

RESEARCH ARTICLE

Effect of Sett Treatments and Establishment Methods on Growth and Yield of Bajra Napier Hybrid Grass

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ABSTRACT

A field experiment was conducted at S. Thangapazham Agricultural College during Summer 2022 to study the sett treatment and establishment methods on the performance of Bajra Napier Hybrid (BNH) grass. The objectives of the study were to identify a suitable planting method and a sett treatment option to improve fodder yield and economics, with feasibility and adoption in mind. BNH (KKM 1) was used as the test variety. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with two replications. The treatment consists of two planting methods as a first factor viz., P₁ - vertical planting and P₂ - horizontal planting and six sett treatments as second factor viz., S₁ - water soaking for 30 mins, S₂ - cow urine 10% for 30 mins, S₃ - vermiwash 5% for 30 mins, S₄ - IBA 500 ppm for 30 mins, S₅ - NAA 500 ppm for 30 mins and S₆ - control (without sett treatment). Various growth and yield parameters were recorded at different growth stages. Among the planting methods, vertical planting (P₁) recorded significantly higher sprouting rates (23.3%, 50.1%, and 56.9% at 10, 15, and 20 DAP, respectively). The same treatment recorded higher growth parameters viz., plant height (80.8 cm, 105.4 cm and 129.8 cm at 30, 60 and 75 DAP respectively), number of tillers/clump (11, 14 and 18 at 30, 60 and 75 DAP respectively), number of leaves/clump (165, 210 and 262 at 30, 60 and 75 DAP respectively) and leaf area index (4.4, 7.5 and 10.9 at 30, 60 and 75 DAP respectively). About sett treatments, treatment of setts with vermiwash 5% for 30 mins, recorded significantly higher sprouting (22.3, 54.3 and 65.2% at 10, 15 and 20 DAP, respectively). The same treatment recorded higher plant height (83.0 cm, 104.4 cm and 128.1 cm at 30, 60 and 75 DAP respectively), number of tillers/clump (14, 17 and 22 at 30, 60 and 75 DAP respectively), number of leaves/clump (210, 255 and 338 at 30, 60 and 75 DAP respectively), leaf area index (5.5, 9.6 and 13.9 at 30, 60 and 75 DAP respectively). The interaction effect between planting methods and sett treatments was significant for the above parameters. Superior results in sprouting per cent, growth parameters, and green and dry fodder yield were recorded in the vertical method of planting and sett treatment with vermiwash @ 5%. In terms of yield, vertical planting recorded significantly higher green and dry fodder yields of 30.5 t/ha/cut and 3.6 t/ha/cut, respectively. About sett treatments, Vermiwash @ 5% for 30 mins recorded significantly higher green and dry fodder yields of 33.9 t/ha/cut and 4.1 t/ha/cut, respectively. The interaction effect between planting methods and sett treatments showed a significant difference in green and dry fodder yields.

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INTRODUCTION

Livestock is considered to be an integral part of Indian agriculture and holds a vital position in the Indian economy. It is estimated that almost 20.5 million people rely heavily on livestock for their income and business. A survey reports that about 16% of income for small farm households comes from livestock, with an average of 14% for all rural households, and that about two-thirds of rural livelihoods depend on this for their income (Chandel, 2024). Livestock contributes about 8.8% of employment in India. Livestock and related businesses account for about 4.5% of our national GDP and about 25.6% of our agricultural GDP (Dash, 2017). The 2019-2020 livestock census shows that cattle, with a population of about 192.49 million, hold about 36% of the total population. The next position was held by buffalos with 109.85 million population, consecutively comes the sheep and goats with a population of 74.26 million and 148.88 million respectively (Dinesh *et al.*, 2023).

