Short Communication

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Performance of hybrid napier cultivars under rainfed ecosystems in humid tropics

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Abstract

A field experiment was conducted during 2011-12 to evaluate the performance of 11 popular cultivars of hybrid napier, *viz*., CO-2, CO-3, CO-4, KKM-1, Suguna, Supriya, IGFRI-3, IGFRI-7, DHN-6, PBN-16 and PTH under rainfed conditions. Among these, CO-3 was found superior with respect to total fodder yield, leafi stem ratio and the ability to withstand drought. The cultivars CO-4 and PTH also survived the drought period, and therefore, can be considered for growing in the humid tropics without irrigation.

Keywords: Fodder, Humid tropics, Hybrid napier, Rainfed ecosystem

Abbreviation: **DMRT**: Duncan's Multiple Range Test; **Mg:** Mega gram; **PTH**: Pennisetum Trispecific Hybrid

Hybrid napier, which is also called bajra-napier hybrid or hybrid pennisetum, is the F_1 hybrid between bajra (*Pennisetum glaucum* (L.) R. Br.) and napier grass (*Pennisetum purpureum* Schum.). It is very popular among dairy farmers of the tropics because of its high yield potential. Compared to other introduced grasses, this grass is well adapted to tropical and sub-tropical conditions because of its wide adaptability, quick growth, ease of establishment, palatability, high nutritive quality, herbage yield, persistence and good response to fertilizers. At present, several high yielding cultivars of hybrid napier is available for cultivation. However, most cultivars of bajra-napier hybrid express high yield potential only when grown under irrigation. This restricts its cultivation especially among resource poor farmers. Water shortage during summer months is a major constraint in successfully growing hybrid napier. Gupta and Mhere (1997) reported that during the dry periods, some cultivars of hybrid napier continued to grow and produced dry matter yield. As there is a genuine demand for high yielding fodder crops, which can be grown under rainfed conditions, an investigation was planned to evaluate the suitability of 11 popular cultivars of hybrid napier for rainfed conditions in the humid tropics of Kerala.

The field experiment was conducted during 2011-12 at the College of Horticulture, Kerala Agricultural University, Thrissur, situated at 10^0 31' N latitude and $76^0$13' E longitude at an altitude of 40.3m above mean sea level. Average monthly rainfall during the experimental period varied from 0-3.5 mm during lean months of December to March and 101.9-799.6 mm during April to November. The soil of the experiment site was sandy clay loam.

The treatments comprised of eleven different cultivars of hybrid napier planted through rooted slips at a spacing of 60 x 60 cm. The cultivars included were CO-2, CO-3, CO-4, KKM-1, Suguna, Supriya, IGFRI-3, IGFRI-7, DHN-6, PBN-16 and PTH (*Pennisetum* trispecific hybrid). The experiment was laid out in randomized block design (RBD) with three replications following recommended package of practices of Kerala Agricultural University (KAU, 2007). The first harvest was taken at 75 days after planting (DAP) and subsequent harvests at 45 days interval. After the fourth harvest, no more harvesting could be planned because of the non-receipt of rains. Green fodder yield from each plot was recorded immediately after cutting and expressed in Mg/ha. Dry weight was recorded by randomly selecting five plants from each plot, and by drying them at 80 ± 5^0C for 24 hours until constant weight was achieved. From this value, yield of dry fodder in Mg/ha was calculated. Plant height and number of leaves were also recorded. Leafiness was assessed based on the number of leaves and the ratio of total leaves to stem portions of the plant. Stems and leaves were separated from the plants and dry weights were recorded separately. From this, leaf: stem ratio was worked out. Observations on completely dried clumps were taken after the receipt of a few pre-monsoon showers and waiting for regeneration. Mortality of plants was expressed as percentage of completely dried clumps. Analysis of variance was performed on all data collected using the statistical package, 'MSTAT' Duncan's multiple range test (DMRT) was used to compare means (Duncan, 1955).

