	0.03	0.01	2.3	2.0	38.8	0.6
CD (P< 0.05)	0.06	0.06	0.23	0.08	0.02	NS	5.9	117.9	NS

Significantly higher mean manganese content (57.7 ppm) was recorded in IGFRI 6 hybrid as compared to remaining hybrids (Table 3). Mean manganese content ranged from 42.1 to 57.7 ppm amongst BN hybrids. Udiba *et al*. (2014) reported manganese levels above 40 ppm (the critical level) in forages are considered adequate to meet requirement of ruminants. BN hybrids recorded significant differences for iron content. IGFRI 6 hybrid (602.5 ppm) at par with BNH 10 recorded higher mean iron content as compared to other hybrids. Mean iron content varied from 325.8 to 602.5 ppm among hybrids. The forage iron values above 50 ppm are considered an adequate level for grazing animals (McDowell, 1985). Mean copper content ranged from 8.6 to 17.4 ppm among BN hybrids. NRC (1996) has recommended copper content level of 10 ppm in forages.

Conclusion

Green fodder yields of two newly notified BN hybrids (BNH 10 and DHN 6) were found at par but slightly better than local checks (CO 3 and APBN 1), CO 4 and other old hybrids popular at national level (IGFRI 6, IGFRI 10 and PBN 233). However, on dry matter yield basis, DHN 6 hybrid at par with BNH 10 and PBN 233 recorded significantly highest dry matter yield and out yielded local checks and remaining BN hybrids. On the basis of two years study, it was concluded that among newly notified hybrids, BNH 10 and DHN 6 are superior in terms of fodder yield and quality, and recommended for fodder cultivation in central Gujarat conditions.

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