

## EVALUATION OF HYBRID NAPIER GRASS GENOTYPES IN DIFFERENT AGRO-ECOLOGICAL ZONES ACROSS INDIA

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### SUMMARY

A varietal evaluation trial on *Hybrid Napier Grass* (*Pennisetum glaucum* × *P. purpureum*), which is grown round the year under assured irrigation conditions was conducted at 18 locations under four different agro-ecological zones viz., North-west, North-east, Central and Southern zones of India during 2016-2018. Six genotypes of *Hybrid Napier Grass* (TNCN 1280, BNH 14, BNH 22, PBN 351, BNH 12 and BNH 11) alongwith three national checks viz. CO 3, CO (BN) 5 and NB 21 were evaluated for assessing their fodder yield potential and quality parameters at CCS Haryana Agricultural University, Hisar, Haryana, India. The hybrid Napier grass genotype BNH 11 gave highest GFY (1050.6 q/ha) followed by TNCN 1280 (1027.7 q/ha) in comparison to mean value of best check CO (BN) 5 at 953.9 q/ha. Similarly, genotype BNH-11 gave highest DMY (243.8 q/ha) followed by PBN 351 (240.6 q/ha) in comparison to mean value of best check CO (BN) 5 at 221.0 q/ha. The highest green fodder yield (2267.3 q/ha) pooled over three years was recorded at Urulikanchan in central zone followed by Coimbatore (1908.7 q/ha) and Vellayani (1886.4 q/ha) in the south zone of India in comparison to mean All India GFY (999.4 q/ha), whereas, the highest pooled dry matter yield (520.8 q/ha) was recorded at Urulikanchan in central zone followed by Vellayani (469.1 q/ha) and Coimbatore (383.3 q/ha) in the south zone in comparison to mean All India DMY (229.8 q/ha). Highest per day production of green fodder pooled over three years was recorded in South zone (7.98 q/ha/day) followed by North West zone (5.94 q/ha/day). Almost same trend was observed for per day production of dry matter (q/ha/day). The highest crude protein yield pooled over three years was obtained at Urulikanchan (34.3 q/ha) followed by Ludhiana (20.5 q/ha) in the Central and North west zone, respectively with a mean value at 13.3 q/ha. Highest crude protein percent pooled over three years was obtained at Ludhiana (8.5%) followed by Rahuri (8.4%) in comparison to all India mean of 7.3%. The genotype BNH 12 gave highest IVDMD% pooled over three years (54.7%) followed by BNH 11 (53.4%) in comparison to mean value of best check CO (BN) 5 at 53.3%. The genotype BNH 12 gave lowest NDF% (62.5%) followed by BNH 11 (63.4%) in comparison to mean value of best check CO (BN) 5 at 64.9%. The hybrid Napier grass genotype BNH 12 had the lowest ADF% (45.4%) in comparison to mean value of best check CO 3 at 46.3%. Data reveals that South zone gave highest green fodder and dry matter yields followed by Central zone of India thereby indicating that climatic and edaphic conditions are very suitable for hybrid Napier grass as compared to North West and North East Zone of India.

**Key words :** *Hybrid Napier Grass*, green fodder, dry matter, quality parameters

Livestock play an important role in the rural economy of India by providing employment and supplementary family income, which contributes significantly to the total agricultural income. The economically competitive and productive yield potential of crossbred milch animals could be exploited through feeding nutritious green fodder round the year (Velayudham *et al.*, 2011). Pearl millet (*Pennisetum glaucum* (L.) R-Br.) is grown mainly as grain crop but it is also grown as fodder crop in the arid, semi arid tracts of India because of its growing habit with

thick and succulent stem and its green fodder is very valuable as a cattle feed on account of its high albuminoid and fat contents and it can be fed to cattle without harm at any stage of growth because of absence of HCN (Narayanan and Babadghao, 2007). Napier grass (*Pennisetum purpureum* (K.) Schum), an allied species of bajra is a perennial heavy yielder of low quality forage besides being less palatable. But it is otherwise endowed with virtues like tall growing, profusely tillering and high leafiness all of which go to contribute towards high biomass production (Powell

and Burton, 1966). The inter-specific hybrids between Bajra and Napier grass are highly vigorous and produces an abundance of quality forage. The hybrid combines the high yielding ability of Napier grass and good quality attributes of bajra and found to exhibit considerable heterosis for both yield and quality (Gupta, 1969, Saini and Paroda, 1975). Bajra Napier hybrid grass (also known as hybrid napier grass) is a potential perennial source of green fodder. It is popular owing to high yield, palatability and adaptability to varying soil and climatic conditions. (Faruqui *et al.*, 2009). It is very popular among dairy farmers of the tropics because of its high yield potential in south India but it is picking pace in the north parts now. It is well adapted to tropical and sub-tropical conditions because of its wide adaptability, quick growth, ease of establishment, palatability, high nutritive quality, herbage yield, persistence and good response to fertilizers (Antony and Thomas, 2014).