Table 1. Plant height, tillers/culm and leaves/culm of hybrid napier at each harvest

	Harvest 1 (75 DAP)			Harvest 2 (120 DAP)		
	Height (cm)	Tillers/culm	Leaves/culm	Height (cm)	Tillers/culm	Leaves/culm
CO-2	295.78^{a}	9.67^{d}	125.09^{i}	242.66^{a}	13.78^{e}	104.55^{h}
CO-3	245.33^{d}	21.67^{a}	195.44^{b}	206.33^{b}	29.33^{b}	216.66^{b}
CO-4	245.89^{d}	10.00^{d}	133.33^{h}	189.00^{e}	13.11^{e}	139.22^{g}
KKM-1	229.39^{e}	17.88^{b}	178.45^{d}	193.67^{d}	33.01^{a}	207.56^{c}
Suguna	201.11^{f}	14.78^{c}	157.73^{f}	170.44^{h}	17.56^{cd}	164.00^{f}
Supriya	200.22^{f}	15.77^{bc}	177.56^{d}	177.33^{g}	16.43^{de}	167.43^{e}
IGFRI-3	169.89^{g}	21.55^{a}	185.22^{c}	142.55^{i}	20.67^{c}	192.56^{d}
IGFRI-7	285.22^{b}	15.22^{bc}	155.22^{f}	199.44^{c}	18.22^{c}	162.89^{f}
DHN-6	268.56^{c}	15.67^{bc}	143.44^{g}	174.22^{gh}	15.21^{de}	167.67^{e}
PTH	282.94^{b}	23.11^{a}	227.45^{a}	184.67^{f}	27.33^{b}	254.00^{a}
PBN-16	174.00^{g}	17.67^{b}	167.33^{e}	137.00^{j}	35.55^{a}	218.44^{b}

	Harvest 3 (165 DAP)			Harvest 4 (210 DAP)		
	Height (cm)	Tillers/culm	Leaves/culm	Height (cm)	Tillers/culm	Leaves/culm
CO-2	155.44^{b}	35.56^{f}	227.33^{i}	66.77^{cd}	42.11^{h}	215.00^{i}
CO-3	155.23^{b}	44.89^{e}	273.43^{g}	66.23^{d}	53.02^{f}	266.10^{f}
CO-4	131.10^{c}	43.12^{e}	274.78^{g}	53.78^{f}	47.17^{g}	247.73^{g}
KKM-1	185.32^{a}	42.48^{e}	254.00^{h}	75.34^{a}	63.54^{d}	314.89^{cd}
Suguna	118.82^{ef}	57.42^{d}	318.78^{f}	75.94^{a}	56.43^{e}	302.47^{e}
Supriya	126.68^{cd}	60.32^{d}	319.96^{f}	69.33^{c}	70.00^{c}	305.00^{de}
IGFRI-3	103.22^{g}	100.34^{a}	575.89^{b}	44.57^{h}	76.00^{b}	448.01^{b}
IGFRI-7	155.12^{b}	69.29^{c}	376.56^{d}	72.44^{b}	69.33^{c}	320.00^{c}
DHN-6	122.56^{de}	43.78^{e}	325.89^{e}	51.07^{g}	47.00^{g}	237.11^{h}
PTH	114.99^{f}	93.00^{b}	633.46^{a}	50.80^{g}	121.24^{a}	618.63^{a}
PBN-16	91.89^{h}	66.44^{c}	404.88^{c}	62.10^{e}	54.57^{ef}	303.00^{e}

In a column, means followed by common letters do not differ significantly at 5% level by DMRT

Table 2. Green fodder yield and dry fodder yield of hybrid napier at each harvest (Mg/ha)