India has three major sources of fodder, viz., crop residues, cultivated fodder, and fodder available from forests, permanent pastures, and grazing lands. In India, fodder is grown in different seasons, and its production is surplus in some areas but deficient in others. Also, the non-commercial nature of fodder makes it less appealing to farmers, and the limited number of people who cultivate it with minimal inputs (Hilli *et al.*, 2023). This leads to a huge gap between fodder requirement and production. The requirement of fodder in India is about 883.95 MT of green fodder and 583.66 MT of dry fodder, but there is an estimation that the fodder production is only 664.73 MT of green fodder and 355.93 MT of dry fodder (Singh *et al.*, 2022). With this a recent survey shows that the country currently faces a net deficit of 35.6% green fodder, 10.95% dry crop residues and 44% concentrate feed ingredients (IGFRI Vision, 2050). It is believed that this gap would further increase due to the rapidly increasing livestock population. The major barrier in improving livestock production is the insufficiency of fodder in terms of qualitative and quantitative factors. The presently vast fodders are cereal fodder and crop residues, but closer inspection reveals that the nutritive value of these forages is not adequate for getting high milk production (Prasanna *et al.*, 2024). This is the main reason behind that the fact that, although India is a world leader in livestock production, the productivity of Indian livestock is very

low (1538 kg/year) compared to the world average (2238 kg/year).

The gap in fodder production and productivity is more pronounced and the ill effects of this gap are clearly visible. Therefore, in order to bridge the gap, more efficient efforts have to be adopted to increase the yield per unit area and time with maximum returns per rupee investment. Therefore, more emphasis has to be given to this. Also, considering the demand for food grains, it is difficult to divert more area to forage crops. This gives rise to an efficient fodder production system that is optimum under all these conditions. Bajra Napier is a crop that is most suitable for such conditions. It is an interspecific hybrid crop between the fodder Cumbu IP 20594 (*Pennisetum glaucum*) and Napier grass FD 437 (*Pennisetum purpureum Schumacher*). These crops are widely distributed in tropical and sub-tropical regions of Asia, Africa, southern Europe and India (Sharma *et al.*, 2025). Bajra Napier is one of the tall-growing (200-300 cm), erect, stout, deep-rooted, perennial grasses with excellent pest and weed resistant capabilities.

Bajra Napier (BN) is one of the important perennial fodder crops with high-yielding potential among different grass fodders cultivated. Generally, it is vegetatively propagated through stem cuttings called setts (Sivakumar *et al.*, 2022). It can be grown in saline soils, wastelands, bund and terraces. Studies prove that these fodders grow well under arid and semi-arid conditions. Singh *et al.* (2002) reported that it is very popular among the farmers due to its high-yielding capacity, palatability, nutritive value and suitability to varying climatic and soil conditions. Conventionally in India, the method of planting 3-4 feet long stem cutting of bajra napier in furrows horizontally or vertically is followed. But it is identified that the planting of two-noded stem cuttings vertically in ridges gave lower germination due to physical injury to the buds at the bottom of the stem while planting (Varshini and Jayanthi, 2021). Further, it was found that planting two-noded stem cutting horizontally was found advantageous and resulted in higher green forage yield (Khan *et al.*, 2000). Therefore, by using a suitable planting method, we can reduce the number of inputs and further improve the efficiency of the fodder grass.

Sett treatment with growth-promoting chemicals and water might hasten

the germination-related metabolic process (Jain et al., 2011). It is a known fact that sprouting is a major potent factor contributing to the final fodder yield. It has special significance in vegetatively propagated crops like bajra napier hybrid grass, where poor sprouting creates gaps, which adversely affect tonnage (Sivakumar et al., 2022). Saving of seed material by changing the type of seed material (sett size) without any deleterious effect on plant stand may help in getting higher yield with lower cost of production. The findings of Yadav et al. (2013) stated that higher sprouting will also help plants to get a greater number of tillers and ultimately high yield. Delayed germination and high temperature also restrict tiller formation and productivity. The number of tillers per plant at an early stage determines the number of tillers, which is the key component of yield (Bell & Garside, 2005). Thereby, with a proper sett treatment, the yield can be improved significantly.

For bajra napier grass, implementing such sett treatment practices will improve the water use efficiency of the fodder, thereby increasing water conservation. This may attract a greater number of farmers to invest in fodder cultivation, since water is considered to be the pronounced barrier for the farmers to go for the bajra napier fodder crop cultivation. The study on sett treatments and the method of establishment on the performance of bajra napier hybrid grass is very meagre in India. Hence, evaluating the best crop establishment technique with suitable sett treatment is needed to get higher yield and water use efficiency in Bajra Napier hybrid grass. Therefore, the present study aims to evaluate the effect of sett treatment and establishment method on the growth and yield of Bajra Napier hybrid grass to identify a suitable establishment method and set treatment technique for obtaining higher growth and productivity.

