



Performance of Planting Methods and Sett Treatments on Quality, Nutrient Uptake and Economics of Bajra Napier Hybrid Grass (*Pennisetum glaucum* L. X *P. purpureum schumach*)

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Authors' contributions

This work was carried out in collaboration among all authors. Author SVV designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors CJ, SDS and AS managed the analyses of the study. Authors PM and RK managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment to assess the effect of planting methods and sett treatments on quality, nutrient uptake and economics of bajra napier hybrid grass CO (BN) 5 was conducted during 2018-2019 at the Eastern block farm of the Department of Agronomy, Tamil Nadu Agricultural University – Coimbatore, Tamil Nadu. The experimental field was laid out in factorial randomized block design. The main plots were vertical planting (M₁) and horizontal planting (M₂) and sub-plots were 13 sett treatments. The results on some quality parameters viz., crude protein, crude fibre, crude fat, total ash contents (%), showed non-significant difference on planting methods, sett treatments and their

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interaction. Among planting methods, vertical planting had registered higher crude protein yield of $1.23 \text{ t ha}^{-1}\text{cut}^{-1}$, nitrogen uptake ($151 \text{ kg ha}^{-1}\text{cut}^{-1}$), phosphorus uptake ($23.4 \text{ kg ha}^{-1}\text{cut}^{-1}$) and potassium uptake ($87.7 \text{ kg ha}^{-1}\text{cut}^{-1}$). Among sett treatments, water soaking for 12 hours and 24 hours incubation (S_1) significantly registered higher crude protein yield ($1.78 \text{ t ha}^{-1}\text{cut}^{-1}$), nitrogen uptake ($186.8 \text{ kg ha}^{-1}\text{cut}^{-1}$), phosphorus uptake ($31.9 \text{ kg ha}^{-1}\text{cut}^{-1}$) and potassium uptake ($108.4 \text{ kg ha}^{-1}\text{cut}^{-1}$). In two planting methods, low cost of cultivation ($\$ 629 \text{ ha}^{-1}$), higher gross return ($\$ 1227 \text{ ha}^{-1}$), net return ($\$ 598 \text{ ha}^{-1}$) and benefit cost ratio (1.98) were registered with vertical planting (M_1). Similarly, among sett treatments, water soaking for 12 hours and 24 hours incubation (S_1) recorded lower cost of cultivation ($\$ 563 \text{ ha}^{-1}$), higher gross return ($\$ 1698 \text{ ha}^{-1}$), net return ($\$ 1135 \text{ ha}^{-1}$) and benefit cost ratio (3.02). With this, it can be concluded that for planting method, vertical planting (M_1), and for sett treatment, water soaking for 12 hours and 24 hours incubation (S_1) are the recommended practices for achieving better quality, nutrient uptake and economics from bajra napier hybrid grass.

Keywords: *Planting methods; sett treatments; baja napier hybrid grass; quality and nutrient uptake.*

1. INTRODUCTION

Livestock plays an important role in Indian economy. At present, India faces a critical imbalance in its natural resource base with about 18% human and 15% of livestock population of the world being supported only by 2.4% of geographical area, 1.5% of forest and pasture lands and 4.2% of water resources [1]. Presently, there is stress on accessibility of forage and feed, as cultivated land for fodder cultivation has been declining. Currently, India is facing shortfall of around 64% feeds, 61.1% green fodder and 21.9% dry crop residues [2].

In order to meet the growing demand of nutritious green fodder for livestock, it is essential to introduce high yielding fodder varieties of grasses, millets and legumes. One such among the cultivated perennial grasses is the bajra napier hybrid grass, acclaimed as the highest forage yielder in a unit time and space. Among the bajra napier grasses, B.N hybrid grass CO (BN) 5 is an inter-specific hybrid between bajra IP 20594 [*Pennisetum glaucum* (L.) R. Br.] and napier grass FD 437 (*P.purpureum schumacheri*) produced throughout the year with heavy yielding potential [3].

Planting methods and number of buds per sett was known to have considerable effect on sprouting and subsequent growth of vegetatively propagated crops [4]. This large mass of planting material poses a great problem in transport, handling, sett material storage etc. The huge stuff of sett material is also prone to disease's attack and undergoes rapid deterioration thus reducing the viability of buds and subsequently their sprouting. Thus, more number of setts is required to get one healthy seedling from the

stock [5]. Therefore, by using the single budded setts considerably reduces the amount of planting material requirement as well as they are easy to transport [6].

In addition, pre-planting treatments can be used to protect the crop from soil borne diseases, sett rotting and damage to buds which affect germination [7]. It may improve the 60% of germination by sett treatment which is quite simple and cheap [8]. Most of the farmers use two or three-budded setts as planting materials without pre-planting treatments, but two or three-budded setts cannot give uniform germination as of an individual bud and damage to setts cause large gaps. To overcome poor germination and poor crop stand, a suitable sett treatments, sett size and planting methods are essential for bajra napier hybrid grass cultivation.

In order to address these problems, this research was conducted to evaluate the effectiveness of various planting methods and pre planting sett treatments for identifying suitable planting method and pre planting sett treatment for bajra napier hybrid grass that could account for better crop productivity and economy.