Cultivars	Harvest 1 (75 DAP)		Harvest 2 (120 DAP)		Harvest 3 (165 DAP)		Harvest 4 (210 DAP)		Total	
(Days)	Green	Dry	Green	Dry	Green	Dry	Green	Dry	Green	Dry
CO-2	45.22^{d}	9.04^{a}	41.00^{bc}	6.56^{d}	31.44^{b}	5.35^{b}	6.07^{b}	1.70^{ef}	123.74^{cde}	22.65^{ab}
CO-3	64.58^{b}	7.10^{cd}	62.45^{a}	8.12^{a}	39.54^{a}	6.72^{a}	6.75^{a}	1.95^{cd}	173.30^{a}	23.90^{a}
CO-4	52.31^{c}	6.80^{cd}	43.80^{bc}	7.88^{ab}	24.61^{cd}	3.94^{de}	5.33^{c}	1.92^{cd}	126.05^{cd}	20.54^{cde}
KKM-1	54.41^{c}	5.44^{e}	36.23^{d}	6.88^{cd}	21.11^{de}	3.59^{ef}	6.58^{ab}	2.17^{a}	118.34^{de}	18.09^{g}
Suguna	47.28^{d}	5.68^{e}	40.61^{c}	5.69^{e}	39.54^{a}	6.72^{a}	5.01^{cd}	1.55^{fg}	132.44^{c}	19.64^{ef}
Supriya	49.80^{cd}	5.48^{e}	36.41^{d}	5.46^{e}	21.78^{de}	3.72^{ef}	6.57^{ab}	2.04^{abc}	114.56^{e}	16.68^{h}
IGFRI-3	31.38^{e}	4.71^{f}	28.26^{e}	5.37^{e}	18.52^{e}	3.52^{ef}	4.68^{d}	1.41^{g}	84.79^{f}	15.00^{i}
IGFRI-7	62.17^{b}	8.70^{ab}	33.36^{d}	6.67^{d}	22.20^{de}	4.66^{c}	6.40^{ab}	1.98^{bcd}	124.13^{cde}	22.01^{bc}
DHN-6	82.71^{a}	8.27^{b}	44.65^{b}	5.81^{e}	20.36^{e}	3.05^{f}	3.89^{e}	1.83^{de}	151.62^{b}	18.96^{fg}
PTH	49.72^{cd}	7.46^{c}	43.31^{bc}	7.36^{bc}	24.63^{cd}	4.93^{bc}	4.84^{cd}	1.50^{g}	122.50^{cde}	21.25^{bcd}
PBN-16	47.18^{d}	6.60^{d}	42.94^{bc}	7.30^{bc}	26.59^{c}	4.52^{cd}	6.85^{a}	2.12^{ab}	123.55^{cde}	20.55^{de}

In a column, means followed by common letters do not differ significantly at 5% level by DMRT

Maximum plant height was recorded at the time of first harvest (75 days after planting). Plant height decreased towards the later part of the experiment due to cessation of rainfall and moisture stress (Table 1). This can be attributed to water deficit, which affected cell division and cell enlargement leading to reduced growth. The average height was higher in CO-2 (295.8 cm) while IGFRI-3(169.89 cm) recorded the minimum at first harvest.

During the initial stages of the experiment, tiller production was less, which gradually increased, but decreased by the final harvest (Table 1). The gradual decrease in tillers during later stages of harvests can be attributed to the stress developed during summer months. The control of tillering in grasses is the contribution of genetic and physiological factors and their interaction with environmental factors (Assuero and Tognetti, 2010). The average number of tillers was maximum for PTH (66.2) followed by IGFRI-3 (54.6) and the lowest number of tillers was in CO-2 (25.3).

Plants showed an increase in number of leaves throughout the experiment except for the last harvest (Table 1). The decrease in leaf numbers by final harvest can be attributed to decrease in growth and tiller production because of deficit in rainfall and soil moisture. The highest number of leaves was recorded in PTH (433.4) followed by IGFRI-3 (350.4) and the lowest in CO-2 (168.0). This can be attributed to the high tillering character of PTH and IGFRI-3 and low tillering in CO-2. The cultivar characteristics and moisture periods affected the production of leaves.

Leaf to stem ratio varied considerably between cultivars (Table 3). The cultivars Suguna (2.3), Supriya (2.2) and CO-3 (2.16) were at par with respect to leaf stem ratio. The supremacy of CO-3 in terms of high leaf to stem ratio making it highly palatable for animals has already been reported (Pandey and Roy, 2011). Although the dry fodder yield of CO-2 was comparable to CO-3, low leaf-stem ratio (1.05) rendered it less preferred by cattle, leading to the replacement of CO-2 by CO-3.