MATERIALS AND METHODS

Experimental Site and Location

The experiment was carried out in 'E' Block at S. Thangapazham Agricultural College, Vasudevanallur during Summer 2022. The experimental site is geographically located at latitude of 9° 14'N and longitude of 77° 24'E with an altitude of 183.4 m above mean sea level, and the chemical properties of the soil are given Table 1.

Crop and Variety

The crop taken for the study was Bajra Napier Hybrid grass, variety KKM 1. This variety KKM 1 was released by Tamil Nadu Agricultural University, Agricultural College and Research Institute, Killikulam.

Treatments

The treatment consists of two planting methods as a first factor viz., P₁ - vertical planting and P₂ - horizontal planting and six sett treatments as second factor viz., S₁ - water soaking for 30 mins, S₂ - cow urine 10% for 30 mins, S₃ - vermiwash 5% for 30 mins, S₄ - IBA 500 ppm for 30 mins, S₅ - NAA 500 ppm for 30 mins and S₆ - control (without sett treatment).

Design and Layout of The Experiment

The experiment was laid out in a Factorial Randomized Block Design (FRBD) with two replications and twelve treatments, each plot measured 1.9 m × 7.5 m with spacing of 60 x 50 cm. Sowing was carried out on 16 May 2022, during the Summer, to assess the crop's growth and yield performance Bajra Napier Hybrid under different establishment method.

RESULTS AND DISCUSSION

Effect of Planting Methods and Sett Treatments on Growth Parameters of Bajra Napier Hybrid Grass

Sprouting percentage is an important parameter in the establishment of Bajra Napier Hybrid grass.

Table 1. Chemical Properties of The Experimental Field

Chemical Properties	Values	Units
Available N (kg/ha)	263.42	(kg/ha)
Available P (kg/ha)	29.67	(kg/ha)
Available K (kg/ha)	302.40	(kg/ha)
Organic Carbon	0.504	(%)
pH	6.8	-
EC (dS/m)	0.11	dS m ⁻¹

It refers to the proportion of planted stem cuttings or setts that successfully produce new shoots after planting. A higher sprouting percentage ensures better field establishment, uniform crop stand, and increased fodder yield. In planting methods, vertical planting (P_1) recorded higher sprouting per cent of 23.3, 50.1 and 56.9 were recorded at 10, 15 and 20 DAP respectively, given in Table 2. This was mainly due to greater root growth, mass, and length in vertically planted setts than in horizontally planted setts, which might have contributed to higher sprouting. It was also proven that the vertically planted setts have their shoots sprout sooner, thus in turn were able to produce more photosynthate for the developing roots, which was also the reason for higher sprouting as reported by Knoll & Anderson (2012). In sett treatment, soaking of setts in vermiwash 5% for 30 minutes (S_3) recorded higher sprouting per cent at 10, 15 and 20 DAP, respectively. It was followed by soaking the setts with water for 30 minutes (S_1) at all the stages of observation. This might be due to the hydrolysis of complex sugars into simple sugars, which are easily utilized by auxins and proteins during synthesis. Therefore, the production of a high number of auxins facilitates softening of the cell wall, thus enhancing growth and protein utilization in the production of new tissues (Hiremath and Hosamath, 2024). Interaction effect of planting methods and sett treatments also showed a significant difference in sprouting percent. Higher sprouting percent was observed with vertical planting with sett treatment of vermiwash 5% for 30 minutes (P_1S_3) at 10, 15 and 20 DAP, respectively. This might be due to

improved metabolic activity in vertically planted setts with vermiwash treatment and an earlier-produced root system which might have increased the photosynthetic activity thus increased the sprouting.