#### MATERIALS AND METHODS

Six entries of Bajra Napier hybrid (perennial) (TNCN 1280, BNH-14, BNH-22, PBN 351, BNH-12 and BNH-11) contributed by various Coordinating Centers under AICRP (FC) were evaluated along with three national checks *viz.* CO-3, CO (BN)-5 and NB-21 for assessing their fodder yield potential in trials during 2016 to 2018 at CCS HAU, Hisar. The same set of entries were also tested at thirteen different locations distributed in the five different agro-ecological zones *viz.* Hill zone, North western (NWZ), North western (NEZ), Central (CZ) and South (SZ) zones of India during this period for fodder trial (Anonymous, 2016, 2017, 2018).

The experiment was sown at the research farm area of Forage Section, CCS HAU, Hisar in *Kharif* season during 2016 with 3 replications. The plot size was 4.0 m x 3.0 m, with row to row distance of 50 cm. The data of green fodder yield, plant height, leaf: stem ratio was recorded at 50 % flowering. Dry matter yield was recorded after drying the green fodder samples; production efficiency was calculated by dividing the green fodder or dry matter yield by number of days to harvesting. The samples of dry fodder were analyzed for quality parameters using standard protocols. Total nitrogen in the samples was estimated by conventional Micro-kjeldahl's method and nitrogen content was converted to crude protein percent by multiplication of a factor 6.25. *In vitro* dry matter digestibility was determined by the method

of Tilley and Terry (1963) as modified by Barnes *et al.* (1971). Structural carbohydrates *viz.* neutral detergent fiber (NDF), acid detergent fiber (ADF), were determined by the method of Goering and Van Soest (1970). The data so obtained was statistically analyzed. The results of the experiment are presented in Tables 1-7.

#### RESULTS AND DISCUSSION

##### a) Green Fodder Yield (GFY)

In Haryana at Hisar, all the genotypes of Bajra Napier hybrid except BNH 22 gave better results than the best check gave highest pooled green fodder yield (Table 1). Best three genotypes are PBN 351 (608.0 q/ha), BNH 11 (601.8 q/ha) and BNH 14 (588.0 q/ha) showed better performance than the best check NB 21 (545.8 q/ha) for this trait. At All-India level, BNH 11 (1050.6 q/ha) gave highest pooled green fodder yield followed by TNCN 1280 and PBN 311 as compared to the best national check CO (BN) 5 (953.9 q/ha). The mean GFY at All-India level (973.3 q/ha) was higher than the mean GFY at Hisar (561.7 q/ha).

Location wise performance of the varietal trial on Bajra Napier hybrid (Table 6) revealed that the highest green fodder yield pooled over three years was recorded at Urulikanchan (2267.3 q/ha) in central zone followed by Coimbatore (1908.7 q/ha) and Vellayani (1886.4 q/ha) in the south zone and Ludhiana (1134.5 q/ha) in the north west zone. The genotype TNCN 1280 gave an increase of 7.76% for green fodder yield as compared to best check CO (BN) 5 over three years. The highest green fodder yield is due to characters like plant height, regeneration capacity and leaf stem ratio. Similar results are also reported by Shashikanth *et al.* (2013), Sheoran *et al.* (2017) and Jindal and Satpal (2020).