Four harvests were taken under rainfed conditions before the onset of summer. Further harvests could not be done after the fourth as there was stunting and drying of plants because of shortage of moisture in summer months. The green and dry fodder yields of hybrid napier cultivars ranged from 84.79 Mg/ha to 173.00 Mg/ha and 15.00 Mg/ha to 23.90 Mg/ha respectively among the cultivars (Table 2). Among the 11 cultivars, CO-3 recorded the highest total green fodder yield (173.30 Mg/ha) and dry fodder yield (23.90 Mg/ha). Higher yield of CO-3 can be attributed to high leaf: stem ratio and its ability to withstand drought as evident from zero percent mortality of clumps (Table 3). Premaratne and Premalal (2006) reported that CO-3 yielded an average green fodder of 5ï 8 kg/plant from a single cutting or 250-350 Mg/ha annually, and it was superior in terms of higher tillering capacity, forage yield, regeneration capacity, leaf to stem ratio, crude protein content, resistance to pest and diseases and free from adverse factors. In terms of green fodder yield, DHN-6 (151.62 Mg/ha) followed CO-3. During the first harvest, DHN-6 out yielded CO-3 and recorded the highest green fodder yield of 82.71 Mg/ha. Soumya (2011) reported that under irrigated condition, DHN-6 recorded annual green fodder yield of 283.31 Mg/ha. However, in the present experiment, DHN-6 showed 25 percent mortality during summer months. This indicated that DHN-6 may perform better under good management with enough soil moisture. The third highest yielder was Suguna with 132.44 Mg/ha. As it survived drought with very little mortality (3.33%), it may be suitable for rainfed areas. The fourth highest yield was recorded by CO-4 (126.05 Mg/ha). This also seems to be a good cultivar for rainfed condition, as it showed zero mortality during drought. The lowest green and dry fodder yields were recorded by IGFRI-3 (84.79 Mg/ha and 15.00 Mg/ha).

Maximum mortality of clumps was noticed in PBN-16 with 52.50 percent loss of clumps followed by IGFRI-3 (33.33%), DHN-6 (25%), CO-2 (22.50%) and KKM-1 (17.50%), indicating that CO-3, CO-4 and PTH survived the dry periods more efficiently.

Table 3. Leaf to stem ratio and mortality of clumps

Cultivars	Leaf: stem ratio	Mortality (%)*
CO-2	1.05^{d}	4.791^{bc} (22.50)
CO-3	2.16^{a}	0.707^{f} (0.00)
CO-4	1.60^{b}	0.707^{f} (0.00)
KKM-1	1.61^{b}	4.215^{c} (17.50)
Suguna	2.32^{a}	1.756^{ef} (3.33)
Supriya	2.20^{a}	2.644^{de} (6.67)
IGFRI-3	1.70^{b}	5.731^{b} (33.33)
IGFRI-7	1.15^{c}	3.064^{d} (9.17)
DHN-6	1.24^{c}	5.046^{bc} (25.00)
PTH	1.12^{cd}	0.707^{f} (0.00)
PBN-16	1.59^{b}	7.279^{a} (52.50)

In a column, means followed by common letters do not differ significantly at 5% level by DMRT.

*(x+0.5) transformed values, original values in parentheses

It can be concluded that CO-3 is superior to all other cultivars with respect to yield, yield contributing factors and the ability to withstand drought, hence suited for rainfed cultivation in the humid tropics. As the mortality of clumps was zero for CO-4 and PTH, these cultivars can also be recommended for rainfed areas in addition to CO-3. The cultivars Suguna, Supriya and IGFRI-7 may be recommended for areas with well-distributed rainfall. Other cultivars included in the study (KKM-1, CO-2, DHN-6, IGFRI-3 and PBN-16) could be grown only with irrigation during summer months.

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