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Comparison of Forage Cropping Systems in the Oxisol of Kerala

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An experiment conducted to compare the productivity of a few forage cropping systems and to study the feasibility of mixing cowpea with annual cereals and perennial grasses, in the laterite soils of Kerala revealed that among the grasses, hybrid napier was superior in terms of forage and crude protein yields followed by guinea grass. Mixing cowpea with perennial grasses (hybrid napier and guinea grass) does not appear to be compatible at the normal spacing of the grasses. Cowpea mixes well with the annual cereals (maize and sorghum) but the yields of these crops and crop combinations are comparatively low.

Importance of fodder needs no emphasis in a mixed farming system. To develop an economic forage cropping system for the laterite soils of Kerala, an evaluation of grass-based cropping systems was thought to be opportune with commonly available fodder crops.

A review of literature on fodder research revealed that napier grass could produce 310 t/ha fresh material in 13 months (Zuniga *et al*; 1967). Semb and Garberg (1969) reported that fresh fodder yield of maize ranged from 8 to 70 t/ha in tropics. Guinea grass yields of 226 t/ha fresh herbage per year was reported by Narayan and Dadabghao (972). Fresh fodder yield of sorghum ranged from 10-45 t/ha (Bodgan, 1977). Green fodder yield of cowpea ranging from 10-25 t/ha was also reported by him.

The present investigation was undertaken to compare the productivity of a few forage cropping systems and to study the feasibility of mixing cowpea with annual fodder cereals and perennial grasses.

MATERIAL AND METHODS

The soil of the experimental site was typical laterite containing 1.71% organic carbon, 31.2 ppm available P and 190 ppm available K with a pH of 4.7. The experiment involved comparison of the performance of two perennial grasses (hybrid napier and guinea grass) and two annual cereals (maize and sorghum) alone and in combination with cowpea. There were two more treatments with annual cereals rotated with cowpea. The experiment was laid out in RBD with 10 treatments and three replications. The details of the treatments are given below.

1. T1-Hybrid napier alone throughout.

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2. T2-Guinea grass alone throughout.
3. T3-Hybrid napier intercropped with cowpea twice-one in June-July and the ot er in Sept.-Oct.
4. Guinea grass intercropped with cowpea as in T3.
5. T5-Hybrid maize grown twice-one in June-July and the other in Sept.-Oct.
6. T6-Sorghum grown twice-as in T5.
7. T7-Maize+cowpea mixed cropping-twice, one in June-July and the other in Sept.-Oct.
8. T8-Sorghum+cowpea mixed cropping as in T7.
9. T9-Maize during June-July followed by cowpea during Sept. Oct.
10. T10-Sorghum during June-July followed by cowpea during Sept.-Oct.

The treatments are further illustrated below :

	S. W. Monsoon				N. E. Monsoon						
	May	J.	J	A.	Sept.	Oct.	N	D	J	F	M	A
T1	Hybrid napier				alone	throughout						
T2	Guinea grass				alone	throughout						
T3	HN+CP				HN+CP	Hybrid napier alone (Continued)						
T4	GG+CP				GG+CP	Guinea gaiss alone (Continued)						
T5	Maize				Maize	no crop						
T6	Sorghum				Sorghum	no crop						
T7	M+CP				M+CP	no crop						
T8	S+CP				S+CP	no crop						
T9	Maize				Cowpea	no crop						
T10	Maize				Cowpea	no crop						

HN—Hybrid napier
GG—Guinea grass
M—Hybrid maize
S—Sorghum
CP—Cowpea

The perennial grasses were planted during May 1977 and retained upto May 1979 whereas the annual cereals and cowpea were raised during the two rainy seasons. (S.W. and N.E monsoon seasons). wherever cowpea was mixed with grasses and cereals, the spacing of the grasess and cereals was maintained the same as the sole crop. All the crops in sequence and in combinations were fertilized separately at the recommended rates. The rates of fertilizer application, the spacing followed and

the varieties used were the following. Wherever cowpea was grown as an intercrop, the quantities of fertilizers added were in proportion to the plant population.

Crop	Rate of fertilizer added			Spacing	Variety
	N	P_2O_5	K_2O		
Hybrid napier	200	50	50	50x50 cm	NB-21
Guinea grass	200	50	50	40x20 ,,	Mannuthy selection
Maize	90	50	50	25x20 ,,	Deccan hydrid macca
Sorghum	90	50	50	25x20 ,,	Local
Cowpea	20	40	50	25x5 ,,	Karnataka local

Flowering in the case of annual fodder cereals and cowpea and com plete field coverage in perennial grasses were used to decide the stage of harvest. Harvesting was done at an interval of about two months in the case of perennial grasses. The fresh fodder obtained at each harvest was recorded.