##### b) Dry Matter Yield (DMY)

In Haryana at Hisar, all the genotypes of Bajra Napier hybrid gave better results than the best check gave highest pooled dry matter yield (Table 1). Best three genotypes are BNH 14 (149.2 q/ha), BNH 11 and PBN 351 (147.6 q/ha) showed better performance than the best check CO (BN) 5 (125.6 q/ha) for this trait. At All-India level, BNH 11 (243.8 q/ha) gave highest pooled dry matter yield followed by PBN 311 and TNCN 1280 as compared to the best national check CO (BN) 5 (221.0 q/ha). The mean DMY at All-India

TABLE 1  
Performance of *Bajra Napier Hybrid* genotypes for fodder yield over three years

S. No.	Genotypes	Green Fodder Yield (q/ha)								Dry Matter Yield (q/ha)							
		Hisar				All-India				Hisar				All-India			
		2016	2017	2018	Pooled	2016	2017	2018	Pooled	2016	2017	2018	Pooled	2016	2017	2018	Pooled
1.	TNCN 1280	576.2	457.2	711.0	581.5	1002.8	1132.8	947.6	1027.7	194.4	109.2	116.0	139.9	217.6	254.0	198.9	223.5
2.	BNH-14	782.2	403.5	578.2	588.0	986.6	1117.8	974.7	1026.4	243.0	96.3	108.2	149.2	228.9	252.5	232.6	238.0
3.	BNH-22	763.1	303.6	465.3	510.7	930.2	1043.6	853.0	942.3	238.4	68.6	78.4	128.5	211.4	254.9	204.0	223.4
4.	PBN 351	819.2	423.6	581.3	608.0	934.3	1226.0	922.2	1027.5	231.0	99.9	112.0	147.6	217.1	277.0	227.6	240.6
5.	BNH-12	784.3	442.1	507.3	577.9	860.3	1115.8	923.2	966.4	191.0	107.0	108.9	135.6	195.2	249.4	213.5	219.4
6.	BNH-11	876.5	422.6	506.2	601.8	967.1	1173.4	1011.2	1050.6	225.2	102.2	115.4	147.6	210.2	280.8	240.4	243.8
<b>National Checks</b>																	
7.	CO-3	611.5	401.9	492.9	502.1	859.7	1092.9	876.0	942.9	162.6	86.9	106.0	118.5	195.9	240.9	207.4	214.7
8.	CO (BN) 5	643.8	386.9	588.5	539.7	932.0	1072.8	857.0	953.9	185.7	92.9	98.1	125.6	212.6	252.7	197.8	221.0
9.	NB-21	718.1	389.7	529.6	545.8	775.3	960.2	729.6	821.7	167.8	92.5	92.7	117.7	179.9	225.9	172.5	192.8
	Mean	730.5	403.5	551.1	561.7	916.5	1103.9	899.4	973.3	204.3	95.1	104.0	134.5	207.7	254.2	210.5	224.1
	CD 5%	55.8	8.1	11.2						28.7	2.4	5.8					
	CV %	12.9	4.7	14.65						14.6	5.8	10.8					

level (224.1 q/ha) was higher than the mean DMY at Hisar (134.5 q/ha).

Location wise performance of the varietal trial on Bajra Napier hybrid (Table 6) revealed that the highest dry matter yield pooled over three years was recorded at Urulikanchan (529.8 q/ha) in central zone followed by Vellayani (469.1 q/ha) and Coimbatore (383.3 q/ha) in the south zone and Ludhiana (230.4 q/ha) in the north west zone. The genotype BNH 11 gave an increase of 10.32% for dry matter yield as compared to best check CO (BN) 5 over three years. The highest dry matter yield is due to characters like plant height and leaf stem ratio. Similar results are also reported by Vanlauwe (2004) and Jindal and Satpal (2020).

### c) Production Efficiency

At All-India level, all the genotypes of Bajra Napier hybrid except TNCN 1280 gave better results than the best check gave highest pooled per day production of green fodder yield (Table 1). Best three genotypes are BNH 14 (9.83 q/ha/day), BNH 11 (9.31 q/ha/day) and BNH 22 (9.23 q/ha/day) showed better performance than the best check CO (BN) 5 (8.35 q/ha/day) for this trait. However, BNH 11 (2.40 q/ha/day) gave highest pooled per day production of dry matter yield followed by BNH 22 and BNH 12 as compared to the best national check CO (BN) 5 (2.24 q/ha/day).

Location wise performance of the varietal trial on Bajra Napier hybrid (Table 6) revealed that the highest per day production of green fodder pooled over three years was recorded at Dharwad (south zone), Raipur (central zone) and Ludhiana (north west

zone) (GFY (q/ha/day) – 11.51, 8.59 and 5.94, respectively) in different zones. Almost same trend was observed for per day production of dry matter (q/ha/day).