2. MATERIALS AND METHODS

A field experiment was conducted during 2018-2019 in Field No. 75 at the Eastern block farm of Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore. The soils in the experimental field are sandy clay loam in texture. Climatic conditions prevailed during cropping period were with rainfall of 68.6 mm, maximum minimum temperatures of 31°C and 23°C respectively and relative humidity during morning and evening of 86 and 57% respectively

based on the data provided by Agroclimate research centre, Tamil Nadu Agricultural University. The chemical analysis of soil indicated that the soil was low in available nitrogen (205 kg ha^{-1}), high in available phosphorus (33 kg ha^{-1}) and high in available potassium (769 kg ha^{-1}). It was moderately alkaline in reaction (pH 8.49) with 0.55 dSm^{-1} electrical conductivity. The organic carbon content was 0.57%. The variety adapted for the study was CO (BN) 5 bajra napier hybrid grass.

The experimental field was laid out in factorial randomized block design (FRBD) with two replications. Main plots comprised of planting methods with vertical (M_1) and horizontal planting (M_2) and sub plots with thirteen sett treatments viz, water soaking for 12 hours and 24 hours incubation (S_1), water soaking for 30 minutes (S_2), hot water soaking at 40°C for 20 minutes (S_3), cowdung slurry (1:1) soaking for 30 minutes (S_4), panchagavya (3%) soaking for 30 minutes (S_5), panchagavya (5%) soaking for 30 minutes (S_6), beejamruth (soaking concentrated solution for 30 minutes) (S_7), beejamruth (50% dilution) soaking for 30 minutes (S_8), GA3 (5 ppm) soaking for 15 minutes (S_9), GA3 (10 ppm) soaking for 15 minutes (S_{10}), ethrel (50 ppm) soaking for 15 minutes (S_{11}), ethrel (100 ppm) soaking for 15 minutes (S_{12}), control (without sett treatment) (S_{13}). The field was thoroughly ploughed and applied with recommended dose of NPK 75:50:40 kg ha^{-1} at basal, subsequently 75 kg ha^{-1} of nitrogen was applied at 30 days after planting (DAP).

The single budded setts were treated as per treatment schedule and planted vertically and horizontally in their respective plots with a spacing of 60 x 50 cm in the month of July. First irrigation was given at the time of planting and life irrigation was provided on 3 DAP. Subsequent irrigations were given at 10 days interval. Hand weeding was done on 20 DAP. The samples used for analysis were taken at 75 DAP during first cut.

The standard analytical methods were used for plant analysis viz., nitrogen (kg ha^{-1}) estimated through Humphries (1956) [9], phosphorus and potassium (kg ha^{-1}) by Jackson (1973) [10]. The quality parameters viz., crude protein content was estimated using the method suggested by Humphries (1956) [9], crude fibre content (%) by Goering and Van Soest (1970) [11] while, crude fat content (%) was determined by AOAC (1970) [12] and total ash content (%) was determined by

AOAC (1990) [13]. Crude protein yield ($\text{t ha}^{-1}\text{cut}^{-1}$) was computed by multiplying the crude protein content with respective dry matter production. The prevailing market prices were taken to work out the economics of different treatments. Also the statistical analysis for all the data pertaining to the crop was carried out using the procedure suggested by Gomez and Gomez (1984) [14]. Wherever the treatment differences were found significant critical difference was worked out at 5% probability level. The treatment differences that were not significant were denoted as "NS".

3. RESULTS AND DISCUSSION

3.1 Quality Parameters

The results on quality parameters (Tables 1 & 2) shows that, crude protein content, crude fibre content, crude fat content, total ash content (%) on bajra napier hybrid grass CO (BN) 5 showed non-significant differences among the two planting methods and sett treatments. But, crude protein yield ($\text{t ha}^{-1}\text{cut}^{-1}$) showed a marked difference on the planting methods and sett treatments. Whereas, interaction effect of quality parameters showed non-significant difference between planting methods and sett treatments.

3.2 Crude Protein Content (%)

Among the planting methods, horizontal planting (M_2) registered numerically higher crude protein content of 13.89%. Lower value of 13.68% was observed with vertical planting (M_1). For sett treatments, water treatment (12 hours soaking and 24 hours incubation) (S_1) recorded numerically higher value of 14.40%. Numerically lower value of 12.92% was observed with control (without sett treatment) (S_{13}). With respect to interaction effect of planting methods and sett treatments, horizontal planting with water treatment (12 hours soaking and 24 hours incubation) (M_2S_1) recorded numerically higher value of 14.53%. Numerically lower value of 12.43% was registered with vertical planting with control (without sett treatment) (M_1S_{13}). Crude protein content of bajra napier hybrid was not influenced significantly due to different planting methods and sett treatments. This might be due to the practice that planting materials were obtained from same origin where did not have influence on quality parameters. This was supported by Pathan et al. [15]. Subsequently, Credo [16] Soriano [17] also reported that equal influence of treatment on planting material

showed non-significant differences among planting methods with sett treatment.

3.3 Crude Fibre Content (%)

Crude fibre content among the planting methods showed numerically higher value of 30.14% with vertical planting (M₁). Numerically lower value of 29.94% was registered with horizontal planting (M₂). For sett treatments, control (without sett treatment) (S₁₃) recorded numerically higher value of 30.45% and lower value of 29.44% was registered with water treatment (12 hours soaking and 24 hours incubation) (S₁). Interaction of planting methods and sett treatments showed numerically superior value of 30.46% in vertical planting with control (without sett treatment) (M₁S₁₃). Lower value of 29.43% was observed with horizontal planting with water treatment (12 hours soaking and 24 hours incubation) (M₂S₁).

