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Plant Spacinginfluence on the Relative Productivity 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, IGFR17 and IGFRI 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^{-1}year^{-1} as well as dry fodder yield of 31.20 tha^{-1}year^{-1}and crude protein yield 2.61 t ha^{-1} year^{-1}.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^{-1} year^{-1}, dry fodder yield 30.90 t ha^{-1} year^{-1} and crude protein yield 2.70 t ha^{-1} year^{-1}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.*

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 relative productivity 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 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

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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^{-1} was applied. Recommended fertilizer dose of 150: 50: 40 kg $N:P_2O_5:K_2O$ ha^{-1} 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^{-1} 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 7thcut 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^{-1}. 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

Growth Parameters

The hybrid CO 3 was far superior by registering higher number of live tillers $hill^{-1}$ (20.71), more number of leaves $hill^{-1}$ (156.15), higher leaf width (2.86 cm), higher leaf to stem ratio (2.63) than all other hybrids. Among the spacings, planting at 45 cm x 45 cm registered favourable growth and yield attributes than other spacings*viz*., 60 cm x 45 cm and 60 cm x 30 cm (Table 1). The hybrid CO 3 was profusely tillering than others with more number of live tillers and less number of dead tillers $hill^{-1}$. The interaction effect of CO 3 hybrid with 45 cm x 45 cm spacing resulted in favourable growth and yield attributes (Table 2). The hybrid IGFRI 7 was superior in terms of plant height (178.19 cm) and leaf length (97.36 m).Leaf to stem ratio was the highest in the hybrid CO 3 as compared to other hybrids. Among the spacings, leaf to stem ratio was the highest at 45 cm x 45 cm as compared to other two spacings. Leaf to stem ratio was the maximum in CO 3 hybrid when planted at 45 cm x 45 cm spacing.

Fodder Yield

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^{-1} cut^{-1} in CO 3 under the coastal ecosystem. Fazlullakkhan*et al*. (1996) reported that the culture CN-2 (CO 3) recorded an average yield of 273.68 t ha^{-1} $year^{-1}$ and very high yields up to 514 t ha^{-1} $year^{-1}$. Whilst, the hybrid KKM 1 registered the lowest green and dry fodder yield due to more number of dead tillers and the lowest NPK uptake.

The total green fodder yield of CO 3 consistently in all the seven cuts as well as in the total of all seven cuts were the highest (177.28 t ha^{-1} $year^{-1}$). This was 6.80, 11.70, 16.70 and 20.40 per cent higher than that of IGFRI 7, IGFRI 10, CO 4 and KKM 1.

The CO 3 hybrid was consistently giving higher green fodder yields than other hybrids at all the seven cuts. Similar trend was observed in respect of dry fodder yield. It was not so in other hybrids. This is also one of the reasons for the supremacy of CO 3 over other hybrids, besides high leaf to stem ratio (Table 3).

The spacing of 45 cm x 45 cm recorded the highest green and dry fodder yield throughout the crop growth which was mainly because of the favorable crop growth condition which improved the growth and yield attributes and nutrient uptake which ultimately resulted in higher yield. This is in accordance with the findings of Pathan and Bhilare (2008) who obtained higher green fodder yield of Bajra Napier hybrid grass with higher spacing. 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 lowest green and dry fodder yield was obtained in 60 cm x 30 cm spacing which might be due to inferior growth and yield attributes and nutrient uptake as a result of more population and mutual competition. It is in accordance with the findings of Velayudham*et al*. (2011) who reported that shading or reduction of leaf area under closer spacing will reduce the fodder yield. Yasin*et al*., (2003a) obtained the highest dry matter yield at 45 cm x 45 cm spacing. On the contrary, Shank *et al*., (1993) and Cox (1996) reported higher dry matter yield at narrow spacing. The low forage yield in closer plantation was probably attributed to mutual competitive and shading effect of the closely planted pants (Nazir*et al*., 1997).

