

## Spacing Influence on the Nutrient Uptake of Bajra Napier Hybrid Grasses

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**ABSTRACT:** A field experiment was carried out to study the influence of plant spacing on the relative productivity of Bajra Napier hybrid grass in the lowlands of coastal region of Karaikal. The experiment was conducted for one year from February 2011 to February 2012. The treatments consisted of five Bajra Napier hybrids viz., CO 3, CO 4, KKM 1, IGFR1 7 and IGFR1 10 and three different plant spacings viz., 60 cm x 45 cm, 60 cm x 30 cm and 45 cm x 45 cm, replicated thrice in a randomized block design. Among the hybrids, CO 3 was better than others in terms of growth and yield attributes and resulted in the highest green fodder yield of 177.28 t ha<sup>-1</sup> year<sup>-1</sup> as well as dry fodder yield of 31.20 t ha<sup>-1</sup> year<sup>-1</sup> and crude protein yield 2.61 t ha<sup>-1</sup> year<sup>-1</sup>. Among the spacings, 45 cm x 45 cm registered higher growth and yield components and produced the highest green fodder yield 175.61 t ha<sup>-1</sup> year<sup>-1</sup>, dry fodder yield 30.90 t ha<sup>-1</sup> year<sup>-1</sup> and crude protein yield 2.70 t ha<sup>-1</sup> year<sup>-1</sup> as compared to other spacings. The interaction effect between the hybrids and plant spacings revealed that the maximum total annual green fodder yield, dry fodder yield were recorded by CO 3 hybrid planted at the spacing of 45 cm x 45 cm. The uptake of N, P and K were higher in CO 3 hybrid than in other hybrids. The uptake of N, P and K were the maximum at 45 cm x 45 cm spacing. The interaction effect of CO 3 hybrid at 45 cm x 45 cm spacing resulted in the highest uptake of N, P and K.

### INTRODUCTION

The livestock rearing is taken up as a subsidiary or supporting activity for the supply of milk, meat, wool and manure besides using them as work or draught animals. It is the major source of income for the people living in drought prone, hilly, tribal and other specific areas where crop production is uncertain. Irrespective of land forms, animal rearing is a supporting means which enhances the earning capacity of the landless, marginal and small farmers. Napier grass (*Pennisetumpurpureum* Schum.) is native of Zimbabwe in tropical Africa. Napier grass is a tall clumped grass with thick growth. It is also known as elephant grass. Its peculiarity is its high herbage yield. The interspecific hybrid between Napier grass and bajra crop was first developed in South Africa and was named as "Bakala Napier hybrid" or "Bana grass". Hybridisation works were started in India at Coimbatore in 1953 and then at New Delhi in 1961, resulting in the release of Cumbu Napier hybrid grasses and Pusa giant hybrid grass, respectively. The hybrids were sterile triploids and are superior to both

Napier and Bajra possessing the beneficial qualities of both parents. Giant Napier or Hybrid *Pennisetum* is synonymously used to refer the Bajra Napier grass hybrids. Compared to Napier grass, hybrid Napier produces more tillers and has numerous persistent hairs on leaf blades and sheaths with less sharper leaf edges. Therefore introduction and evaluation of new hybrid Napier grass with improved agronomic practices is the right approach to augment the supply of green fodder. Studies on these aspects are meagre in the coastal region of Union Territory of Pondicherry. Hence an attempt has been made in the present investigation to study the influence of plant spacing on the nutrient uptake of Bajra Napier hybrid grass in the lowlands of coastal region of Karaikal.

### MATERIALS AND METHODS

A field experiment was conducted at Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA&RI), Karaikal, Union Territory of Puducherry, to study the Influence of plant spacing on the relative productivity of Bajra

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Napier hybrid grass in the lowlands of coastal region of Karaikal. The experiment was conducted for one year (February 2011 to February 2012). It was laid out in field number 'D11' of Eastern farm of PAJANCOA & RI, Karaikal. The farm is situated between 10°49' and 11°01' N latitude and 78°43' and 79°52' E longitude and at an altitude of four meters above mean sea level. Five Bajra Napier hybrid grasses *viz.*, CO 3, CO 4, KKM 1, IGFRI 7 and

IGFRI 10 were planted under three different plant spacings (60 cm x 45 cm, 60 cm x 30 cm and 45 cm x 45 cm), laid out in Randomized Block Design (RBD) with three replications. The root slips of 30 cm length of the five hybrid grasses were planted in each plot with three different spacings as per the treatment. Basal application of FYM @ 10 t ha<sup>-1</sup> was applied. Recommended fertilizer dose of 150: 50: 40 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup> was applied. Full dose of P and K and 50 per cent N were applied as basal and the remaining 50 per cent N was applied as top dress on 45 days after planting. After every cut, a common dose of 75 kg N ha<sup>-1</sup> was applied up to 7th cut. The first cut of Bajra Napier hybrid grasses was made at 90 days after planting and the subsequent cuts were made at 45 days interval up to 7th cut leaving the stubbles of 15 cm height from the ground level. The green fodder yield was recorded in the net plot and expressed in t ha<sup>-1</sup>. The various biometric observations, the analytical data of soil and plant samples and the computed data were subjected to statistical scrutiny as per the procedures given by Gomez and Gomez (2010).