Plant height is one of the important growth parameters used to assess the vigor and productivity of Bajra Napier Hybrid grass. It reflects the vegetative growth and biomass accumulation capacity of the crop. Higher plant height generally indicates better growth performance and greater fodder yield potential. Plant height of BNH grass (KKM 1) at 30, 60 and 75 DAP was recorded, and the data are represented in Table 3. For planting methods, vertical planting (P_1) recorded the highest plant height of 80.8, 105.4 and 129.8 cm at 30, 60 and 75 DAP, respectively. The increased plant height under vertical planting might be attributed to better orientation of setts, which facilitated improved sprouting, deeper root penetration, efficient nutrient and moisture absorption, and enhanced translocation of photosynthates. This favourable establishment promoted vigorous vegetative growth and stem elongation. Similar findings were reported by Singh *et al.* (2015), who observed improved growth performance and increased plant height in fodder grasses under vertical planting, attributed to efficient utilization of soil resources and improved establishment. Different sett treatments also showed significant influence among treatments. Similarly, Ortiz and Sansinenea (2022) also stated that higher beneficial microorganisms help in mobilizing more plant nutrients and required plant growth-promoting substances and other micronutrients, which were made available to the

Table 2. Effect of Planting Method and Sett Treatment on Sprouting Percent of Bajra Napier Hybrid Grass

Planting method / Sett treatment	10 DAP			15 DAP			20 DAP		
	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
S_1	30.0	13.5	21.7	52.5	44.2	48.4	63.5	47.5	55.5
S_2	25.0	13.5	19.2	55.8	37.5	46.6	60.0	50.0	55.0
S_3	35.0	9.6	22.3	62.5	46.2	54.3	65.4	65.0	65.2
S_4	22.5	5.8	14.1	45.0	38.5	41.7	57.5	50.0	53.7
S_5	17.5	3.8	10.7	42.5	25.0	33.7	52.5	30.8	41.6
S_6	10.0	5.8	7.9	42.5	13.5	28.0	42.5	23.1	32.8
Mean	23.3	8.6		50.1	34.2		56.9	44.4	
	P	S	P×S	P	S	P×S	P	S	P×S
SE.d	0.96	0.91	1.15	2.51	2.46	3.28	3.11	2.95	2.65
CD (p=0.05)	1.91	1.81	2.32	5.10	4.93	6.56	6.07	5.88	5.30

plants due to vermiwash treatment and thus in turn increased the plant height. Vermiwash treatment may be due to the presence of essential nutrients, enzymes, vitamins, growth-promoting hormones such as auxins and cytokinins, and beneficial microorganisms, which enhance cell division, root growth, and nutrient uptake. Similar observations were reported by Suthar (2010), who stated that vermiwash acts as a bio-stimulant and promotes vegetative growth in crops. The interaction effect of P_1S_3 may be due to the combined effects of proper sett orientation and enhanced physiological activity induced by vermiwash treatment, which collectively improved plant establishment and growth. These findings are in accordance with the reports of Kale *et al.* (2012), who observed improved vegetative growth and plant vigour in crops treated with vermiwash.

Tillers are the most important characteristic of a fodder crop. It is the key aspect that determines the green fodder yield. Tillers are the side shoots that arise from the basal nodes of the plant, and they play a major role in determining fodder biomass and productivity. A higher number of tillers per clump generally results in increased leaf production, better canopy development, and higher green fodder yield. The number of tillers/clump of bajra napier hybrid grass KKM 1 at 30, 60 and 75 DAP was studied, and the data are presented in Table 4. For planting methods, the vertical-planting treatment (P_1) recorded higher numbers of tillers/clump of 11, 14, and 18 at 30, 60, and 75 DAP, respectively. The increased tiller production under vertical planting (P_1) might

be due to better sett establishment, enhanced root proliferation, and efficient absorption of nutrients and moisture, which promoted vigorous vegetative growth and activation of axillary buds responsible for tiller formation. Proper orientation of setts under vertical planting also ensures better aeration and sprouting, leading to increased tillering capacity. Similar findings were reported by Singh *et al.* (2015), who observed higher tiller production and better growth performance in fodder grasses under vertical planting methods. In the sett treatment, soaking of setts in 5% vermiwash for 30 minutes (S_3) recorded higher numbers of tillers/clump of 14, 17, and 22 at 30, 60, and 75 DAP, respectively. It was followed by soaking the setts in water for 30 minutes (S_1) at all observation stages. The presence of a higher number of tillers from the vermiwash treatment was mainly due to improved nutrient uptake by an efficient root system, which might have stimulated auxiliary buds to grow, thus increasing the number of tillers per clump. This result is supported by Manivel *et al.* (2024) in pulses. The interaction effect of planting methods and sett treatments also showed a significant difference in the number of tillers/clump. Higher number of tillers/clump of 14, 18 and 23 were observed with vertical planting with sett treatment of vermiwash 5% for 30 minutes (P_1S_3) at 30, 60 and 75 DAP, respectively. The superior performance of (P_1S_3) might be due to the synergistic effect of optimum sett orientation and bio-stimulatory action of vermiwash, which enhanced sprouting, nutrient absorption, root establishment, and vegetative growth, ultimately resulting in higher tiller production. These findings are in agreement with the