### d) Plant Height

At Hisar, BNH 14, PBN 351, BNH 11 and BNH 12 of Bajra Napier hybrid (Table 3) were tall (167.2 cm, 161.2 cm, 158.8 cm and 157.4 cm, respectively) pooled over three years as compared to best national check CO 3 (150.7 cm). However, at All-India level, BNH 12, BNH 11, BNH 14 and PBN 351 of Bajra Napier hybrid (Table 3) were tall (155.3 cm, 154.8 cm, 151.9 cm and 147.5 cm, respectively) pooled over three years as compared to best national check CO (BN) 5 (146.8 cm). The mean plant height at Hisar (151.6 cm) was taller than the mean plant height at All-India level (146.8 cm).

Location wise performance of the varietal trial on Bajra Napier hybrid (Table 7) revealed that the tallest plants pooled over three years (227.3 cm) was recorded at Jhansi followed by Raipur (193.2 cm) and Vellayani (185.9 cm). More height of the plants is mainly due to the high input intake by the crop plants. Similar reports are also reported by Zewdu *et al.* (2002), Tessema *et al.* (2003) and Jindal and Satpal (2020).

### e) Leaf Stem Ratio

At Hisar, none of the Bajra Napier hybrid genotypes (Table 3) gave a high value for leaf: stem ratio (range 0.63 – 0.79) against the best check NB 21 (0.84) pooled over three years. At All-India level

TABLE 2  
Performance of *Bajra Napier Hybrid* genotypes for production efficiency over three years

S. No.	Genotypes	GFY (q/ha/day)				DMY (q/ha/day)			
		All-India				All-India			
		2016	2017	2018	Pooled	2016	2017	2018	Pooled
1.	TNCN 1280	4.57	9.45	10.46	8.16	1.01	2.45	2.47	1.98
2.	BNH-14	4.88	11.55	13.06	9.83	1.20	2.69	2.98	2.29
3.	BNH-22	4.61	11.17	11.92	9.23	1.14	3.00	3.02	2.39
4.	PBN 351	4.58	10.99	11.29	8.95	1.17	2.93	2.83	2.31
5.	BNH-12	4.38	11.23	12.03	9.21	1.08	2.94	2.95	2.32
6.	BNH-11	5.16	11.05	11.71	9.31	1.26	2.89	3.06	2.40
<b>National Checks</b>									
7.	CO-3	4.47	8.44	10.56	7.82	1.12	2.22	2.63	1.99
8.	CO (BN) 5	4.14	10.06	10.85	8.35	1.06	2.98	2.69	2.24
9.	NB-21	4.15	7.12	9.04	6.77	1.06	2.15	2.31	1.84
Mean		4.55	10.12	11.21	8.63	1.12	2.69	2.77	2.19

TABLE 3  
Performance of *Bajra Napier Hybrid* genotypes for morphological traits over three years

S. No.	Genotypes	Plant Height (cm)								Leaf: Stem Ratio							
		Hisar				All-India				Hisar				All-India			
		2016	2017	2018	Pooled	2016	2017	2018	Pooled	2016	2017	2018	Pooled	2016	2017	2018	Pooled
1.	TNCN 1280	130.7	138.2	156.6	141.8	150.5	152.2	134.0	145.6	0.73	0.69	0.48	0.63	0.73	0.78	0.72	0.74
2.	BNH-14	160.5	166.6	174.5	167.2	156.6	154.0	145.2	151.9	1.12	0.75	0.49	0.79	0.76	0.74	0.79	0.76
3.	BNH-22	146.7	145.7	139.1	143.8	155.1	149.5	125.9	143.5	1.09	0.70	0.58	0.79	0.73	0.80	0.78	0.77
4.	PBN 351	169.6	163.8	150.3	161.2	150.8	150.9	140.9	147.5	0.68	0.98	0.56	0.74	0.78	0.80	0.86	0.81
5.	BNH-12	166.2	158.8	147.2	157.4	158.3	155.9	151.7	155.3	1.29	0.58	0.48	0.78	0.72	0.81	0.74	0.76
6.	BNH-11	156.7	167.9	151.7	158.8	151.8	160.1	152.5	154.8	1.05	0.77	0.45	0.76	0.73	0.75	0.75	0.74
<b>National Checks</b>																	
7.	CO-3	143.6	159.7	148.7	150.7	142.8	146.6	134.0	141.1	0.53	0.91	0.50	0.65	0.82	0.78	0.87	0.82
8.	CO (BN) 5	136.3	140.4	159.5	145.4	155.1	150.0	135.3	146.8	1.09	0.63	0.54	0.75	0.77	0.84	0.81	0.81
9.	NB-21	136.3	138.5	140.1	138.3	132.8	141.3	129.0	134.4	0.87	1.08	0.56	0.84	0.85	0.78	1.01	0.88
Mean		149.6	153.3	152.0	151.6	150.4	151.2	138.7	146.8	0.94	0.79	0.52	0.75	0.77	0.79	0.81	0.79

also, same trend was observed. The mean leaf: stem ratio at All-India level (0.79) was higher than the mean leaf: stem ratio at Hisar (0.52).