The hybrid CO 3 planted at 45 cm x 45 cm spacing recorded the highest green and dry fodder yield

Table 1
Yield attributing parameters of Bajra Napier hybrids under different plant spacings

	Mean of 7 cuts						
Treatments	*Plant Height (cm)*	*Leaf length (cm)*	*Leaf width (cm)*	*No. of leaves*	*No. of live tillers*	*No. of dead tillers*	*Leaf to stem ratio*
Hybrids							
H_1: CO3	144.19	82.26	2.86	156.15	20.71	8.76	2.63
H_2: CO4	149.41	85.30	2.10	129.98	17.17	10.28	2.35
H_3: KKM 1	159.10	89.19	2.32	126.52	16.07	12.02	2.18
H_4: IGFRI 7	178.19	97.36	2.77	135.93	18.46	9.48	2.55
H_5: IGFRI 10	163.48	91.92	2.42	129.46	17.69	9.57	2.38
SEd	1.95	0.92	0.07	1.11	0.29	0.15	0.05
CD (P = 0.05)*	4.00	1.88	0.14	2.28	0.60	0.31	0.10
Spacings (S) cm							
S_1:60 x 45	160.66	89.37	2.48	135.59	17.65	9.56	2.39
S_2:60 x 30	145.65	83.53	2.29	127.25	16.78	10.80	2.34
S_3:45 x 45	170.31	94.71	2.70	143.99	19.62	9.71	2.51
SEd	1.51	0.71	0.05	0.86	0.22	0.11	0.04
CD (P = 0.05)*	**3.10**	**1.46**	**0.10**	**1.76**	**0.45**	**0.24**	**0.08**

Table 2
Interaction effect of Yield attributing parameters of Bajra Napier hybrids under different plant spacings

	Mean of 7 cuts						
Interaction (HxS)	*Plant Height (cm)*	*Leaf length (cm)*	*Leaf width (cm)*	*No. of leaves*	*No. of live tillers*	*No. of dead tillers*	*Leaf to stem ratio*
H_1S_1	144.30	83.43	2.88	155.45	19.84	8.53	2.62
H_1S_2	135.67	75.96	2.58	146.15	19.04	9.41	2.50
H_1S_3	152.60	87.38	3.11	166.85	23.25	8.32	2.77
H_2S_1	153.35	84.69	2.10	133.33	17.16	9.92	2.34
H_2S_2	137.70	79.96	1.92	116.53	16.38	11.18	2.39
H_2S_3	157.17	91.25	2.26	140.08	17.96	9.74	2.33
H_3S_1	162.06	89.24	2.36	127.51	15.91	11.20	2.16
H_3S_2	137.96	82.85	2.15	119.19	14.56	12.88	2.11
H_3S_3	177.29	95.47	2.44	132.85	17.75	11.99	2.26
H_4S_1	178.86	98.15	2.71	134.89	17.80	9.11	2.47
H_4S_2	167.86	91.55	2.62	130.14	17.50	10.16	2.45
H_4S_3	187.76	102.38	2.96	142.76	20.06	9.17	2.72
H_5S_1	164.71	91.33	2.35	126.75	17.56	9.04	2.37
H_5S_2	149.08	87.35	2.20	124.24	16.43	10.36	2.28
H_5S_3	176.64	97.08	2.71	137.39	19.10	9.31	2.48
SEd	3.38	1.59	0.13	1.92	0.50	0.26	0.09
CD (P = 0.05)*	**6.94**	**3.27**	**0.27**	**3.95**	**1.02**	**0.54**	**0.18**

H_1: CO 3, H_2: CO 4, H_3: KKM 1, H_4: IGFRI 7, H_5: IGFRI 10
S_1: 60cm x 45cm, S_2: 60cm x 30cm, S_3: 45cm x 45cm

Table 3
Green fodder yieldper cut (t ha^{-1}) of Bajra Napier hybrids under different plantspacings