Crude fibre is an indirect indication of digestibility of the forage and occupies prime position in the evaluation of forage material. Crude fibre mainly consists of cellulose, hemicellulose and lignin and reduces the digestibility of forage. Crude fibre content was not influenced significantly by different planting methods and sett treatments. However, there had been decreasing trend of

crude fibre content with increased nitrogen uptake. Due to higher nitrogen uptake, more rapidly synthesized carbohydrates were produced and converted to protein and protoplasm, only smaller proportion was left available for cell wall material [18]. This might be the reason for non-significant result of crude fibre content. These results were also confirms with the findings of Pathan et al. [15] and Patel and Chaudhary [19].

3.4 Crude Fat Content (%)

Results on crude fat content shows that among the planting methods numerically higher value of 4.87% was registered with horizontal planting (M₂). Numerically lower value of 4.84% was recorded with vertical planting (M₁). For sett treatments, water treatment (12 hours soaking and 24 hours incubation) (S₁) registered numerically higher value of 5.20%. Numerically lower value of 4.67% was recorded with control (without sett treatment) (S₁₃). With regarded to interaction effect between planting methods and sett treatments, horizontal planting with water treatment (12 hours soaking and 24 hours incubation) (M₂S₁) recorded numerically higher value of 5.23%. Numerically lower value of 4.65 was observed with vertical planting with control (without sett treatment) (M₁S₁₃). These

Table 1. Effect of sett treatments and planting methods on crude protein content and crude protein yield of B. N. hybrid grass

Treatments	Crude protein content (%)			Crude protein yield (t ha ⁻¹ cut ⁻¹)		
	M ₁ Vertical	M ₂ Horizontal	Mean	M ₁ Vertical	M ₂ Horizontal	Mean
Planting methods						
Sett treatments						
S ₁ Water (12 hrs. soaking & 24 hours incubation)	14.26	14.53	14.40	1.88	1.67	1.78
S ₂ Water (30 minutes)	13.14	13.50	13.32	0.84	0.82	0.83
S ₃ Hot water	14.01	14.07	14.04	1.27	1.24	1.26
S ₄ Cowdung slurry	14.07	14.12	14.10	1.49	1.38	1.44
S ₅ Panchagavya 3%	13.77	13.72	13.75	1.07	0.95	1.01
S ₆ Panchagavya 5%	13.81	13.83	13.82	1.12	1.00	1.06
S ₇ Beejamruth	14.21	14.47	14.34	1.80	1.66	1.73
S ₈ Beejamruth 50% dilution	14.14	14.25	14.20	1.64	1.47	1.55
S ₉ GA3 (5 ppm)	13.70	13.64	13.67	1.03	0.91	0.97
S ₁₀ GA3 (10 ppm)	13.95	13.96	13.96	1.19	1.12	1.15
S ₁₁ Ethrel (50 ppm)	13.33	13.55	13.44	0.97	0.88	0.93
S ₁₂ Ethrel (100 ppm)	13.04	13.48	13.26	0.93	0.88	0.90
S ₁₃ Control	12.43	13.41	12.92	0.71	0.74	0.72
Mean	13.68	13.89		1.23	1.13	
	P	S	PXS	P	S	PXS
SEd	0.31	0.79	1.13	0.03	0.07	0.92
CD (P=0.05)	NS	NS	NS	S	S	NS

Table 2. Effect of sett treatments and planting methods on crude fibre, crude fat and total ash content of B. N. hybrid grass

Treatments Planting methods	Crude fibre content (%)			Crude fat content (%)			Total ash content (%)		
	M ₁ Vertical	M ₂ Horizontal	Mean	M ₁ Vertical	M ₂ Horizontal	Mean	M ₁ Vertical	M ₂ Horizontal	Mean
Sett treatments									
S ₁ Water (12 hrs. soaking & 24 hours incubation)	29.45	29.43	29.44	5.17	5.23	5.20	11.96	12.09	12.03
S ₂ Water (30 minutes)	30.37	30.36	30.37	4.70	4.73	4.72	10.46	10.55	10.51
S ₃ Hot water	30.19	29.70	29.95	4.87	4.90	4.89	11.21	11.26	11.24
S ₄ Cowdung slurry	29.93	29.68	29.81	4.95	4.98	4.97	11.37	11.42	11.40
S ₅ Panchagavya 3%	30.27	30.04	30.16	4.75	4.78	4.77	10.68	10.72	10.70
S ₆ Panchagavya 5%	30.25	29.83	30.04	4.78	4.80	4.79	10.94	10.97	10.96
S ₇ Beejamruth	29.76	29.61	29.69	5.10	5.16	5.13	11.92	11.96	11.94
S ₈ Beejamruth 50% dilution	29.87	29.64	29.76	5.01	5.04	5.03	11.61	11.73	11.67
S ₉ GA3 (5 ppm)	30.32	30.15	30.24	4.73	4.75	4.74	10.63	10.63	10.63
S ₁₀ GA3 (10 ppm)	30.22	29.75	29.99	4.80	4.82	4.81	11.02	11.05	11.04
S ₁₁ Ethrel (50 ppm)	30.35	30.24	30.30	4.72	4.76	4.74	10.53	10.58	10.56
S ₁₂ Ethrel (100 ppm)	30.41	30.39	30.40	4.69	4.70	4.70	10.42	10.47	10.45
S ₁₃ Control	30.46	30.44	30.45	4.65	4.69	4.67	10.34	10.40	10.37
Mean	30.14	29.94		4.84	4.87		11.01	11.06	
	P	S	PXS	P	S	PXS	P	S	PXS
SEd	0.69	1.76	2.49	0.11	2.89	0.40	0.26	0.65	0.93
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3. Effect of sett treatments and planting methods on cost of cultivation and gross return of B. N. hybrid grass