## RESULTS AND DISCUSSION

### Nitrogen uptake

There was significant difference in the nitrogen uptake among hybrids. Nitrogen uptake pattern was almost similar for the four cuts and three seasons. The mean of four cuts revealed that the N uptake was the highest for CO 3 hybrid (59.43 kg N ha<sup>-1</sup> cut<sup>-1</sup>). This was followed by IGFRI 10 (56.36 kg N ha<sup>-1</sup> cut<sup>-1</sup>) and IGFRI 7 (55.86 kg N ha<sup>-1</sup> cut<sup>-1</sup>) which were on par with each other. The lowest N uptake was estimated in KKM 1 hybrid (45.04 kg N ha<sup>-1</sup> cut<sup>-1</sup>). As far as N uptake of individual cuts was concerned, it was maximum at IV cut than the other cuts for all the hybrids. Among the plant spacings 45 cm x 45 cm spacing registered the highest N uptake (60.91 kg N ha<sup>-1</sup> cut<sup>-1</sup>), followed by 60 cm x 45 cm spacing (52.51 kg N ha<sup>-1</sup> cut<sup>-1</sup>) as evident from the mean of four cuts. Whereas the lowest N uptake was obtained in 60 cm x 30 cm spacing (48.05 kg N ha<sup>-1</sup> cut<sup>-1</sup>). Significant interaction

effect was noticed between hybrids and spacing. The CO 3 hybrid planted at 45 cm x 45 cm spacing showed its statistical supremacy by registering the highest N uptake (69.56 kg N ha<sup>-1</sup> cut<sup>-1</sup>). Whereas planting of KKM1 at 60 cm x 30 cm spacing registered the lowest N uptake (40.40 kg N ha<sup>-1</sup> cut<sup>-1</sup>).

### Phosphorus uptake

Phosphorus uptake pattern for individual cuttings and mean of four cuttings followed similar trend. There was significant difference among hybrids with regard to P uptake. The mean of four cuts revealed that CO 3 hybrid registered the highest P uptake (15.24 kg P ha<sup>-1</sup> cut<sup>-1</sup>) whereas the lowest P uptake was estimated in KKM 1 hybrid (11.19 kg P ha<sup>-1</sup> cut<sup>-1</sup>). Plant spacings had significant influence on P uptake. The spacing of 45 cm x 45 cm showed its statistical supremacy by registering the highest P uptake (14.74 kg P ha<sup>-1</sup> cut<sup>-1</sup>), followed by 60 cm x 45 cm spacing (13.00 kg P ha<sup>-1</sup> cut<sup>-1</sup>) as revealed by mean of four cuts. Whereas 60 cm x 30 cm spacing recorded the lowest P uptake (11.62 kg P ha<sup>-1</sup> cut<sup>-1</sup>). In terms of P uptake in individual cuts at different spacings, it was observed that the P uptake was high at IV cut as compared to other cuts at all spacings. Significant interaction effect was observed between hybrids and spacings with respect to P uptake. The mean of four cuts revealed that CO 3 hybrid planted at 45 cm x 45 cm spacing recorded the highest P uptake (17.43 kg P ha<sup>-1</sup> cut<sup>-1</sup>), whereas CO 4 hybrid at 60 cm x 30 cm spacing registered the lowest P uptake (10.55 kg P ha<sup>-1</sup> cut<sup>-1</sup>).