Location wise performance of the varietal trial on Bajra Napier hybrid (Table 7) revealed that highest leaf: stem ratio (pooled over three years) of 1.08 recorded at Vellayani followed by Rahuri, Jorhat and Hyderabad (1.01, 0.89 and 0.84, respectively). Leaf: stem ratio increase is mainly due to increase in the foliage that have utilized the solar energy in the production of photosynthates ending in higher biomass production. Similar results have been reported by Gupta (1995) and Shashikanth *et al.* (2013).

#### Forage Quality parameters

The nutritive value or quality of forage (*i.e.* content of CP, NDF and extent of digestibility) is

important for animal consumption and productivity (Abdalla *et al.*, 2007). Plant cell wall is an important source of energy for the ruminant. Its main components are structural carbohydrates *i.e.* Neutral Detergent fibre and acid detergent fibre. Digestibility of structural carbohydrates and amount of energy released depends largely on the degree of lignification of the tissue and tends to decline as plant age increase (Said *et al.*, 1979). Large amount of cell wall carbohydrates remains indigestible even with a relatively small amount of lignin. A strong negative correlation exists between lignin concentration and digestibility of tropical forages (Ford *et al.*, 1979).

#### f) Crude Protein Yield (q/ha)

At Hisar, Bajra Napier hybrid genotype TNCN 1280 (Table 4) gave high crude protein (5.6 q/ha) as

compared to the best check CO 3 (4.7 q/ha). At All-India level, all the genotypes except BNH 22 gave higher crude protein yield (range 12.2 – 14.8 q/ha) as compared to the best check CO 3 (12.7 q/ha) pooled over three years. The mean crude protein yield at All-India level (13.3 q/ha) was higher than the mean for this character at Hisar (4.7 q/ha). Higher crude protein yields may be due to increased photosynthetic activities leading to higher cell division and elongation of the cells that resulted in accumulation of more photosynthates, leading to higher dry matter production which ultimately resulted in higher crude protein production. These results are also in line with the findings of Wandera *et al.*, (2000), Joshi *et al.*, (2012) and Prajapati *et al.*, (2020).

Location wise performance of the varietal trial on Bajra Napier hybrid (Table 7) revealed that the highest crude protein yield pooled over three years was obtained at Urulikanchan (34.3 q/ha) followed by Ludhiana (20.5 q/ha) and Rahuri (19.6 q/ha).

#### g) Crude Protein (%)

At Hisar, the Bajra Napier hybrid best check CO 3 (Table 4) gave highest crude protein percent pooled over three years (8.5%) as compared to genotypes which fall in a range of 7.0 – 8.0%. At All-India level genotype BNH 14 gave slightly high crude protein (7.6%) than the best check CO 3 (7.5%). The mean crude protein percent at Hisar (7.6%) was a bit higher than the mean at All-India level (7.3%) for this character.

Location wise performance of the varietal trial on Bajra Napier hybrid (Table 4) revealed that the

highest crude protein percent pooled over three years was obtained at Hyderabad (9.8%) followed by Ludhiana (8.5%) and Rahuri (8.4%). Higher crude protein percent may be due to more nitrogen accumulation and its conversion to the protein in the particular genotype.

#### h) *In vitro* Dry Matter Digestibility (IVDMD %)

At Hisar, the Bajra Napier hybrid genotypes (Table 5) BNH 12 and BNH 11 gave IVDMD% pooled over three years (54.7% and 53.4%, respectively) which is at a par with the best check CO (BN)5 (53.3%). Higher IVDMD percent is desirable and it was mainly due to less lignin content in BNH 12 (45.4%) than the best check CO 3 (46.3%) as observed in ADF%. Moreover, IVDMD primarily depends upon the concentration of cellulose and hemicelluloses, which in turn influenced by the degree of lignification, silicification (Van-Soest and Jones, 1968) and fiber components (Luthra *et al.*, 1988). A strong negative correlation exists between lignin concentration and digestibility of tropical forages (Ford *et al.*, 1979).