Table 3. Effect of Planting Method and Sett Treatment on Plant Height (Cm) of Bajra Napier Hybrid Grass

Planting method / Sett treatment	30 DAP			60 DAP			75 DAP		
	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
S_1	85.3	75.0	80.2	106.2	94.8	100.5	129.8	121.2	125.5
S_2	83.6	76.3	80.0	104.4	98.3	101.4	128.1	122.0	125.1
S_3	88.0	78.0	83.0	109.0	99.8	104.4	132.7	123.5	128.1
S_4	80.2	77.3	78.8	109.3	87.5	98.4	126.0	123.5	124.8
S_5	84.5	71.7	78.1	104.2	84.3	94.3	129.3	118.7	124.0
S_6	63.0	60.2	61.6	99.0	85.3	92.2	133.0	112.7	122.9
Mean	80.8	73.1		105.4	91.7		129.8	120.3	
	P	S	P×S	P	S	P×S	P	S	P×S
SE.d	4.61	6.35	4.45	5.91	6.12	6.56	2.38	2.56	4.68
CD (p=0.05)	9.23	NS	NS	11.82	NS	NS	9.52	NS	NS

Table 4. Effect of Planting Method and Sett Treatment on Number of Tillers/Clump of Bajra Napier hybrid Grass

Planting method / Sett treatment	30 DAP			60 DAP			75 DAP		
	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean
S ₁	11	10	11	14	13	13	18	17	17
S ₂	12	7	10	15	9	12	19	12	15
S ₃	14	13	14	18	17	17	23	22	22
S ₄	11	6	9	14	8	11	18	10	14
S ₅	9	5	7	12	11	11	15	11	13
S ₆	7	5	6	9	6	8	12	8	10
Mean	11	8		14	11		18	13	
	P	S	P×S	P	S	P×S	P	S	P×S
SE.d	0.57	0.75	0.97	0.37	0.37	0.51	0.47	0.49	0.62
CD (p=0.05)	1.14	1.50	1.97	0.75	0.75	1.02	0.93	0.96	1.23

reports of Mukhi *et al.* (2022), who stated that organic liquid formulations such as vermiwash significantly improve growth attributes and tillering in forage crops.

The number of leaves per clump is an important growth parameter in Bajra Napier Hybrid grass, as it directly influences photosynthetic activity, fodder quality, and biomass production. Leaves are the primary sites of food synthesis, and a greater number of leaves contributes to higher dry matter accumulation and improved nutritive value of the fodder. The number of leaves/clump of BNH grass (KKM 1) at 30, 60, and 75 DAP was recorded, and the data are presented in Table 5. For planting methods, the treatment vertical planting (P₁) recorded higher number of leaves/clump of 165, 210 and 262 at 30, 60 and 75 DAP respectively. The increased number of leaves under vertical planting (P₁) may be attributed to better sett establishment, enhanced root development, and efficient uptake of water and nutrients, which promoted vigorous vegetative growth and increased leaf production. Vertical planting also provides favourable aeration and exposure for sprouting buds, leading to improved canopy development and leaf emergence. Similar findings were reported by Singh *et al.* (2015), who observed enhanced vegetative growth and increased leaf production in fodder grasses under vertical planting methods. In the sett treatment, soaking of setts in vermiwash 5% for 30 minutes (S₃) recorded a higher number of leaves/clump of 210, 255 and 338 at 30, 60 and 75 DAP, respectively. The presence of beneficial microorganisms in organic liquid formulation and its constituents such as cow