Treatments Planting methods	Cost of cultivation (\$ ha ⁻¹ cut ⁻¹)			Gross return (\$ ha ⁻¹ cut ⁻¹)			
	Sett treatments	M ₁ Vertical	M ₂ Horizontal	Mean	M ₁ Vertical	M ₂ Horizontal	Mean
S ₁ Water (12 hrs. soaking & 24 hours incubation)		550	576	563	1777	1619	1698
S ₂ Water (30 minutes)		550	576	563	819	724	771
S ₃ Hot water		550	576	563	1373	1158	1265
S ₄ Cowdung slurry		560	586	573	1517	1240	1379
S ₅ Panchagavya 3%		694	720	707	1053	994	1023
S ₆ Panchagavya 5%		791	817	804	1169	1049	1109
S ₇ Beejamruth		731	758	744	1737	1458	1597
S ₈ Beejamruth 50% dilution		671	697	684	1639	1316	1478
S ₉ GA3 (5 ppm)		568	594	581	1039	958	998
S ₁₀ GA3 (10 ppm)		588	614	601	1295	1098	1197
S ₁₁ Ethrel (50 ppm)		643	669	656	925	880	902
S ₁₂ Ethrel (100 ppm)		736	746	741	876	876	876
S ₁₃ Control		550	576	563	737	705	721
Mean		629	661		1227	1083	

Table 4. Effect of sett treatments and planting methods on net return and B: C ratio of B. N. hybrid grass

Treatments Planting methods	Net return (\$ ha ⁻¹ cut ⁻¹)			B:C ratio			
	Sett treatments	M ₁ Vertical	M ₂ Horizontal	Mean	M ₁ Vertical	M ₂ Horizontal	Mean
S ₁ Water (12 hrs. soaking & 24 hours incubation)		1228	1043	1135	3.23	2.81	3.02
S ₂ Water (30 minutes)		269	148	209	1.49	1.26	1.38
S ₃ Hot water		824	582	703	2.5	2.01	2.26
S ₄ Cowdung slurry		957	654	806	2.71	2.12	2.42
S ₅ Panchagavya 3%		359	274	316	1.52	1.38	1.45
S ₆ Panchagavya 5%		378	232	305	1.48	1.28	1.38
S ₇ Beejamruth		1006	700	853	2.37	1.92	2.15
S ₈ Beejamruth 50% dilution		968	619	794	2.44	1.89	2.17
S ₉ GA3 (5 ppm)		471	363	417	1.83	1.61	1.72
S ₁₀ GA3 (10 ppm)		707	483	595	2.2	1.79	2.00
S ₁₁ Ethrel (50 ppm)		282	211	247	1.44	1.32	1.38
S ₁₂ Ethrel (100 ppm)		140	130	135	1.19	1.17	1.18
S ₁₃ Control		187	130	158	1.34	1.23	1.29
Mean		598	428		1.98	1.68	

results were in line with the findings of Pathan et al. [15] who reported that crude fat content of bajra napier hybrid grass was not significantly varied with different planting methods. Subsequently Nithya [20] also reported that same planting material with different planting methods does not show any significant difference on crude protein content of bajra napier hybrid grass. These results are further supported by Shukla and Lal [21].

3.5 Total Ash Content (%)

Among planting methods, horizontal planting (M₂) recorded numerically higher value of 11.06%. Whereas, numerically lower value of 11.01% was registered with vertical planting (M₁). For sett treatments, water treatment (12 hours soaking and 24 hours incubation) (S₁) recorded numerically superior value of 12.03%. Numerically lower value of 10.37% was observed with control (without sett treatment) (S₁₃).

Interaction of planting methods and sett treatments, horizontal planting with water treatment (12 hours soaking and 24 hours incubation) (M_2S_1) recorded numerically higher value of 12.09%. Lower value of 10.34% was observed with vertical planting with control (without sett treatment) (M_1S_{13}). These results were quite in line with the findings of Pathan Sarfrajkhan [22] in bajra napier hybrid grass.

Higher ash content registered on horizontal planting (M_2) and water treatment (12 hours soaking and 24 hours incubation) (S_1) might be due to higher mineral absorption at initial growth stage which was reflected in higher dry matter yield which in turn increased the ash content. These results were correlated with the findings of Tessema and Alemayehu [23]. Planting methods and sett treatments combination did not exert significant influence on total ash content.

3.6 Crude Protein Yield ($t\ ha^{-1}cut^{-1}$)

Significant variation was observed in crude protein yield due to planting methods and sett treatments. But interaction effect between planting methods and sett treatments had non-significant difference on crude protein yield. Crude protein yield was significantly higher under vertical planting (M_1) which recorded $1.23\ t\ ha^{-1}cut^{-1}$. The lower crude protein yield of $1.13\ t\ ha^{-1}cut^{-1}$ was registered with horizontal planting (M_2). Regarding sett treatments, higher crude protein yield of $1.78\ t\ ha^{-1}cut^{-1}$ was recorded with water treatment (12 hours soaking and 24 hours incubation) (S_1). Lower crude protein yield of $0.72\ t\ ha^{-1}cut^{-1}$ was observed with control (without sett treatment) (S_{13}). Though crude protein content not varied with different planting methods and sett treatments, crude protein yield differed significantly. Since the crude protein yield is derived by multiplying crude protein percentage with dry matter yield.