### Potassium uptake

The K uptake pattern was also similar as that of N and P uptake for the individual cuttings and mean of four cuts. There was significant difference in the K uptake among hybrids. The mean of four cuts revealed that CO 3 hybrid showed its superiority by registering the highest K uptake (99.41 kg K ha<sup>-1</sup> cut<sup>-1</sup>), whereas KKM 1 recorded the lowest K uptake (80.39 kg K ha<sup>-1</sup> cut<sup>-1</sup>). In terms of K uptake by individual cuts, it was maximum at IV cut for all the hybrids as compared to other cuts. Among the plant spacings, 45 cm x 45 cm attained its statistical supremacy by registering more K uptake (95.31 kg K ha<sup>-1</sup> cut<sup>-1</sup>), followed by 60 cm x 45 cm spacing (88.22 kg K ha<sup>-1</sup> cut<sup>-1</sup>). Whereas the lowest K uptake was estimated in 60 cm x 30 cm spacing (82.14 kg K ha<sup>-1</sup> cut<sup>-1</sup>). Considering the K uptake by individual cuts at different spacings, it was observed that K uptake was maximum at IV cut as compared to other cuts. The

hybrids and spacings significantly interacted with each other with regard to K uptake. The CO 3 hybrid planted at 45 cm x 45 cm spacing recorded the highest K uptake (106.49 kg K ha<sup>-1</sup> cut<sup>-1</sup>), whereas KKM 1 planted at 60 cm x 30 cm spacing resulted in the lowest K uptake (75.18 kg K ha<sup>-1</sup> cut<sup>-1</sup>).

**Nutrient uptake**

The green as well as dry fodder yield was the highest in the hybrid CO 3. This might be due to the superior growth and yield attributes and high nutrient uptake. This is in conformity with the findings of Chellamuthu *et al.* (2011) who stated that there were only numerical differences among hybrids in respect of green fodder yields, with the highest yield of 29.77 t ha<sup>-1</sup> cut<sup>-1</sup> in CO 3 under the coastal ecosystem. Fazlullakhan *et al.* (1996) reported that the culture CN-2 (CO 3) recorded an average yield of 273.68 t ha<sup>-1</sup> year<sup>-1</sup> and very high yields up to 514 t ha<sup>-1</sup> year<sup>-1</sup>. Uptake is a product of nutrient content and dry matter. Khan and Manghatt (1965) and Saeed *et al.* (1996) also reported that green fodder yield of mott grass decreased as plant spacing was increased. The CO 3 hybrid recorded the highest N, P and K uptake which might be ascribed to more dry matter production and absorption and translocation of nutrients from the soil by the healthy and extensive root system.

The plant spacing of 45 cm x 45 cm showed its superiority by registering more N, P and K uptake. This could be attributed to less competition and more foraging area which resulted in well developed root system and more dry matter production and ultimately enhanced the nutrient uptake. These results are in conformity with the findings of Kar *et al.* (2006) who reported that optimum plant spacing

**Table 1**  
Nitrogen uptake (kg ha<sup>-1</sup>) of Bajra Napier hybrids under different plant spacings

Treatments	Cuttings				Mean of 4 cuts
	II	III	IV	V	
Hybrids (H)					
H <sub>1</sub> :CO3	59.78	53.24	69.67	55.02	59.43
H <sub>2</sub> :CO4	56.09	39.56	63.00	49.62	52.07
H <sub>3</sub> :KKM 1	50.03	40.22	49.32	42.02	45.40
H <sub>4</sub> :IGFRI 7	58.82	47.11	66.47	51.05	55.86
H <sub>5</sub> :IGFRI 10	58.25	45.45	68.16	53.57	56.36
SEd	2.23	2.64	2.49	1.72	1.32
CD(P=0.05)	4.57	5.41	5.11	3.53	2.80
Spacing (S)					
S <sub>1</sub> :60x45	55.89	45.98	59.83	48.33	52.51
S <sub>2</sub> :60x30	52.03	39.92	53.29	46.95	48.05
S <sub>3</sub> :45x45	61.85	49.46	76.85	55.49	60.91
SEd	1.68	1.60	1.93	1.33	1.06
CD(P=0.05)*	3.44	3.28	3.96	2.73	2.17

