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Evaluation of the performance of CO 3, CO 5 and Super Napier varieties planted under water stress and supported by irrigation in humid tropical conditions of Kerala

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Abstract

The performance of CO 3, CO 5 and Super Napier varieties planted in trench method under summer stress with irrigation support was evaluated. The experiment was conducted using different types of farmyard manure viz., cow dung, goat manure and poultry manure. Total yield, stem weight and projected yield did not differ significantly among the varieties. Survivability of CO 5 appeared low in the experiment ($p<0.01$). In general, the evaluated parameters were statistically significant ($p<0.01$) except tiller number, number of internodes, leaf weight and total weight. Stem weight was observed to be higher in CO 5 and Super Napier than CO 3 ($p<0.01$). Among all the parameters studied, the type of manure apparently influenced only leaf width ($p<0.05$). The yield (t/ha) observed after the first cut of CO 3, CO 5 and Super Napier were 123.41±41.22, 153.27±45.33 and 145.82±28.67 tons respectively on fresh cut basis.

Keywords: *CO 3, CO 5, Super Napier, water stress, farmyard manure*

The use of Hybrid Napier varieties as fodder has been in practise for a long time. Napier hybrids are typically produced by inter specific hybridisation of Bajra (*Pennisetum glaucum*) and Napier grass (*Pennisetum purpureum*). The hybridisation was also known to occur naturally. Bajra is resistant to most pests and is cultivated in Asia and Africa for grain and in some regions of America as forage for livestock. Napier grass or elephant grass is cultivated as forage in tropical regions of Africa, Asia and America. The inter specific hybridisation combined palatability, pest resistance and the ability to grow into broad clumps (tillering) which resulted in higher biomass yield when compared with other conventional fodder varieties. Furthermore, the plant thrives well in soils with pH 5 to 8, making it one of the high yielding forage varieties available in the world (Premratne and Premlal,

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2006; Babu *et al*., 2021). The development and release of CO 3 for cultivation in 1997 by Tamil Nadu Agricultural University could be regarded as a landmark in the efforts to develop a resilient fodder variety. Ever since the release of CO 3 which has a tested yield of 130-300 t/ha, several other hybrids were developed and released for field level cultivation. The Hybrid Napier variety CO 5 has enhanced growth and biomass production potential. The fodder also has a high crude protein content of 14 per cent, making it a component of cost-effective rations (Babu *et al*., 2018). Both CO 3 and CO 5 have been included in several fodder development programmes of the Government of Kerala and are particularly popular with the dairy farmers of Kerala. Pakchong 1, the Hybrid Napier variety developed in Thailand, known as Super Napier (SN) is also rapidly gaining acceptance in the state. Super Napier was demonstrated to have a crude protein yield of 16-18 per cent and was used for different applications including the preparation of silage (Liangco *et al*., 2019). On an average, the dairy farmers in Kerala spend 16.44 per cent of total expenses for providing roughages to their cows (Sabin *et al*., 2022). Therefore, fodders with higher nutritive value will be accepted by the farmers and there is little doubt that the popularity of Napier varieties as a fodder source is likely to stay for a long period.

The present study was designed to compare the performance of CO 3, CO 5 and Super Napier varieties planted in trench method under summer stress with irrigation support. The study also tested the performance of these varieties under different types of farmyard manure *viz*., cow dung, goat manure and poultry manure.

Materials and methods

The experiment was conducted in rectangular plots of 25 m (length) × 3 m (width) between January to April (2022) at Livestock Research Station, Thiruvazhamkunnu. Trenches with a width of 90 cm, length of 25 m and depth of 75 cm were prepared one meter apart using excavator in East-West orientation. The trenches were filled with organic fertiliser (*viz*. dried cow dung, goat manure and poultry manure) at the rate of 25 t/ha and were topped off with about 20 cm of soil. Prior to planting, lime was applied at the rate of 500 kg per hectare. Stem cuttings of Hybrid Napier varieties with three internodes *viz*., CO 5, CO 3 and Super Napier were planted with a space of 30 cm in between, across the width of the pit. The distance between two such rows was also maintained at 30 cm. The planting operations were completed in the last week of January and the plot was irrigated twice weekly for 8 weeks. Irrigation was discontinued from last week of March due to the regular receipt of summer showers. Yield and productivity were studied on 90th day after planting.

The study was performed using a completely randomised design. Samples were taken from a uniform area of 8 square feet. Each lane with a particular Napier variety under a specific manure type was sampled from a minimum of 6 locations. Yield in t/ha was calculated by assuming 440 square feet per cent of land. The tallest plant in a cluster was visually identified and marked before cutting. The clusters were cut at about 10 cm from the base and were bundled separately with tags for identification. The weights of each cluster were measured with a spring balance. The lengths were measured using commercial tapes in centimeters. Stem diameter was measured using Vernier calipers in millimeters. Main effects and interactions were tested using factorial ANOVA and Duncan's multiple range tests (post hoc test). Non parametric test (Kruskal Wallis test, superscripted #) was used in case of leaf stem ratio, tiller number, number survived, number of internodes and total weight, since the assumptions of normality were not holding due to a significant Levene's test ($p<0.05$). Data analysis was performed using SPSS version 24.