	Cuttings							*Mean of*
Treatments	I	II	III	IV	V	VI	VII	*7 cuts*
Hybrids (H)								
H_1:CO3	27.56	28.23	24.57	35.54	26.38	17.75	17.62	25.32
H_2:CO4	24.73	24.25	20.34	33.41	18.89	13.24	16.94	21.70
H_3:KKM 1	22.84	22.88	19.91	31.29	24.22	12.68	13.39	21.03
H_4:IGFRI 7	25.16	25.55	22.65	34.96	25.04	15.31	17.28	23.71
H_5:IGFRI 10	24.76	24.54	20.50	32.89	24.67	14.68	17.11	22.73
SEd	0.84	1.06	1.05	1.10	0.64	0.78	0.82	0.30
CD (P = 0.05)*	1.73	2.17	2.16	2.26	1.31	1.60	1.69	0.62
Spacings (S) cm								
S_1:60x45	24.48	25.13	21.76	33.52	22.59	14.35	16.95	22.68
S_2:60x30	23.96	23.48	19.25	31.47	20.73	13.69	13.94	20.93
S_3:45x45	26.60	26.65	23.79	35.66	28.21	16.15	18.52	25.08
SEd	0.65	0.82	0.81	0.85	0.49	0.60	0.64	0.23
CD(P=0.05)*	**1.34**	**1.68**	**1.67**	**1.75**	**1.02**	**1.23**	**1.31**	**0.48**

Table 4
Interaction effect of Bajra Napier hybrids and plant spacings on green fodder yield per cut (t ha^{-1})

	Cuttings							*Mean of*
Interaction (HxS)	I	II	III	IV	V	VI	VII	*7 cuts*
H_1S_1	27.35	28.45	25.22	36.73	24.53	18.25	16.58	25.30
H_1S_2	27.28	26.78	20.95	33.48	24.90	15.14	15.70	23.46
H_1S_3	28.07	29.46	27.55	35.21	29.72	19.86	20.57	27.20
H_2S_1	23.89	25.03	19.74	32.66	18.89	11.98	18.98	21.52
H_2S_2	22.69	22.68	18.81	30.85	18.09	13.49	12.74	19.90
H_2S_3	27.62	25.09	22.47	36.90	19.70	14.77	19.11	23.66
H_3S_1	22.43	23.44	19.69	30.11	21.22	11.34	13.60	20.26
H_3S_2	21.52	20.85	17.92	29.88	20.94	12.56	11.56	19.32
H_3S_3	24.58	24.37	22.13	33.88	30.51	14.14	15.01	23.52
H_4S_1	24.62	25.69	24.02	34.60	24.96	15.36	17.25	23.78
H_4S_2	24.41	24.58	19.07	33.29	21.36	15.06	15.84	21.87
H_4S_3	26.46	26.38	24.87	36.98	28.81	18.80	19.27	25.47
H_5S_1	24.10	23.07	20.11	33.48	23.22	18.34	18.32	22.53
H_5S_2	23.92	22.50	19.48	29.85	18.36	12.22	14.38	20.10
H_5S_3	26.27	28.02	21.91	35.33	32.33	16.48	18.63	25.57
SEd	1.46	1.84	1.82	1.91	1.11	1.35	1.43	0.52
CD (P = 0.05)*	**2.99**	**3.77**	**3.74**	**NS**	**2.28**	**2.77**	**2.92**	**1.08**

H_1: CO 3, H_2: CO 4, H_3: KKM 1, H_4: IGFRI 7, H_5: IGFRI 10
S_1: 60cm x 45cm, S_2: 60cm x 30cm, S_3: 45cm x 45cm

because of higher growth and yield components (Table 4). In the present investigation, CO 3 hybrid planted at 45 cm x 45 cm spacing recorded highest number of live tillers throughout the crop period and similarly registered the lowest number of dead tillers hill^{-1}. Moreover CO 3 registered the highest number of leaves hill^{-1}. The profuse tillering ability of CO 3 coupled with more number of leaves has greatly contributed for the highest green fodder yield.

The interaction effect between the hybrids and plant spacing revealed that CO 3 hybrid planted at 45 cm x 45 cm spacing produced the highest green fodder yield as compared to other interactions. This is attributed to the genetic superiority of CO 3 and its better adaptability to lowland coast ecosystem as to the other hybrids, at an optimum plant spacing of 45 cm x 45 cm than other spacings.

From the results of the experiment, it is concluded that the CO 3 hybrid planted at 45 cm x 45 cm spacing registered the highest growth and yield attributes which resulted in the highest green and dry fodder yield which ultimately gave the highest gross and net return.

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