Journal of Scientific Research and Reports

Volume 30, Issue 10, Page 990-995, 2024; Article no.JSRR.125501
ISSN: 2320-0227

Assessment of BxN Hybrids for Fodder Productivity in South Gujarat, India

Patil, L. M. [a++*], Gomkale, S. R. [a++], Modi, D. J. [a++] and Vasava, H. M. [a++]

[a] Krishi Vigyan Kendra, Chaswad, Dist: Bharuch 393 130, Gujarat, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jsrr/2024/v30i102520

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/125501

Original Research Article

Received: 15/08/2024
Accepted: 17/10/2024
Published: 21/10/2024

ABSTRACT

A field experiment was conducted at Krishi Vigyan Kendra (KVK), Bharuch, Gujarat to evaluate eight Bajra x Napier (BxN) hybrids *viz.* BNH-10, BNH-11, CO-5, CO-6, DHN-5, DHN-15, Phule Jaywant, and Phule Gunwant for their fodder yield potentials and quality parameters over three years (2021-2024). A Randomized Block Design (RBD) with three replications was employed for the experiment. The pooled results of three years revealed that significant variations were observed in hybrids investigated. The hybrid BNH-11 consistently and significantly outperformed other tested hybrids, demonstrating superior performance across multiple parameters, including plant height (143.25 cm), tillers per plant (26), leaf-to-stem ratio (1.14), green fodder yield (207.05 MT ha^{-1}), dry matter yield (80.36 MT ha^{-1}) and crude protein yield (6.06 MT ha^{-1}). Phule Gunwant closely followed BNH-11, performing on par across all evaluated parameters. These findings indicate that BxN hybrids exhibit substantial potential for fodder production, supporting their use in sustainable livestock farming systems in the region.

[++] *Scientist;*
**Corresponding author: E-mail: lalitpatil59@gmail.com;*

Cite as: *L. M., Patil, Gomkale, S. R., Modi, D. J., and Vasava, H. M. 2024. "Assessment of BxN Hybrids for Fodder Productivity in South Gujarat, India". Journal of Scientific Research and Reports 30 (10):990-95. https://doi.org/10.9734/jsrr/2024/v30i102520.*

Keywords: Hybrid Napier; green fodder yield; dry matter yield; crude protein.

1. INTRODUCTION

Animal husbandry in India is closely linked with agriculture and plays a critical role in the socio-economic development of rural households, significantly contributing to the national economy [1]. Despite this, only 4% of the cropped area in India is allocated for fodder cultivation, limiting fodder availability. Gujarat has a prominent position in India's livestock sector, with 26.9 million livestock (5.02% of the country's total) according to the 20th Livestock Census (2017). The state has approximately 9.70 million cattle and 10.4 million buffaloes, making it one of the leading buffalo milk producers in India. However, the current fodder production in Gujarat is insufficient to meet the demands of its large livestock population. The total availability of green forage is estimated to be 608 lakh metric tonnes, while dry fodder availability is 139 lakh metric tonnes, leading to deficits of 25% and 44%, respectively [2]. The average green fodder yield is 40 metric tonnes per hectare per year for cultivated land and 0.75 metric tonnes per hectare per year for common grazing land.

The South Gujarat region, blessed with the highest rainfall in the state and a well-developed irrigation network, has seen a shift in farming practices with many farmers replacing traditional food and fodder crops with cash crops. Although some dairy farmers have attempted to grow seasonal fodder to address the shortage, these efforts have proven neither economical nor sustainable, falling short of meeting the rising demand driven by the growing livestock population. Moreover, the shift from cereal crops—an important source of crop residues—to commercial crops has further aggravated the fodder scarcity [3]. To address this gap between fodder demand and supply, there is a need to intensify forage production per unit area and time.