Results and discussion

The stem cuttings were planted at the beginning of summer and were supported with irrigation. Photographs depicting the method of planting and vegetative growth after 28, 50 and 90 days are presented as figures (1-4).

The yield from an area of 8 square feet was used to calculate the results. In general, the studied parameters were statistically significant ($p<0.01$) except tiller number,

number of internodes, leaf weight and total weight. The interaction between manure and plant variety did not emerge significant for any of the tested parameters. The results from the study with respect to yield and survivability are presented in Table 1. Total yield, stem weight and projected yield did not differ significantly between the varieties. Survivability of CO 5 appeared low in the experiment ($p<0.01$). Stem weight was observed to be higher in CO 5 and Super Napier than CO 3 ($p<0.01$).

The biometric parameters studied are summarised in Table 2. Among all the parameters studied, the type of manure influenced only leaf width ($p<0.05$). Leaves were larger in lanes fertilised with goat manure or cow dung when compared with poultry manure. However, the use of poultry manure did not affect other studied parameters adversely. In contrast to this, higher yields were reported in CO 3 from Sri Lanka where the use of poultry manure resulted in a higher number of tillers and plants with wide leaves (Jemziya and Mubarak, 2018). Higher yield was reported in maize plots fertilised with poultry manure than with cow dung from Kenya (Payebo and Ogidi, 2021). Reason for the apparent negative effect of poultry manure on leaf width is not known and might be due to the type of litter material used, especially the tree species from which the sawdust used as litter was collected.

Among the three studied Napier varieties, CO 5 plants appeared to have significantly higher plant height, stem height

Fig 1: Day of planting

Fig 2: After 28 days of growth

Fig 3: After 50 days of growth

Fig 4: Day of harvest (90 days)

Table 1: Yield and survivability of Hybrid Napier varieties in plots fertilised with different types of farmyard manure

Parameter	Plant variety			Type of manure			P values		
	CO 3	CO 5	SN	Cow	Goat	Poultry	Variety	Manure	Variety x Manure
Total weight (Kg)	8.98 ±3.00	11.15 ±3.30	10.61 ±2.09	11.17 ±2.23	10.29 ±2.20	10.42 ±2.08	0.074	0.306	0.889
Leaf weight (Kg)	3.87 ±1.49	3.88 ±1.36	3.56 ±1.14	4.03 ±1.70	3.83 ±1.09	3.41 ±1.11	0.782	0.472	0.905
Stem weight (Kg)	5.26 ±1.81^{a}	7.59 ±1.99^{b}	7.26 ±1.87^{b}	7.17 ±2.38	6.93 ±1.77	7.75 ±1.67	0.001	0.942	0.739
Projected yield (t/ha/cut)	123.41 ±41.22	153.27 ±45.33	145.82 ±28.67	145.99 ±43.38	146.44 ±36.86	128.09 ±40.17	0.074	0.306	0.889
Leaf stem ratio#	0.71 ±0.25^{a}	0.49 ±0.20^{b}	0.53 ±0.39^{b}	0.71 ±0.65	0.50 ±0.11	0.38 ±0.22	0.001	0.236	-
Number survived#	2.72 ±0.46^{a}	2.12 ±0.60^{b}	2.89 ±0.32^{a}	2.83 ±0.41	3.00 ±0.00	2.83 ±0.41	0	0.436	-

Different superscripts between columns within the same main factor of overall mean indicate significant difference.
Superscript # represent Kruskal-Wallis test

and leaf width ($p<0.01$), while CO 3 had longer leaves ($p<0.01$). The performance of CO 5 and super Napier were similar but higher than CO 3 with respect to leaves per tiller, leaf width, stem diameter and stem height ($p<0.01$). However, no significant differences were observed between the varieties in the case of number of tillers, number of internodes, leaf weight, total weight and projected yield per cut ($p>0.05$). A direct comparison of the results with other similar studies could not be made due to wide spread variations in harvesting periods.

The height of CO 3 at 75 days of growth recorded by Antony and Thomas (2014) from Thrissur, Kerala was 245.33 cm, while the mean height observed in the present study was 299.42 cm at 90 days. Even though direct comparison is not possible, the performance of CO 3 could be similar in these experiments. A report from the Konkan region of Maharashtra indicated that the height of CO 3 at 45 days was 80.39 cm, which concluded that Bajra Napier hybrid BNH-10 performed better with a mean height of 111.64 cm (Dahipahle *et al*., 2015).