Among planting methods used, vertical planting registered higher crude protein yield. Due to early establishment on vertical planting and sett treatment, it absorbed more nutrients and produced more herbage yield with higher accumulation of dry matter and crude protein content in plants, which in turn increased crude protein yield [24] and [25]. This finding corroborate with the results of Sinare et al. [26]. Similar findings by Pathan et al. [15] also states that, this might be due to superior vegetative growth attributes and more green forage yield

resulted in higher dry matter accumulation which resulted in higher crude protein yield. Further the lower crude protein yield with horizontal planting and control (without sett treatment) is because of the inferior growth attributes viz., plant height, number of leaves, number of tillers and leaf : stem ratio which was reflected in less dry matter accumulation and thereby lower amount of crude protein yield.

3.7 Nutrient Uptake ($kg\ ha^{-1}cut^{-1}$)

The impact of planting methods and sett treatments on nutrient uptake (Fig.1) revealed that both had significant influence on nutrient uptake. Whereas interaction effect of planting methods and sett treatments had non-significant influence on nutrient uptake.

3.8 Nitrogen Uptake ($kg\ ha^{-1}cut^{-1}$)

The results showed that nitrogen uptake was significantly superior under vertical planting (M_1) which recorded $151.0\ kg\ ha^{-1}cut^{-1}$. This was mainly due to the fact that the vertical planting was associated with greater above ground biomass and better root mass which in turn increased the nutrient uptake. This claim was supported by the findings of Howeler [27]. Whereas, lower nitrogen uptake of $142.7\ kg\ ha^{-1}cut^{-1}$ was registered with horizontal planting (M_2). Among sett treatments, water treatment (12 hours soaking and 24 hours incubation) (S_1) recorded higher nitrogen uptake of $186.8\ kg\ ha^{-1}cut^{-1}$. This superiority can be attributed to rapid sprouting and establishment, the best survival, high ground green cover and consequently the efficient use of light and soil moisture. This in turn increased the nitrogen uptake [28]. It was further comparable with beejamruth (Concentrated solution) (S_7) which recorded $181.3\ kg\ ha^{-1}cut^{-1}$. The lower nitrogen uptake of $97.9\ kg\ ha^{-1}cut^{-1}$ was observed with control (without sett treatment) which was on par with water soaking for 30 minutes (S_2) with nitrogen uptake of $110.2\ kg\ ha^{-1}cut^{-1}$.

3.9 Phosphorus Uptake ($kg\ ha^{-1}cut^{-1}$)

Results for phosphorus uptake showed that, for planting methods vertical planting (M_1) registered significantly the highest phosphorus uptake of $23.4\ kg\ ha^{-1}cut^{-1}$. This is because of the fact that their shoots sprouted earlier and produce more photosynthate for the developing roots this in turn increased the phosphorus uptake. Lower phosphorus uptake of $21.6\ kg\ ha^{-1}cut^{-1}$ was

recorded with horizontal planting (M_2). Higher phosphorus uptake of $31.9 \text{ kg ha}^{-1}\text{cut}^{-1}$ was observed with water treatment (12 hours soaking and 24 hours incubation) (S_1). This might be due to higher earlier sprouting and growth, which might improve the plant capability for nutrient uptake from the soil [29]. This was at par with beejamruth (Concentrated solution) (S_7) which recorded $29.9 \text{ kg ha}^{-1}\text{cut}^{-1}$. This might be due to phytohormones and beneficial microorganisms present in the beejamruth enhanced the root mass thus enhanced the nutrient uptake. Setts treated with beejamruth increases the bioavailability of nutrient in the root zone. Microbial release of nutrient enhanced the nutrient concentration in soil hence more uptake by plants [30]. The lowest phosphorus uptake of $11.4 \text{ kg ha}^{-1}\text{cut}^{-1}$ was registered with control (without sett treatment) which was at par with water soaking for 30 minutes (S_2) with phosphorus uptake of $13.1 \text{ kg ha}^{-1}\text{cut}^{-1}$.

3.10 Potassium Uptake ($\text{kg ha}^{-1}\text{cut}^{-1}$)

Potassium uptake was significantly superior under vertical planting (M_1) which recorded $87.7 \text{ kg ha}^{-1}\text{cut}^{-1}$. It might be because of the fact that vertically planted cuttings produced new shoots on a longer period than horizontally planted cuttings due to the early resource acquisition of sprouting buds which are permanently exposed to light. Plants might allocate more resources to continuous shoot production when exposed to sunlight as a competitive strategy, as long as they are not too shaded which ultimately increase the nutrient uptake [27]. The reason might also be the fact that, vertical planting enables the planting material to be established as early as possible and start the absorption of water which resulted in better growth and development. Therefore, the vertical planting registered the highest potassium uptake. Whereas, horizontal planting take more time for their establishment hence absorption of water and nutrient gets delayed, which in turn results in less quantity of NPK in plant [22]. The lower potassium uptake of $84.1 \text{ kg ha}^{-1}\text{cut}^{-1}$ was observed with horizontal planting (M_2).