Cereal fodder and crop residues are major sources of forage but the nutritive value of these forage is not adequate for getting high milk production. This can be achieved through the adoption of improved, high-yielding fodder crops and better management practices, which will help increase productivity and ensure adequate nutrition for the state's livestock population. A promising perennial source of green fodder is Bajra x Napier hybrid and it is widely used for its excellent yield, palatability, and tolerance to diverse soil and climatic conditions [4]. With this background a field experiment was conducted to study the production potential of different BxN hybrids under irrigated conditions of South Gujarat which could provide a viable option to dairy farmers for growing the best new BxN hybrid.

2. MATERIALS AND METHODS

Total eight Bajra x Napier hybrids (perennial) *viz.* BNH-10, BNH-11, CO-5, CO-6, DHN-5, DHN-15, Phule Jaywant, and Phule Gunwant) were evaluated for assessing their fodder yield potentials during 2021-22 to 2023-24 at KVK, Chaswad in Bharuch district of Gujarat. The experiment site at KVK farm is located at an altitude of 138 meter on above mean sea level on 21°34'31 "N latitude and 73°21'56 "E longitudes. The temperatures were raises upto 40 ^{0}C in summer and comes closer to 17 ^{0}C during the winter season. The average annual rainfall is around 960 mm per annum and the maximum was received during the months of June to August. The soil of the experimental field was clayey in texture having medium available nitrogen (269.7 kgha^{-1}) and organic carbon (0.53 %), high available phosphorus (62.05 kgha^{-1}) and available potassium (498 kgha^{-1}), neutral in soil reaction (pH 6.95) and EC of 0.42 dSm^{-1}. The field experiment was laid out in Randomized Block Design (RBD) with eight hybrids and replicated thrice. The plot size was 5.0 m x 3.0 m. The varieties were planted in June 2021 with a common row spacing of 100 cm and 60 cm between plants. The crop was cultivated following the standard package of agronomic practices. The dry matter yield was measured after drying the green fodder samples. Quality parameters of the dry fodder samples were analyzed using standard protocols. Total nitrogen content in the samples was estimated using the conventional Micro-Kjeldahl method, and the nitrogen content was converted to crude protein percentage by multiplying by a factor of 6.25.

2.1 Statistical Analysis

For growth and yield-attributing parameters, five plants were randomly selected from each net plot area for observation. Each crop within the net plots was harvested separately according to the treatment, and the values were converted to a hectare basis and expressed in quintals. The statistical analysis of the data was performed using ANOVA at a 0.05 probability level.

3. RESULTS AND DISCUSSION

The observations recorded on plant height, number of tillers per plant, leaf to stem ratio, green fodder yield, dry matter yield and crude protein yield of eight BxN hybrids are provided in Tables 1-3.

3.1 Plant Height

Significantly highest plant height was noticed with CO-6 (T4), however, which was comparable with BNH-10 (T1) during the first year of the study. (Table 1). However, BNH-10 and BNH-11 recorded significantly highest plant height in second and third year, respectively. The lowest plant height was recorded with DHN-6 (T2) in all three years. Pooled data of three year showed significant variation in plant height among different BxN hybrids tried under south Gujarat irrigated ecosystem. The significantly highest plant height obtained in BNH-10 (153.39 cm) which was followed by CO-6 (148.34 cm) and BNH-11 (143.25 cm). The increase in plant height among the varieties may be attributed to differences in their genetic makeup, internodal length, nutrient absorption capacity, and the ability to convert radiant energy in the presence of chlorophyll. The findings of Jindal and Tokas [5] and Tomar et al. [6] supported the above results.

3.2 Number of Tillers Per Plant

The significantly highest number of tillers per plant was noticed with Phule Gunwant in the first year and BNH-11 in the last two years which was significantly superior to other BxN hybrids investigated (Table 1). The pooled data of three years revealed that number of tillers per plant was significantly highest in BNH-11 (26) followed by Phule Gunwant (25). The variety CO-5 produced the lower number of tillers per plant among the hybrids tested. This could be mainly due to their genetic makeup. The number of tillers is typically controlled by genetic factors, hormonal influences, light intensity and quality, maximum and minimum temperatures, and a favorable rhizosphere environment. This environment supports various resources, including minerals, and the mineral content and their proportions in the roots and basal stem parts also play a crucial role [7]. Increased assimilatory surface area per plant might have led to increased biomass production, ultimately accumulating a large number of photo assimilates.