dung, cow urine, calcium chloride, and jaggery and their products supply an adequate quantity of nutrients and growth-promoting substances, leading to an increase in the number of leaves. This is in line with the findings of Hiremath and Hosamath (2024), who reported that enhanced germination with protection from phytopathogenic infections increased tillering, the number of leaves, and plant vigor. The interaction effect of planting methods and sett treatments also showed a significant difference in the number of leaves/clump. A higher number of leaves/clump of 210, 270, and 345 was observed with vertical planting and a vermi wash 5% sett treatment for 30 minutes (P₁S₃) at 30, 60, and 75 DAP, respectively. The superior performance of (P₁S₃) might be due to the combined effect of proper sett orientation and bio-stimulatory action of vermiwash, which enhanced sprouting, root establishment, nutrient uptake, and overall vegetative growth, thereby increasing leaf production and canopy development. These findings are in agreement with the reports of Mukhi *et al.* (2022), who emphasized that organic liquid formulations like vermiwash significantly improve growth attributes and foliage development in forage crops.

Effect of Planting Methods and Sett Treatments on Physiological Parameters of Bajra Napier Hybrid Grass

Leaf Area Index (LAI) is an important physiological parameter used to measure the leafiness and photosynthetic efficiency of Bajra Napier Hybrid grass. It is defined as the ratio of total leaf area to the ground

Table 5. Effect of Planting Method and Sett Treatment on Number of Leaves/Clump of Bajra Napier Hybrid Grass

Planting method / Sett treatment	30 DAP			60 DAP			75 DAP		
	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean
S ₁	165	150	165	210	195	195	270	255	263
S ₂	180	105	150	225	135	180	285	180	233
S ₃	210	195	210	270	255	255	345	330	338
S ₄	165	90	135	210	120	165	270	150	210
S ₅	135	75	105	180	165	165	225	165	195
S ₆	105	75	90	135	90	120	175	120	148
Mean	165	120		210	165		262	200	
	P	S	P×S	P	S	P×S	P	S	P×S
SE.d	6.4	6.7	8.1	8.4	8.9	10.8	13.8	18.2	22.1
CD (p=0.05)	12.8	13.5	16.2	16.8	17.2	21.6	27.7	36.4	44.2

area occupied by the crop. LAI indicates the crop's ability to intercept sunlight and produce biomass, thereby influencing fodder yield and quality. In BNH, a higher Leaf Area Index reflects vigorous vegetative growth and greater photosynthetic activity. Under optimum management conditions, BNH develops a dense canopy with broad leaves, resulting in higher LAI values and increased green fodder production. Leaf area index of BNH grass (KKM 1) at 30, 60, and 75 DAP was studied, and the data are presented in Table 6. For planting methods, the vertical-planting treatment (P₁) recorded higher leaf area indices of 4.4, 7.5, and 10.9 at 30, 60, and 75 DAP, respectively. The increased LAI under vertical planting (P₁) (Figure 2) may be attributed to better sprouting and establishment of setts, resulting in vigorous vegetative growth, increased tillering, and greater leaf expansion. Proper orientation of setts in vertical planting facilitates efficient absorption of water and nutrients, thereby enhancing photosynthetic surface area and canopy development. Similar findings were reported by Singh *et al.* (2015), who observed improved vegetative growth and leaf development in fodder grasses under vertical planting methods. The data on the effects of sett treatments on the LAI of BNH grass (KKM 1) showed a marked effect on LAI. In sett treatment, soaking of setts in 5% vermi wash for 30 minutes (S₃) recorded higher leaf area indices of 5.5, 9.6, and 13.9 at 30, 60, and 75 DAP, respectively. The enhancement in leaf area index observed with to vermiwash treatment may be due to the presence of macro and micronutrients, plant growth regulators such as auxins and cytokinins, enzymes, vitamins, and beneficial

microbes in vermiwash, which stimulate cell division, chlorophyll synthesis, and leaf expansion. Increased leaf area ultimately improves photosynthetic efficiency and biomass production. Similar observations were reported by Suthar, (2010); Kale *et al.* (2012), who stated that vermiwash application enhanced leaf growth and physiological activities in fodder and field crops. The interaction effect of planting methods and sett treatments also showed a significant difference in leaf area index. Higher leaf area index of 6.0, 10.4 and 15.1 were observed with vertical planting with sett treatment of vermi wash 5% for 30 minutes (P₁S₃) at 30, 60 and 75 DAP respectively. The superior performance of P₁S₃ could be attributed to the synergistic effect of optimum sett orientation and the bio-stimulant action of vermiwash, which enhanced root growth, nutrient uptake, and leaf production, thereby increasing canopy development and photosynthetic area. These findings are in accordance with the reports of Mukhi *et al.* (2022), who emphasized that organic liquid formulations like vermiwash significantly improve plant growth parameters and leaf development.