**Table 2**  
Interaction effect between Bajra Napier hybrids and plant spacings on nitrogen uptake (kg ha<sup>-1</sup>)

Interaction(H x S)	Cuttings				Mean of 4 cuts
	II	III	IV	V	
H <sub>1</sub> S <sub>1</sub>	59.15	57.09	63.99	53.36	58.40
H <sub>1</sub> S <sub>2</sub>	57.88	41.70	53.65	48.06	50.32
H <sub>1</sub> S <sub>3</sub>	62.30	60.95	91.38	63.63	69.56
H <sub>2</sub> S <sub>1</sub>	53.98	39.32	63.16	45.26	50.43
H <sub>2</sub> S <sub>2</sub>	55.88	37.09	48.32	46.53	46.95
H <sub>2</sub> S <sub>3</sub>	58.40	42.27	77.52	57.07	58.82
H <sub>3</sub> S <sub>1</sub>	51.11	43.35	48.87	40.84	46.04
H <sub>3</sub> S <sub>2</sub>	39.65	33.86	46.99	41.10	40.40
H <sub>3</sub> S <sub>3</sub>	59.35	43.44	52.10	44.13	49.75
H <sub>4</sub> S <sub>1</sub>	59.60	44.78	61.35	47.92	53.41
H <sub>4</sub> S <sub>2</sub>	52.63	42.21	55.05	47.10	49.25
H <sub>4</sub> S <sub>3</sub>	64.23	54.34	83.02	58.12	64.93
H <sub>5</sub> S <sub>1</sub>	55.63	45.34	61.80	54.25	54.25
H <sub>5</sub> S <sub>2</sub>	54.13	44.73	62.43	51.99	53.32
H <sub>5</sub> S <sub>3</sub>	64.99	46.29	80.25	54.48	61.50
SEd	5.10	4.83	4.32	2.98	2.37
CD(P=0.05)*	10.45	9.90	8.86	6.11	4.85

H<sub>1</sub>: CO 3, H<sub>2</sub>: CO 4, H<sub>3</sub>: KKM 1, H<sub>4</sub>: IGFRI 7, H<sub>5</sub>: IGFRI 10  
S<sub>1</sub>: 60cm x 45cm, S<sub>2</sub>: 60cm x 30cm, S<sub>3</sub>: 45cm x 45cm

**Table 3**  
Phosphorus uptake (kg ha<sup>-1</sup>) of Bajra Napier hybrids under different plant spacings

Treatments	Cuttings				Mean of 4 cuts
	II	III	IV	V	
Hybrids (H)					
H <sub>1</sub> :CO3	12.89	13.94	22.66	11.47	15.24
H <sub>2</sub> :CO4	10.15	11.16	18.44	9.04	12.20
H <sub>3</sub> :KKM 1	10.04	10.51	15.75	8.46	11.19
H <sub>4</sub> :IGFRI 7	12.13	13.80	18.87	10.08	13.72
H <sub>5</sub> :IGFRI 10	11.67	12.10	19.26	10.02	13.26
SEd	0.55	0.62	0.75	0.69	0.72
CD(P=0.05)	1.12	1.27	1.53	1.42	1.48
Spacings (S)					
S <sub>1</sub> :60x45	10.59	12.69	19.17	9.53	13.00
S <sub>2</sub> :60x30	10.60	10.48	16.76	8.65	11.62
S <sub>3</sub> :45x45	12.93	13.73	21.06	11.25	14.74
SEd	0.45	0.57	0.48	0.53	0.56
CD(P=0.05)*	0.92	1.16	0.98	1.10	1.14

**Table 4**  
Interaction effect between Bajra Napier hybrids and plant spacings on phosphorus uptake (kg ha<sup>-1</sup>)

Interaction(H x S)	Cuttings				Mean of 4 cuts
	II	III	IV	V	
H <sub>1</sub> S <sub>1</sub>	12.47	14.79	21.49	11.02	14.94
H <sub>1</sub> S <sub>2</sub>	10.87	10.18	23.76	8.61	13.35
H <sub>1</sub> S <sub>3</sub>	15.34	16.85	22.75	14.77	17.43
H <sub>2</sub> S <sub>1</sub>	10.55	12.33	18.48	9.04	12.60
H <sub>2</sub> S <sub>2</sub>	7.42	10.72	14.84	9.23	10.55
H <sub>2</sub> S <sub>3</sub>	12.47	10.42	21.99	8.84	13.43
H <sub>3</sub> S <sub>1</sub>	8.33	10.04	15.63	8.45	10.61
H <sub>3</sub> S <sub>2</sub>	11.01	9.70	14.76	8.09	10.89
H <sub>3</sub> S <sub>3</sub>	10.79	11.78	16.85	8.83	12.06
H <sub>4</sub> S <sub>1</sub>	11.73	14.18	20.23	9.80	13.98
H <sub>4</sub> S <sub>2</sub>	11.12	9.43	13.21	8.49	10.56
H <sub>4</sub> S <sub>3</sub>	13.55	17.79	23.17	11.95	16.62
H <sub>5</sub> S <sub>1</sub>	9.89	12.12	20.00	9.35	12.84
H <sub>5</sub> S <sub>2</sub>	12.61	12.40	17.21	8.85	12.77
H <sub>5</sub> S <sub>3</sub>	12.50	11.79	20.56	11.85	14.18
SEd	1.51	1.53	2.04	1.20	1.25
CD(P=0.05)*	<b>3.09</b>	<b>3.13</b>	<b>4.18</b>	<b>2.46</b>	<b>2.56</b>