Among the sett treatments, water treatment (12 hours soaking and 24 hours incubation) (S_1) registered higher potassium uptake of $108.4 \text{ kg ha}^{-1}\text{cut}^{-1}$. This might be attributed due to early establishment of roots, which absorb applied nutrients from soil immediately after planting and in turn increased the K concentration and dry matter accumulation ultimately higher uptake

[31]. It was further comparable with beejamruth (Concentrated solution) (S_7) which recorded $102.6 \text{ kg ha}^{-1}\text{cut}^{-1}$. The lower potassium uptake of $66.7 \text{ kg ha}^{-1}\text{cut}^{-1}$ was observed with control (without sett treatment) (S_{13}), which was at par with water soaking for 30 minutes (S_2) which recorded $71.9 \text{ kg ha}^{-1}\text{cut}^{-1}$.

3.11 Economics

The results obtained for economics viz., cost of cultivation, gross return, net return and benefit cost ratio of the study are given in the Tables 3 & 4.

3.12 Cost of Cultivation ($\text{\$ ha}^{-1}\text{cut}^{-1}$)

For planting methods, the higher cost of cultivation $\text{\$ } 661 \text{ ha}^{-1}\text{cut}^{-1}$ was registered with horizontal planting (M_2). This mainly because horizontal planting require more time to plant which in turn increases the overall cost associate with planting [32]. Lower cost of cultivation of $\text{\$ } 629 \text{ ha}^{-1}\text{cut}^{-1}$ was incurred with vertical planting (M_1). This might be due to vertical intrusion in the soil take lesser time when compared with horizontal planting [33]. Regarding sett treatments, the higher cost of cultivation of $\text{\$ } 804 \text{ ha}^{-1}\text{cut}^{-1}$ was obtained with panchagavya (5%) (S_6). This was owing to the high cost involved in panchagavya preparation. Lower cost of cultivation of $\text{\$ } 563 \text{ ha}^{-1}\text{cut}^{-1}$ was registered with control (without sett treatment) (S_{13}). In combination, highest cost of cultivation of $\text{\$ } 817 \text{ ha}^{-1}\text{cut}^{-1}$ was incurred with the treatment horizontal planting with panchagavya (5%) treatment (M_2S_6). The lowest cost of cultivation of $\text{\$ } 550 \text{ ha}^{-1}\text{cut}^{-1}$ was registered by vertical planting with water treatment (12 hours soaking and 24 hours incubation) (M_1S_1).

3.13 Gross Return ($\text{\$ ha}^{-1}\text{cut}^{-1}$)

With regarded to planting methods, higher gross return of $\text{\$ } 1227 \text{ ha}^{-1}\text{cut}^{-1}$ was recorded with vertical planting (M_1) but lower gross return of $\text{\$ } 1083 \text{ ha}^{-1}\text{cut}^{-1}$ was registered with horizontal planting (M_2). For sett treatments, maximum gross return of $\text{\$ } 1698 \text{ ha}^{-1}\text{cut}^{-1}$ was registered with water treatment (12 hours soaking and 24 hours incubation). Lower gross return of $\text{\$ } 721 \text{ ha}^{-1}\text{cut}^{-1}$ was observed with control (without sett treatment) (S_{13}). Interaction effect during the study showed that the maximum gross return of $\text{\$ } 1777 \text{ ha}^{-1}\text{cut}^{-1}$ was recorded by the treatment vertical planting with water treatment (12 hours soaking and 24 hours incubation) (M_1S_1). The

minimum gross return of \$ 705 ha⁻¹cut⁻¹ was registered by horizontal planting with control (without sett treatment) (M₂S₁₃). The higher gross return registered with vertical planting with water treatment (12 hours soaking and 24 hours incubation) might be due to higher sprouting and establishment percentage of vertical planting with water treatment combined with higher green fodder yield [26]. These results are in agreement with findings of Shukla et al. [34] who reported that treated setts establish earlier which produce higher root mass which improved the vegetative growth results in higher green and dry fodder yield thus increases the economic returns.

3.14 Net Return (\$ ha⁻¹cut⁻¹)

The higher net return of \$ 598 ha⁻¹cut⁻¹ was registered with vertical planting (M₁). Whereas, lower net return of \$ 428 ha⁻¹cut⁻¹ was recorded with horizontal planting (M₂). For sett treatments, water treatment (12 hours soaking and 24 hours incubation) (S₁)

registered maximum net return of \$ 1135 ha⁻¹cut⁻¹. Lower net return of \$ 135 ha⁻¹cut⁻¹ was observed with ethrel (100 ppm) (S₁₂). In combination, vertical planting with water treatment (12 hours soaking and 24 hours incubation) (M₁S₁) registered higher net return of \$ 1228 ha⁻¹cut⁻¹. The might be due to earlier sprouting induce root system very rapidly that will increases the nutrient uptake which in turn improve the growth, green and dry fodder yield this leads to higher economic value and net return [35]. Lower net return of \$ 130 ha⁻¹cut⁻¹ was recorded with horizontal planting with control (without sett treatment) (M₂S₁₃).