Effect of Planting Methods and Sett Treatments on Yield Parameters of Bajra Napier Hybrid Grass

Green fodder yield is the most important component of a forage crop, as it has the main economic value and determines the overall efficiency of the crop. Green fodders are important because of their utility as direct feed for livestock. The effects of planting methods and sett treatments on green and dry fodder yield of BNH grass (KKM 1) were studied,

Table 6. Effect of Planting Method and Sett Treatment on Leaf Area Index of Bajra Napier Hybrid Grass

Planting method / Sett treatment	30 DAP			60 DAP			75 DAP		
	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean
S ₁	4.9	4.6	4.8	8.5	7.9	8.2	12.3	11.5	11.9
S ₂	4.4	4.0	4.2	7.6	7.0	7.3	11.0	10.1	10.6
S ₃	6.0	5.0	5.5	10.4	8.7	9.6	15.1	12.6	13.9
S ₄	3.9	3.4	3.7	6.8	5.9	6.3	9.8	8.6	9.2
S ₅	3.8	3.2	3.5	6.5	5.5	6.0	9.4	7.9	8.7
S ₆	3.2	3.0	3.1	5.5	5.2	5.3	8.0	7.5	7.8
Mean	4.4	3.9		7.5	6.7		10.9	9.7	
	P	S	P×S	P	S	P×S	P	S	P×S
SE.d	0.10	0.12	0.17	0.24	0.26	0.32	0.30	0.33	0.43
CD (p=0.05)	0.23	0.25	0.35	0.49	0.55	0.68	0.61	0.65	0.86

and the data are represented in Fig 1. For planting methods, the treatment vertical planting (P₁) recorded higher green and dry fodder yield of 30.5 t/ha and 3.6 t/ha, respectively. This difference is because of the early establishment of setts in vertical planting, which made way for better root system development that further accounts for efficient absorption of nutrients and moisture from the soil. This finding is supported by Edelfeldt *et al.* (2015), who stated that vertical planting induced profuse vegetative growth, which in turn resulted in high green fodder yield. This might also

be due to the high sprouting percentage of the vertical planting. Further, the endurance of a high population might have allowed the fodder crop to intercept and utilise solar radiation more efficiently, accounting for maximum photosynthate assimilation, which might also be the reason for high green fodder yield. Whereas, the lower green and dry fodder yield of 27.7 t/ha and 3.0 t/ha, respectively, were observed with the treatment horizontal planting (P₂). Similarly, the lower green fodder yield was registered with horizontal planting. This might be due to higher mortality and poor