3.3 Leaf-to-Stem Ratio

Significant differences were also found with respect to leaf and stem ratio in each year as well as in the pooled data. The data revealed that BNH-11 showed a highest leaf-stem ratio (1.14) as compared to other hybrids and it was on par with Phule Gunwant (1.12). The increase in the leaf-to-stem ratio was primarily due to the rapid expansion of dark green foliage, which efficiently intercepted and utilized incident solar radiation for the production of photosynthates, ultimately enhancing meristematic activity. These results are in conformity with the findings of Shashikanth et al. [8] and Biradar et al. [9].

Table 1. Performance of BxN hybrids for growth parameters over three years

	Plant Height (cm)				Number of tillers per plant			
Treatment	**2021-22**	**2022-23**	**2023-24**	**Pooled**	**2021-22**	**2022-23**	**2023-24**	**Pooled**
T1: BNH-10	171.94	166.86	121.36	153.39	26	22	17	22
T2: BNH-11	148.26	158.02	123.47	143.25	28	27	23	26
T3: CO-5	133.12	129.43	120.03	127.53	18	15	12	15
T4: CO-6	169.74	159.21	116.08	148.34	21	18	14	18
T5: DHN-6	95.18	96.54	73.87	88.53	19	17	13	16
T6: DHN-15	103.16	103.16	88.97	98.43	20	18	14	17
T7: Phule Gunwant	147.97	137.84	109.16	131.66	34	22	21	25
T8: Phule Jaywant	134.67	134.67	106.09	125.14	25	22	17	21
S.Em.±	9.09	7.54	7.48	4.66	1.75	1.25	0.98	0.79
CD P=(0.05)	27.58	22.88	22.68	13.31	5.00	4.00	3.00	2.00

3.4 Green Fodder Yield (GFY)

In the first year, the BxN hybrid Phule Gunwant recorded the highest green fodder yield at 234.60 MT ha^{-1} significantly outperforming the other BxN hybrids. This was followed by BNH-11 at 221.91 MT ha^{-1}, while DHN-6 had the lowest yield of 111.41 MT ha^{-1}. In the second year, a general decline in yield was observed across most varieties, but BNH-11 maintained its strong performance with a significantly higher yield of 218.00 MT ha^{-1}, demonstrating consistency. The third year showed a further decline in yield for all varieties; however, BNH-11 continued to lead with 181.25 MT ha^{-1}.

The pooled analysis of the three years revealed BNH-11 as the top-performing BxN hybrids, with a cumulative yield of 207.05 MT ha^{-1}, closely followed by Phule Gunwant at 195.51 MT ha^{-1}. Both varieties demonstrated stable performance under varying conditions. In contrast, DHN-6 consistently had the lowest yield, with a pooled value of 111.39 MT ha^{-1}, indicating that it may be less suited to the climatic conditions of south Gujarat. The highest green fodder yield is due to characters like plant height, regeneration capacity and leaf stem ratio. Similar results are also reported by and Jindal and Satpal [10] Singh et al. [11] and Meena et al. [12].

3.5 Dry Matter Yield

The table 3 presents the dry matter yield ($MTha^{-1}$) and crude protein yield ($MTha^{-1}$) of different treatments over three years, along with their pooled averages.

The treatment T2 (BNH-11) consistently produced significantly highest dry matter yield across all years, with a pooled average of 80.36 $MTha^{-1}$, showing its strong performance over time. Phule Gunwant also showed competitive results, especially in 2021-22, where it had the highest yield (93.46 $MTha^{-1}$), but its performance dropped in subsequent years, leading to a pooled average of 78.48 $MTha^{-1}$. On the other hand, DHN-15 had the lowest dry matter yield in all three years, with a pooled average of 35.90 $MTha^{-1}$, indicating it may be less suitable in terms of biomass production compared to other treatments. Napier hybrids typically demonstrate improved photosynthetic capacity due to optimized leaf structure and arrangement, allowing for better light interception. This increased photosynthetic efficiency translates to higher accumulation of photosynthates, resulting in greater overall biomass and dry matter yield. These results are in agreement with the findings of Pathan et al. [13] and Jindal and Tokas [5] which also reported similar trends.