3.15 Benefit Cost Ratio (B: C)

For planting methods, higher B:C of 1.98 was recorded with vertical planting (M₁). Lower B:C of 1.68 was registered with horizontal planting (M₂). Regarding sett treatments, water treatment (12 hours soaking and 24 hours incubation) (S₁)

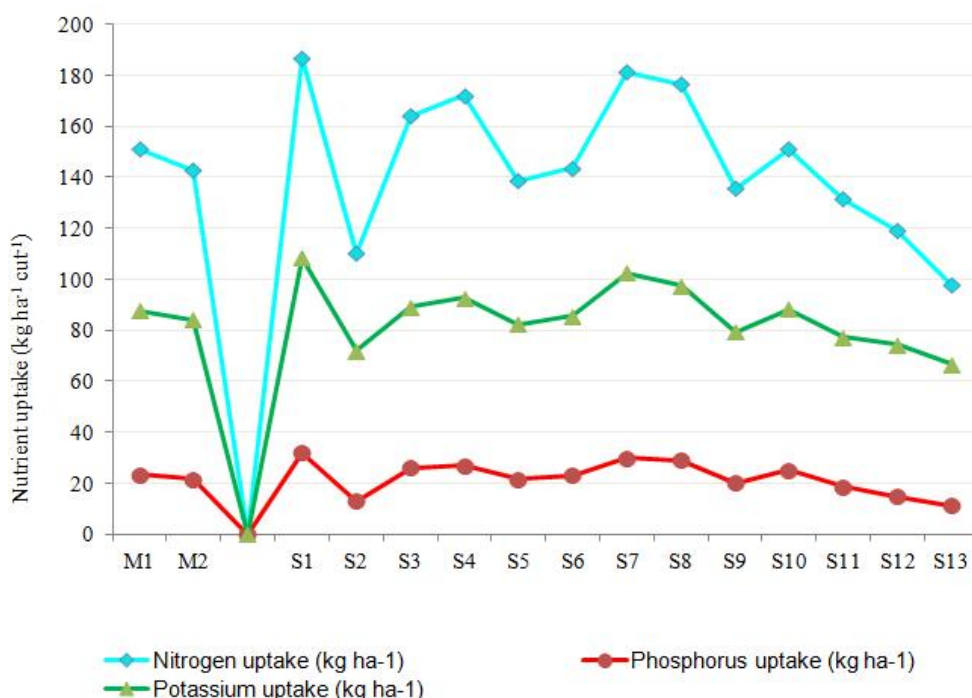


Fig. 1. Effect of sett treatments and planting methods on nutrient uptake (kg ha⁻¹ cut⁻¹) of B.N. hybrid grass

M₁ - Vertical planting, M₂ - Horizontal planting, S₁ – water soaking for 12 hour and 24 hours incubation, S₂ - water soaking for 30 minutes, S₃ - hot water soaking at 40°C for 20 minutes, S₄ - cowdung slurry (1:1) soaking for 30 minutes, S₅ - panchagavya (3%) soaking for 30 minutes, S₆ - panchagavya (5%) soaking for 30 minutes, S₇ - beejamruth soaking concentrated solution for 30 minutes, S₈ - beejamruth (50% dilution) soaking for 30 minutes, S₉ - GA3 (5 ppm) soaking for 15 minutes, S₁₀ - GA3 (10 ppm) soaking for 15 minutes, S₁₁ - ethrel (50 ppm) soaking for 15 minutes, S₁₂ - ethrel (100 ppm) soaking for 15 minutes, S₁₃ - control (without sett treatment)

recorded higher B:C of 3.02. Lower B:C of 1.18 was registered with ethrel (100 ppm) (S₁₂). In interaction higher B:C ratio of 3.23 was registered with vertical planting with water treatment (12 hours soaking and 24 hours incubation) (M₁S₁). Lower B:C ratio of 1.17 was recorded with horizontal planting with ethrel (100 ppm) (M₂S₁₂) treatment. The impact of increased growth and yield attributes produced higher biomass yield [36] and in turn resulted in higher net return and B: C ratio [34].

4. CONCLUSION

Based on the results, it can be concluded that planting methods and sett treatments had significantly increased the nutrient uptake and crude protein yield. However the quality parameters viz., crude protein content, crude fibre content, crude fat content and total ash content had no significant influence neither by planting methods and sett treatments or the interaction effect between them. This study also concluded that for achieving better nutrient uptake, crude protein yield, higher net return, gross return, benefit cost ratio and reduced cost of cultivation, vertical planting with water soaking for 12 hours and 24 hours incubation is the best practice for bajra napier hybrid grass CO (BN) 5.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Palsaniya DR, Singh R, Tewari RK, Yadav RS, Dhyani SK. Integrated watershed management for natural resource conservation and livelihood security in Semi Arid Tropics of India. *Indian Journal of Agricultural Science*. 2012;82(3):241-47.
- Dhananjay Datta. Indian fodder management towards 2030: A Case of Vision or Myopia *international Journal of Management and Social Sciences Research*. 2013;2(2):33-41.
- Babu C, Iyanar K, Kalamani A. High green fodder yielding new grass varieties. *Electronic Journal of Plant Breeding*. 2014;5(2):220-229.
- Worku Burraya. The influence of different portions of the stalk cuttings and number of buds per sett on sprouting, tillering and yield of sugarcane, M.Sc. Thesis. Alemaya University of Agriculture, Ethiopia; 1992.
- Khalid Shahfazal, Munsif Amjid, Ali Muhammad, Ismail Noorul, Haq S. Iqbal, Saeed M. Evaluation of chipbud settling of sugarcane for enhancing yield to various row spacing. *International Journal of Agriculture and Environment Research*. 2015;12:41-48.
- Jain R, Solomon S, Shrivastava AK, Chandra A. Sugarcane bud chips a promising seed material. *Indian Journal of Sugar Technology*. 2010;12(1):67-69.
- OO KTZ, Thant AM, Win KK, Toe K, Khaing EE. Evaluation of seed cane treatments on sugarcane germination in two planting methods. *International Journal of Environmental and Rural Development*. 2018;9(2):14-19.
- Sundara B. Sugarcane cultivation. Vikas Publishing House Pvt. Ltd., 1998;156-234. New Delhi.
- Humphries EC. Mineral components and ash analysis. In: *Modern methods of plant analysis*. Springer-Verlang, Berlin. 1956; 468-502.
- Jackson ML. Soil chemical analysis. Prentice -Hall of India Pvt. Ltd. New Delhi. 1973;1-498.
- Goering HK, Vansoet PJ. Forage fibre analysis. *Agriculture Hand Book*. USA. 1970;397.
- AOAC. Official methods of analysis. 15th ed., Association of Official Analytical Chemists, Washington, USA. 1990;700.
- AOAC. (Association of official Agricultural Chemist), Method of analysis, Washington, D.C (U.S.A); 1970.
- Gomez KA, Gomez AA. Statistical procedures for Agricultural Research; 1984.
- Pathan SH, Tumbare AD, Kamble AB. Impact of planting material, cutting management and fertilizer levels on nutritional quality of bajra x Napier Hybrid. *Forage Research*. 2012;38(2):74-79.
- Credo JO. The effects of the length of cuttings on the growth and yield of Golden Yellow cassava grown under three methods of planting, BSc. Thesis, UEP, Catarman, Samar; 1982.
- Soriano MB. Growth and yield performance of cassava on the length and method of planting, BSc. Thesis, PSUCA, San Carlos, Pangasinan; 1986.
- Alagudurai S, Muthukrishnan P. Growth and fodder yield of Bajra Napier hybrid grass as influenced by crop geometry, irrigation regimes and nitrogen fertigation.