#### i) Neutral Detergent Fiber (NDF %)

At Hisar, the Bajra Napier hybrid genotype (Table 5) BNH 12 gave NDF% (62.5%) as compared to the best check CO (BN) 5 (64.9%). Lower NDF percent is desirable and it might be due to low hemicellulose and less lignification of the tissues. Further, high leaf to stem ratio also contribute to low NDF content as leaves are generally less lignified than stem.

TABLE 4  
Performance of *Bajra Napier Hybrid* genotypes for quality parameters over three years

S. No.	Genotypes	Crude Protein Yield (q/ha)					Crude Protein (%)						
		Hisar		All-India			Hisar			All-India			
		2017	2016	2017	2018	Pooled	2016	2017	Pooled	2016	2017	2018	Pooled
1.	TNCN 1280	5.6	13.2	17.8	9.5	13.5	9.6	5.1	7.4	8.3	6.9	6.8	7.3
2.	BNH-14	4.8	14.9	18.4	11.1	14.8	9.9	5.0	7.5	8.6	7.3	6.8	7.6
3.	BNH-22	3.1	12.4	15.4	8.9	12.2	9.8	4.4	7.1	8.2	6.5	6.7	7.1
4.	PBN 351	4.8	12.2	18.9	12.3	14.5	9.2	4.8	7.0	8.2	6.6	6.8	7.2
5.	BNH-12	5.2	11.2	17.5	10.4	13.0	11.1	4.9	8.0	8.4	7.0	6.8	7.4
6.	BNH-11	5.0	11.9	19.7	12.8	14.8	10.9	4.9	7.9	7.9	6.8	6.8	7.2
<b>National Checks</b>													
7.	CO-3	4.7	12.1	15.4	10.7	12.7	11.5	5.4	8.5	8.3	6.9	7.2	7.5
8.	CO (BN) 5	4.4	12.0	16.5	8.9	12.5	9.4	4.7	7.1	8.2	7.0	6.7	7.3
9.	NB-21	4.6	9.4	16.3	9.1	11.6	10.2	5.0	7.6	7.9	6.8	7.3	7.3
	Mean	4.7	12.1	17.3	10.4	13.3	10.2	4.9	7.6	8.2	6.9	6.9	7.3

TABLE 5  
Performance of *Bajra Napier Hybrid* genotypes for quality parameters over three years at Hisar

S. No.	Genotypes	IVDMD%				NDF%				ADF%			
		2016	2017	2018	Pooled	2016	2017	2018	Pooled	2016	2017	2018	Pooled
1	TNCN 1280	54.5	51.6	53.1	53.1	64.6	66.1	66.7	65.8	47.4	48.2	46.4	47.3
2	BNH-14	54.3	51.8	53.6	53.2	63.3	65.3	66.7	65.1	46.5	46.7	46.0	46.4
3	BNH-22	54.1	51.6	52.9	52.9	64.5	65.7	67.4	65.9	47.5	47.5	46.6	47.2
4	PBN 351	51.6	53.6	53.4	52.9	65.0	65.5	67.8	66.1	48.1	46.7	45.2	46.7
5	BNH-12	55.5	53.7	55.0	54.7	60.7	62.6	64.1	62.5	45.2	45.8	45.2	45.4
6	BNH-11	55.3	51.3	53.6	53.4	62.8	62.9	64.6	63.4	46.3	46.9	45.6	46.3
National Checks													
7	CO-3	54.3	49.6	54.2	52.7	63.6	66.2	67.0	65.6	46.6	47.1	45.1	46.3
8	CO (BN) 5	53.6	51.3	55.1	53.3	64.8	64.4	65.6	64.9	48.5	48.0	45.1	47.2
9	NB-21	53.7	51.6	54.3	53.2	64.0	67.1	64.0	65.0	47.0	48.9	45.7	47.2
Mean		54.1	51.8	53.9	53.3	63.7	65.1	66.0	64.9	47.0	47.3	45.7	46.7

IVDMD - In vitro dry matter digestibility; NDF - Neutral Detergent Fiber; ADF - Acid Detergent Fiber.