3.6 Crude Protein Yield

In terms of crude protein yield, BNH-11 again performed the best, with a pooled average of 6.06 $MTha^{-1}$, followed closely by Phule Gunwant with 5.86 $MTha^{-1}$. These treatments not only produced high dry matter yields but also had high crude protein yields, making them ideal for both biomass production and protein content. Higher crude protein yields may be attributed to increased photosynthetic activity, which promotes greater cell division and elongation. This leads to the accumulation of more photosynthates, resulting in increased dry matter production and, ultimately, higher crude protein content. These results are also in line with the findings of Rahmati et al. [14] Basbag et al. [15] and Prajapati et al. [16].

Table 2. Performance of BxN hybrids for yield parameters over three years

	Leaf: Stem Ratio				GFY ($MTha^{-1}$)			
Treatment	**2021-22**	**2022-23**	**2023-24**	**Pooled**	**2021-22**	**2022-23**	**2023-24**	**Pooled**
T1: BNH-10	1.07	1.00	0.76	0.94	162.45	142.50	126.25	143.73
T2: BNH-11	1.27	1.20	0.94	1.14	221.91	218.00	181.25	207.05
T3: CO-5	1.04	0.95	0.74	0.91	164.34	160.00	131.50	151.95
T4: CO-6	0.99	0.86	0.66	0.84	168.12	152.00	132.20	150.77
T5: DHN-6	0.83	0.78	0.60	0.73	118.75	111.14	104.00	111.30
T6: DHN-15	0.85	0.76	0.59	0.73	124.42	105.00	113.50	114.31
T7: Phule Gunwant	1.25	1.12	0.87	1.08	234.60	207.27	144.67	195.51
T8: Phule Jaywant	0.89	0.78	0.60	0.76	161.19	136.73	145.92	147.95
S.Em.±	0.06	0.05	0.04	0.03	8.53	6.90	8.34	8.46
CD P=(0.05)	0.18	0.16	0.13	0.09	25.88	20.93	25.31	25.66

Table 3. Performance of BxN hybrids for quality parameters over three years

	DMY (MTha^{-1})				CPY (MTha^{-1})			
Treatment	**2021-22**	**2022-23**	**2023-24**	**Pooled**	**2021-22**	**2022-23**	**2023-24**	**Pooled**
T1: BNH-10	61.00	52.73	45.45	53.06	3.54	2.99	2.37	2.97
T2: BNH-11	83.55	85.02	72.52	80.36	6.56	6.51	5.11	6.06
T3: CO-5	55.74	54.27	65.79	58.60	3.30	3.14	3.50	3.31
T4: CO-6	68.62	63.07	52.90	61.53	3.90	3.50	2.70	3.37
T5: DHN-6	52.78	49.39	46.86	49.68	3.44	3.14	2.73	3.10
T6: DHN-15	37.65	33.60	36.44	35.90	3.31	3.00	2.99	3.10
T7: Phule Gunwant	93.46	84.30	57.68	78.48	7.23	6.36	4.00	5.86
T8: Phule Jaywant	68.67	57.44	61.23	62.45	5.20	4.24	4.17	4.54
S.Em.±	4.82	3.25	3.12	4.30	0.31	0.25	0.19	0.32
CD P=(0.05)	14.62	9.87	9.47	13.04	0.95	0.76	0.59	0.98