- Trends in Biosciences. 2014;19:3097-3102.
19. Patel, Darpana, Chaudhary MP. Influence of plant growth regulators on growth, yield and quality of sugarcane under south Gujarat. *Journal of Pharmacognosy and Phytochemistry*. 2018;95-97.
 20. Nithya. S. Evaluation of planting material in bajra napier hybrid grass. M.Sc., (Ag.). Thesis, Department of Agronomy, Agricultural College and Research Institute, Tamil Nadu agricultural university, Coimbatore; 2016.
 21. Shukla SK, Lal M. Effect of sett size, planting method and soil-moisture regime on growth and yield of sugarcane. *Indian Journal of Agricultural Science*. 2003; 73(10):534-537.
 22. Pathan Sarfrajkhan, H. Effect of planting material, cutting management and fertilizer levels on growth, yield and quality of bajra x napier hybrid (RBN-13) (Doctoral dissertation, MPKV, University library); 2013.
 23. Tessema ZK, Alemayehu M. *Ethiopian J Am. Prodn*. 2010;10:73-94.
 24. Caballero R, Goicoechea EL, Hernaiz PJ. Forage yields and quality of common vetch and oat sown at varying seeding ratios and seeding rates of common vetch // *Field Crops Research*. 1995;41:135–140.
 25. Assefa G, Ledin I. Effect of variety, soil type and fertilizer on the establishment, growth, forage yield, quality and voluntary intake by cattle of oats and vetches cultivated in distiller stands and mixtures // *Animal Feed Science and Technology*. 2001;92:95–111.
 26. Sinare B, Pathan S, Pardeshi H. Effect of planting material on productivity of bajra x napier hybrid. *Forage Research*. 2018; 44(3):201-204.
 27. Howeler RH. Mineral nutrition and fertilization of cassava. Series 09EC-4, Centro Internacional de Agric Tropical, Cali. 1981;52.
 28. Ghassemi-Golezani KAZEM, Bahman Abdurrahmani. Seed priming, a way for improving grain yield and nutritional value of barley (*Hordeum vulgare L.*) under dry land condition. *Research Crops*. 2012;13: 62-66.
 29. Ajouri A, Asgedom H, Becker M. Seed priming enhances germination and seedling growth of barley under conditions of P and Zn deficiency. *Journal of Plant Nutrition and Soil Science*. 2004;167:630-636.
 30. Jagdale AL. Studies on effect of organic formulations on growth yield and soil nutrient dynamics in soybean (Doctoral dissertation, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani); 2018.
 31. Kushwaha, Abhishek AH. Khan RK. Yadav, Nikita Nehal, and Nitish Sharma. Role of seed priming on biochemical changes and NPK uptake of rice (*Oryza sativa L.*). *Journal of Pharmacognosy and Phytochemistry*. 2018;2:01-04.
 32. Ssekabembe CK. Effect of planting method on establishment of napier grass varieties. *African Crop Science Journal*. 1998;6(4): 407-415.
 33. Haegele MT, Arjharn W. The effects of cultivation methods and planting season on biomass yield of Napier grass (*Pennisetum purpureum schumach.*) under rainfed conditions in the northeast region of Thailand. *Field Crops Research*. 2017; 214:359-364.
 34. Shukla SK, Yadav SK, Menhi Lal, Pathak AD. Low cost technologies in sugarcane agriculture Published by ICAR-All India Coordinated Research Project on Sugarcane, IISR, Lucknow. 2018;1-55.
 35. Meena BS, Meena DS, Narolia RS, Meena RK. Effect of ethrel and gibberelic acid application on emergence, growth, yield, juice quality and economics of sugarcane (*Saccharum officinarum*). *Annuals of Agricultural Research*. 2018;39(3):258-264.
 36. Patel, Darpana, Rinku Patel. Influence of sett size, seed rate and sett treatment on yield and quality of sugarcane. *The Bioscan*. 2014;9(1):55-57.

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