The leaf to stem ratio observed in CO 3 in the present study was higher than that reported by Dahipahle *et al*. (2015) but lower than that reported by Antony and Thomas (2014). Better tillering (26 per plant) and leaf stem ratio (2.60) were reported by Biradar *et al*. (2020) in CO 3 plants from Northern Karnataka. All the Napier varieties studied, performed better than Bangladesh Livestock Research Institute (BLRI) Napier-3 with the reported height of 184.75 cm (73.9 inches), leaf to stem ratio of 0.65 and a yield per hectare of 41.0 T at 90 days (Sarkar *et al*., 2019). Difference in agronomical practices, climate and genetic capabilities could be the reasons for variation.

The average height of CO 5 plants was observed to be 258 cm by Biradar *et al*. (2020) at 65 days of growth. The mean height and mean width of leaf in CO 5, observed by Haritha *et al*. (2020), after conducting an experiment in Andhra Pradesh was 268 cm and 1.40 cm respectively at 79 days of age. Lower height of 219 cm in CO 5 was reported by Sushma *et al*. (2021) from Karnataka at 90 days. In comparison, the mean height of CO 5 plants observed in the study was 381.29 cm at 90 days. A higher number of tillers per plant of 23.33 and 32 than the present study were reported by Sushma *et al*. (2021) and Biradar *et al*. (2020), respectively. The projected yield per cut in the present study was higher than 129.2 t as reported by Biradar *et al*. (2020). The annual yield reported for CO 5 by Tamil Nadu Agricultural University was 360 t/ha (Babu *et al*., 2018). The leaf to stem ratio (75 days) reported by Ramya *et al*. (2017) from CO 5 cultivated at Namakkal was 0.84 and was nearly twice the value observed in the present study. Higher leaf to stem ratio of 2.73 was also reported by

Table 2: Performance of Hybrid Napier varieties in plots fertilised with different types of farmyard manure

Parameter	Hybrid Napier variety			Type of manure			p values		
	CO 3	CO 5	SN	Cow	Goat	Poultry	Variety	Manure	Variety x Manure
Plant Height (Cm)	299.42 ±37.38[a]	381.29 ±19.36[b]	349.74 ±32.49[c]	337.53 ±48.41	352.85 ±40.73	334.50 ±48.06	0.000	0.28	.592
Stem Height (Cm)	153.50 ±46.62[a]	262.94 ±22.91[b]	224.68 ±29.76[c]	208.00 ±60.74	217.88 ±59.13	209.00 ±53.72	0.000	0.835	.605
Leaves per tiller	13.05 ±2.93[a]	16.88 ±2.03[b]	15.74 ±2.64[b]	14.71 ±3.46	15.25 ±2.94	15.50 ±2.73	0.000	0.811	.245
Leaf length (Cm)	145.61 ±14.01[a]	124.47 ±6.81[b]	130.58 ±12.81[b]	132.71 ±13.50	136.08 ±17.65	132.56 ±12.29	0.000	0.385	.795
Leaf width (Cm)	1.92 ±0.16[a]	2.26 ±0.31[b]	2.16 ±0.28[b]	2.11 ±0.28	2.09 ±0.32	2.13 ±0.29	0.000	0.034	.208
Stem diameter (Cm)	1.92 ±0.16[a]	2.26 ±0.31[b]	2.16 ±0.28[b]	2.11 ±0.28	2.09 ±0.32	2.13 ±0.29	0.001	0.706	.684
Tiller number[#]	14.61 ±4.65	15.41 ±4.94	12.05 ±2.80	14.35 ±5.10	14.30 ±4.77	13.18 ±3.05	0.073	0.894	-
Number of internodes[#]	10.58 ±2.97[a]	15.71 ±1.61[b]	14.21 ±2.55[b]	12.82 ±3.28	14.00 ±3.29	13.33 ±3.25	0.000	0.314	-

Biradar *et al*. (2020). Differences in the time to harvest may account for some of the variations between the studies, since leafiness tended to decrease with age.

Ahmed *et al*. (2021) observed the height (263 cm), tiller diameter (15.15 mm), tillers per plant (22.6) and leaves per tiller (13.63) at 60 days, following a field trial of Super Napier plants at Bangladesh Livestock Research Institute. Tiller numbers were higher than that observed in the present study while other parameters were not comparable due to difference in the time of harvest. Wangchuk *et al*. (2015) observed that the mean height of Super Napier plants was 256 cm at 80 days. They also observed on average, 40 tillers per plant, with 7 leaves and a mean stem diameter of 13.1 mm; with the tiller number observed being lower in the present study. A yield of 69.3 (t/ha) was reported by Sarkar *et al*. (2019) per cut for Super Napier. It was observed that planting Hybrid Napier in trenches with farmyard manure resulted in higher biomass production.

Conclusion

In general, all the three Hybrid Napier varieties performed well in the experiment. Results from the present study indicated that CO 5 had the potential to provide the highest return of biomass in relatively short periods. All the Napier varieties thrived well in pH corrected well drained soils and hence could be supported with irrigation during summer. Relatively high yields were obtained using farmyard manure alone, which implies that the use of costly inorganic fertilisers could be minimised for fodder production.

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Conflict of interest

The authors declare that they have no conflict of interest

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