TABLE 6  
Location wise performance of *Bajra Napier Hybrid* varietal trial for fodder yield over three years

S. No.	Locations across the country	GFY (q/ha)				DMY (q/ha)				GFY (q/ha/day)				DMY (q/ha/day)			
		2016	2017	2018	Pooled	2016	2017	2018	Pooled	2016	2017	2018	Pooled	2016	2017	2018	Pooled
1.	Palampur (Hill Zone)	397.3	781.4	508.5	562.4	75.3	165.4	99.8	113.5	-	-	-	-	-	-	-	-
2.	Ludhiana	1305.5	1077.8	1020.3	1134.5	278.3	218.1	194.9	230.4	7.06	5.37	5.39	5.94	1.49	1.08	1.01	1.19
3.	Hisar	730.5	403.5	551.1	561.7	204.3	95.1	104.0	134.5	-	-	-	-	-	-	-	-
	<b>NWZ Average</b>	1018.0	740.7	785.7	848.1	241.3	156.6	149.4	182.4	7.06	5.37	5.39	5.94	1.49	1.08	1.01	1.19
4.	Bhubaneswar	395.6	1455.1	292.3	714.3	-	-	-	-	-	-	-	-	-	-	-	-
5.	Ranchi	523.1	120.3	556.8	400.1	113.5	33.8	134.0	93.8	1.43	0.33	1.53	1.10	0.31	0.09	0.37	0.26
6.	Jorhat	719.7	644.5	653.3	672.5	168.1	158.5	156.8	161.1	-	-	-	-	-	-	-	-
	<b>NEZ Average</b>	557.6	740.0	500.8	599.5	140.8	96.2	145.4	127.5	1.43	0.33	1.53	1.10	0.31	0.09	0.37	0.26
7.	Anand	1975.7	837.8	631.7	1148.4	313.9	188.0	143.9	215.3	6.61	2.55	1.58	3.58	1.05	0.57	0.36	0.66
8.	Rahuri	841.4	1428.8	688.6	986.3	203.2	333.6	161.6	232.8	-	-	-	-	-	-	-	-
9.	Urulikanchan	736.6	4243.3	1822.1	2267.3	142.2	1043.5	403.6	529.8	-	-	-	-	-	-	-	-
10.	Jabalpur	-	610.9	800.1	705.5	-	109.9	141.8	125.9	0.38	1.67	2.01	1.35	0.06	0.30	0.38	0.25
11.	Raipur	-	1088.9	340.3	714.6	-	328.7	54.1	191.4	2.34	17.56	5.86	8.59	0.63	5.30	0.93	2.29
12.	Palghar	1168.6	1179.3	-	1174.0	218.1	222.1	-	220.1	-	-	-	-	-	-	-	-
13.	Jhansi	1316.8	1124.2	-	1220.5	383.3	244.2	-	313.8	-	-	-	-	-	-	-	-
	<b>CZ Average</b>	1207.8	1501.9	856.6	1188.8	252.1	352.9	181.0	262.0	3.11	7.26	3.15	4.51	0.58	2.06	0.56	1.07
14.	Coimbatore	1878.0	2103.0	1745.1	1908.7	343.2	446.2	360.4	383.3	-	-	-	-	-	-	-	-
15.	Mandya	426.8	814.2	660.0	633.7	83.5	158.4	134.1	125.3	-	-	-	-	-	-	-	-
16.	Vellayani	1094.8	2131.1	2433.3	1886.4	269.6	526.8	610.8	469.1	-	-	-	-	-	-	-	-
17.	Hyderabad	483.8	645.7	925.8	685.1	93.4	140.8	202.3	145.5	2.89	4.30	6.17	4.45	0.57	0.94	1.35	0.95
18.	Dharwad	669.3	594.2	760.9	674.8	225.0	199.8	255.9	226.9	11.15	10.25	13.12	11.51	3.57	3.45	4.41	3.81
	<b>SZ Average</b>	910.5	1257.7	1305.0	1157.7	202.9	294.4	312.7	270.0	7.02	7.28	9.65	7.98	2.07	2.20	2.88	2.38
	All India Average	916.5	1182.4	899.4	999.4	207.7	271.3	210.5	229.8	5.07	10.12	11.21	5.22	1.12	2.69	2.77	1.34

Locations 1 - Hill zone; 2-3: North West Zone; 4-6: North East Zone; 7-13: Central Zone of India; 14-18: South zone.