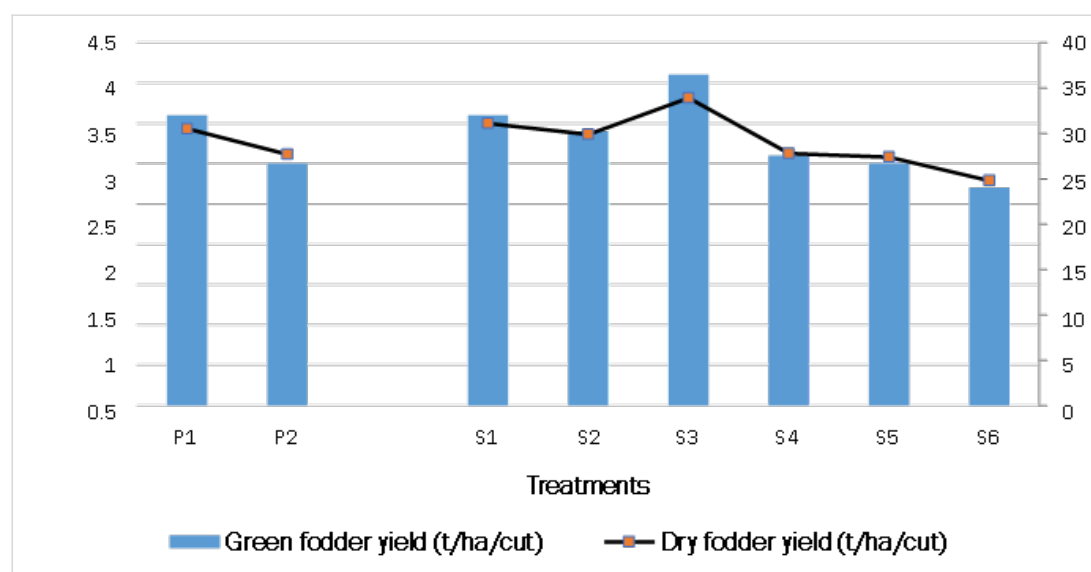


Figure 1. Effect of sett treatments and planting methods on dry and green fodder yield (t/ha/cut) of BNH grass

establishment percentage as reflected in lower growth and yield attributes, which resulted in lower green fodder yield. This finding is supported by Edelfeldt *et al.* (2015), who stated that horizontal planting of Napier grass stem cuttings resulted in lower fodder yield. Subsequently, similar results are also reported by Knoll and Anderson (2012) in Napier grass. In terms of sett treatment, soaking of setts in vermi wash 5% for 30 minutes (S_3) recorded higher green and dry fodder yield of 33.9 t/ha and 4.1 t/ha, respectively. Vermiwash recorded a higher green fodder yield because of the earlier vegetative growth, which increased the photosynthetic rate, thus promoting the green fodder yield. The results are in accordance with the findings of Prasanna *et al.*, (2024), who reported that seeds treated with vermiwash increased the fruit yield of tomato. This might be due to the fact that vermiwash contains microbial biomass, plant growth-promoting substances and nutrients that helped in improving sprouting, plant growth and metabolic activities, which in turn increased the yield. Lower green and dry fodder yields of 24.8 t/ha and 2.7 t/ha, respectively, were recorded with the control (without sett treatment) (S_0). The interaction effect of planting methods and sett treatments also showed a significant difference in green and dry fodder yield. Higher green and dry fodder yield of 36.5 t/ha and 4.8 t/ha respectively, were observed with vertical planting with sett treatment of vermiwash 5% for 30 minutes (P_1S_3). The lower green and dry fodder yield was recorded with horizontal planting with control (without sett treatment) (P_2S_0), due to higher mortality and poor establishment percentage as reflected in lower growth and yield attributes, which resulted in lower green and dry fodder yield.

The results of the field experiment clearly indicated that planting methods and sett treatments significantly influenced the sprouting, growth, and fodder yield of Bajra Napier Hybrid grass (KKM 1). Among the planting methods, vertical planting proved superior with higher sprouting percentage, better growth attributes, and increased green and dry fodder yields compared to horizontal planting. Similarly, among the sett treatments, soaking the setts in vermiwash 5% for 30 minutes significantly enhanced sprouting, plant growth, leaf production, tillering, leaf area index and fodder yield over other treatments. The interaction effect also revealed that the combination of vertical planting along with vermiwash 5% treatment produced the best overall performance in terms of growth and

yield parameters. Hence, it can be concluded that the adoption of vertical planting, coupled with soaking the setts in 5% vermiwash for 30 minutes, is an effective, economical, and eco-friendly practice for improving the establishment, productivity, and fodder yield of Bajra Napier Hybrid grass.

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Ethics Statement:

Ethical approval was not applicable for this research experiment as only plant materials were used.

Originality and Plagiarism:

The author confirms that this manuscript is original, has not been published previously, and is not under consideration for publication elsewhere. All sources used have been appropriately cited, and the manuscript has been prepared in compliance with plagiarism and publication ethics standards.

Consent for Publication:

Not applicable.

Competing Interests:

The author declares no competing interests.

Data Availability:

The data supporting the findings of this study are available from the corresponding author upon reasonable request

Author Contributions:

Prakash P conceived and designed the research idea, Lakshmanan S and Christinal Infanta S performed the experiments. Christinal Infanta S, Prakash P and Lakshmanan S contributed to the research coordination and interpretation of the findings. The manuscript was written, reviewed and revised collectively by all authors. All authors have read and approved the final version of the manuscript.

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