4. CONCLUSION

The study concludes that Bajra x Napier hybrids, particularly BNH-11 and Phule Gunwant, demonstrate exceptional performance in terms of growth, green fodder yield, dry matter yield and crude protein content under the irrigated conditions of south Gujarat. The observed traits such as high plant height, tillering capacity, and favorable leaf-to-stem ratios contribute significantly to their productivity. These hybrids are well-suited for fodder production, making them ideal candidates for enhancing the nutritional value of livestock diets in the region. Further research may focus on optimizing management practices and exploring the adaptability of these hybrids in varying climatic conditions to maximize their yield potential.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Birthal PS. Innovations in marketing of livestock products in India. Indian Journal of Agricultural Marketing. 2016;30(3):88–107.
2. Kalamkar SS, Sharma H, Makwana M. Assessment of livestock feed and fodder in Gujarat. AERC Report No. 193, Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar, Anand, Gujarat; 2020.
3. Patil LM, Kauthale VK, Bhalani TG, Modi DJ. Productivity and economics of different forage production systems in south Gujarat conditions of India. Forage Res. 2018;44(1):14-18.
4. Faruqui SA, Kumar S, Singh DN. Napier Bajra hybrid: Excellent perennial fodder, AICRP on fodder crops, IGFRI, Jhansi. 2009;16.
5. Jindal YK, Tokas J. Evaluation of hybrid Napier grass genotypes in different agro-ecological zones across India. Forage Res. 2021;47(1):50–7.
6. Tomar A, Singh BK, Priya S, Singh S. Growth, yield and economics of fodder grasses at Prayagraj, Uttar Pradesh. Brazilian Journal of Development, Curitiba. 2024;10(2):01-9.
7. Gardner FP, Pearce RB, Mitchell RL. Physiology of crop plants. Iowa University Press; 1985;327.
8. Shashikanth VS, Somashekhar KS, Shekara BG, Krishnappa MR. Performance of Bajra napier hybrid varieties in southern dry zone of Karnataka for the Kharif season of different years. Forage Res. 2013;39(2):64-66.
9. Biradar SA, Mallappa B, Hotkar S, Devarnavadagi V, Kolhar BC. Performance of hybrid Napier grass cultivars under irrigated condition of northern dry zone of Karnataka. Journal of Pharmacognosy and Phytochemistry. 2020;9(4):1813–1815.

10. Jindal Y, Satpal. Comparative evaluation of *Cenchrus ciliaris* genotypes for fodder yield and its attributes with quality parameters under different agro-ecological zones of India. Forage Res. 2020;46(2):191–197.
11. Singh I, Singh SK, Kumar M, Kumari S, Singh G. Napier: Miraculous fodder grass for the dry hot regions of Western Rajasthan. Indian Farming. 2020;70(12):47-48.
12. Meena RK, Hindoriya PS, Kumar R, Ram H, Singh M, Kumar D. Quality, productivity and profitability of diversified fodder-based cropping systems for year-round fodder production in Indo-gangetic plains of India. Range Management and Agroforestry. 2023;44(1):152–159.
13. Pathan SH, Tumbare AD, Kamble AB. Impact of planting material, cutting management and fertilizer levels on nutritional quality of Bajra x Napier hybrid. Forage Res. 2012;38(2):74–79.
14. Rahmati T, Azarfar A, Mahdavi A, Khademi K, Fatahnia F, Shaikhahmadi B, Darabighane B. Chemical composition and forage yield of three *Vicia varieties* (*Vicia spp*.) at full blooming stage. Italian Journal of Animal Science. 2012;11(e57):309-311.
15. Basbag M, Sayar MS, Aydin A, Hosgoren H, Demirel R. Some agronomical and quality traits in nine vetch (*Vicia spp*.) species cultivated in Southeastern Anatolia, Turkey. Turkish Journal of Agricultural and Natural Science. 2015;2(1):69–77.
16. Prajapati B, Tiwari S, Kumar K. Effect of fodder based intercropping systems on herbage yield and quality of fodder under tarai region of Uttarakhand. Forage Res. 2020;46(1):63-68.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the publisher and/or the editor(s). This publisher and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/125501