#### j) Acid Detergent Fiber (ADF %)

At Hisar, the Bajra Napier hybrid (Table 5) genotype BNH 12 gave ADF% (45.4%) as compared to the best check CO (BN) 5 (64.9%). Lower ADF percent is desirable and it might be due to low lignin content.

Multipurpose fodder trees that had NDF and ADF content below 30% and 40%, respectively, are

believed to have high digestibility (Norton, 1994, Kaitho *et al.* (1996) and Solomon, 2002). The NDF, ADF and CP contents of Bajra Napier hybrid were comparable to findings of Canbolat *et al.* (2006) and Kiraz (2011). NDF digestion can be attributed to lignin which in association with cell walls limit microbial degradation. In addition, lignin, being a component of the cell wall, influences directly its digestibility and hence forage digestibility (Jung and Allen, 1995).

TABLE 7  
Location wise performance of *Bajra Napier Hybrid* varietal trial for morphological traits over three years

S. No.	Locations across the country	Plant height (cm)				Leaf: stem ratio				Crude Protein Yield (q/ha)				Crude Protein (%)			
		2016	2017	2018	Pooled	2016	2017	2018	Pooled	2016	2017	2018	Pooled	2016	2017	2018	Pooled
1	Palampur	193.3	118.4	117.3	143.0	0.57	0.58	0.52	0.56	6.0	14.2	8.1	9.4	8.0	8.5	8.2	8.2
2	Ludhiana	126.4	130.7	133.8	130.3	0.77	0.82	0.89	0.83	27.2	-	13.8	20.5	9.8	-	7.1	8.5
3	Hisar	149.6	153.3	152.0	151.6	0.94	0.79	0.52	0.75	-	4.7	-	4.7	10.2	4.9	-	7.6
4	Ranchi	96.2	189.3	188.5	158.0	0.64	0.61	0.96	0.74	-	2.2	8.5	5.4	-	6.2	6.3	6.3
5	Jorhat	178.8	181.8	170.2	176.9	0.89	-	0.89	0.89	11.6	3.6	3.2	6.1	6.8	5.4	4.3	5.5
6	Anand	174.9	172.1	155.0	167.3	-	-	-	-	27.8	11.4	13.5	17.6	9.3	6.3	9.0	8.2
7	Rahuri	211.6	143.2	94.8	149.9	0.85	1.18	1.01	1.01	17.4	28.8	12.6	19.6	8.6	8.7	7.8	8.4
8	Urulikanchan	133.0	136.2	134.1	134.4	0.53	0.58	0.57	0.56	10.4	66.3	26.2	34.3	7.3	6.3	6.5	6.7
9	Jabalpur	-	70.3	70.5	70.4	0.77	0.75	0.83	0.78	1.9	8.8	10.6	7.1	8.1	8.1	7.8	8.0
10	Raipur	200.8	237.1	193.2	210.4	0.95	0.53	0.96	0.81	2.6	23.3	3.9	9.9	7.2	7.1	7.2	7.2
11	Palghar	102.2	106.1	-	104.2	0.67	0.70	-	0.69	14.8	15.0	-	14.9	6.8	6.7	-	6.8
12	Jhansi	195.5	259.1	-	227.3	0.43	0.72	-	0.58	-	-	-	-	-	-	-	-
13	Mandya	73.2	82.7	69.6	75.2	0.74	0.77	0.70	0.74	4.3	12.3	3.8	6.8	5.2	7.4	4.8	5.8
14	Vellayani	205.4	185.9	185.9	192.4	1.00	1.13	1.12	1.08	-	-	-	-	-	-	-	-
15	Hyderabad	175.8	-	-	175.8	0.84	-	-	0.84	9.4	-	-	9.4	9.8	-	-	9.8
	Average	150.4	151.2	138.7	146.8	0.76	0.79	0.81	0.79	12.1	17.3	10.4	13.3	8.2	6.9	6.9	7.3

Locations 1 - Hill zone; 2-3: North West Zone; 4-5: North East Zone; 6-12: Central Zone of India; 13-15: South zone.

A close look at the data reveals that Central Zone (Anand, Rahuri, Urulikanchan, Jabalpur, Raipur, Palghar, Jhansi) gave higher green fodder and dry matter yields, plant height and production efficiency followed by Southern zone represented by Coimbatore, Mandya, Vellayani, Hyderabad, and Dharwad and other zones thereby indicating that climatic and edaphic conditions are very suitable for Bajra Napier hybrid as compared to and North West Zone, North East Zone and Hill Zone.

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