H<sub>1</sub>: CO 3, H<sub>2</sub>: CO 4, H<sub>3</sub>: KKM 1, H<sub>4</sub>: IGFRI 7, H<sub>5</sub>: IGFRI 10  
S<sub>1</sub>: 60cm x 45cm, S<sub>2</sub>: 60cm x 30cm, S<sub>3</sub>: 45cm x 45cm

**Table 5**  
Potassium uptake (kg ha<sup>-1</sup>) of Bajra Napier hybrids under different plant spacings

Treatments	Cuttings				Mean of 4 cuts
	II	III	IV	V	
Hybrids (H)					
H <sub>1</sub> :CO3	95.35	101.27	108.51	92.51	99.41
H <sub>2</sub> :CO4	81.39	80.10	97.61	76.38	83.87
H <sub>3</sub> :KKM 1	79.47	79.02	89.17	73.92	80.39
H <sub>4</sub> :IGFRI 7	87.31	96.47	97.10	82.52	90.85
H <sub>5</sub> :IGFRI 10	84.51	84.91	103.04	80.54	88.25
SEd	3.68	3.33	3.41	3.56	3.47
CD(P=0.05)	7.54	6.82	6.99	7.29	7.11
Spacings (S)					
S <sub>1</sub> :60x45	84.65	86.89	98.38	82.96	88.22
S <sub>2</sub> :60x30	80.32	81.96	94.18	72.09	82.14
S <sub>3</sub> :45x45	91.85	96.21	104.70	88.47	95.31
SEd	2.26	2.35	2.42	2.31	2.69
CD(P=0.05)*	<b>4.63</b>	<b>4.81</b>	<b>4.96</b>	<b>4.73</b>	<b>5.51</b>

**Table 6**  
Interaction effect between Bajra Napier hybrids and plant spacings on potassium uptake (kg ha<sup>-1</sup>)

Interaction(H x S)	Cuttings				Mean of 4 cuts
	II	III	IV	V	
H <sub>1</sub> S <sub>1</sub>	94.39	98.62	109.87	95.72	99.65
H <sub>1</sub> S <sub>2</sub>	90.86	97.34	102.95	77.21	92.09
H <sub>1</sub> S <sub>3</sub>	100.81	107.84	112.71	104.61	106.49
H <sub>2</sub> S <sub>1</sub>	78.39	75.26	96.91	76.67	81.81
H <sub>2</sub> S <sub>2</sub>	67.16	71.40	93.62	71.61	75.95
H <sub>2</sub> S <sub>3</sub>	98.62	93.64	102.29	80.84	93.85
H <sub>3</sub> S <sub>1</sub>	79.91	79.05	87.31	72.95	79.80
H <sub>3</sub> S <sub>2</sub>	76.87	78.47	81.17	64.21	75.18
H <sub>3</sub> S <sub>3</sub>	81.64	79.53	99.03	84.59	86.20
H <sub>4</sub> S <sub>1</sub>	86.99	98.77	97.79	89.95	93.37
H <sub>4</sub> S <sub>2</sub>	84.49	83.45	94.99	70.31	83.31
H <sub>4</sub> S <sub>3</sub>	90.47	107.21	98.52	87.30	95.87
H <sub>5</sub> S <sub>1</sub>	83.57	82.78	100.03	79.48	86.46
H <sub>5</sub> S <sub>2</sub>	82.24	79.14	98.15	77.12	84.16
H <sub>5</sub> S <sub>3</sub>	87.71	92.81	110.93	85.01	94.12
SEd	6.77	7.50	7.64	9.64	6.01
CD(P=0.05)*	<b>13.87</b>	<b>15.37</b>	<b>15.66</b>	<b>19.76</b>	<b>12.32</b>

H<sub>1</sub>: CO 3, H<sub>2</sub>: CO 4, H<sub>3</sub>: KKM 1, H<sub>4</sub>: IGFRI 7, H<sub>5</sub>: IGFRI 10  
S<sub>1</sub>: 60cm x 45cm, S<sub>2</sub>: 60cm x 30cm, S<sub>3</sub>: 45cm x 45cm

in maize significantly increased the N uptake. The poor uptake of nutrients in the 60 cm x 30 cm spacing might be due to poor development of root system coupled with the more plant population per unit area that could have resulted in competition for nutrients.

The hybrid CO 3 planted at 45 cm x 45cm spacing recorded the highest N, P and K uptake due to more demand of nutrients by the vigorously growing plant population of CO 3 cultivars coupled with more foraging area and less competition among the plants.

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