RESULTS AND DISCUSSION

Data on the yields of fresh fodder and crude protein for 1977-78, 1978-79 are presented in Tables 1 and 2, respectively.

Data for the S.W. monsoon season of 1977 showed that hybrid napier outyielded all the other grasses cereals with an avesage yieid of 68 t/ha. It was followed by guinea grass which recorded a yields of 44.1 t/ha. The annual cereals gave much lower yields in the range of 18 to 23 tonnes. Mixing cowpea with the perennial grasses led to a conspicuous decline in yield of grasses which was 36.5 per cent in hybrid napier and 50.3 per cent in guinea grass. Not only the the grass yield deciined because of cowpea mixing, the total forage yield also declined because of the crop mixing. The yield declined because of cowpea intercropping in the case of annual cereals also; but the extent in yield decline was much smaller. It was 32.90 per cent in the case of maize and 5.49 per cent only in sorghum. Further in sorghum, the total forage yield was higher when cowpea was mized. Excepting in the case of sorghum-cowpea mix, the yield of cowpea was nearly same in all the treatments (in the range from 15 to 17.5 tonnes).

During the second season also, hybrid napier outyielded all other forages (59.4 t/ha) followed by guinea grass (29.9 t/ha). The yields of aunual cereals were much lower as in the previons season. However, in marked

contrast to the first season, cowpae mixing led to practically little yield decline of perennial grasses. Also, the yield of cowpea when mixed with the perennials was negligibly small (in the range from 0.8 to 1.3 tonnes). Such a marked decline may be considered to be because of the competition between the crops in association for light. During the first season when the grass slips were newly planted, there was smothering by cowpea to such an extent as to bring down grass yield substantially.

During the second season when the grass had already established, there was strong smothering of grass over cow pea and the latter practically failed to grow. It may be noted that such a trend continued during all the seasons of the second year also. The performance of the annual cereal-legume mixture continued to be nearly the same during all the seasons, there being an indication of the association being compatible. However, the total yield was very low as compared to the perennial grasses. Another peculiar feature was the lack of stability in the performance of both maize and sorghum. One major factor that contributed to the unsteady performance of sorghum and maize was the difference in the crop stand. There were substantial losses in crop stand n some seasons because of poor germination due to soil moisture variations and because of bird damage.

During the period, November to April when only perennial grasses were retained, the average yields declined but the distinct superiority of hybrid napier over guinea grass wae evident. One interesting observation made was that the grass yield of the plots in which cowpea was raised in the previous seasons was slightly higher presumably because of either the residual advantages of the phosphatic and potassic fertiiisers applied to the previous legumes or because of the incorporation of part of symbiotically fixed nitrogen by the legumes or both. With advancing dry season, the grass yields generally declined further but the superiority of hybrid napier was still evident. However, the advantage due to legume cropping did not persist beyond the first dry season (November).

Essentially the same yield trend as in the North-East monsoon season of first year was observed in both the monsoon season crops of second year with hybrid napier yielding the highest followed by guinea grass, and there being no better performance of legume. Sorghum and maize yields were considerably lower though these crops were found to mix well with the legume.

The overall forage and crude protein yields of first year, second year and the total for the two years showed superiority of hybrid napier followed by guinea grass. During the first year hybrid napier gave total forage and crude protein yields of 228.1 and 2.-281 t/ha respectively while during the second year the corresponding figures were 168.6 and 1.686 t/ha. The comparable figures for guinea grass were 120.3 and 1.564 t/ha and 83.2 anp 1.082 t/ha respectively for the first and second years. Mixing perennia grasses with cowpea resulted in no significant change in the quantity or

quaiity of forage. The total yields of legume grown mixed with hybrid napier and guinea grass during the first year were 16.3 and 17 tonnes/ha respectively. The comparable figures for second year were 2.0 and 2.3 tonnes respectively. The major contribution towards the legume yield of the first year came from the first crop.

A comparison of the forage yields of first and second years would also reveal a conspicuous decline in yield of all the crops and crop mixes during the second year.

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Table-1. Green yield of forage at different harvests and crude protein yield (t/ha) for the year 1977-1978 (May 1977 to April 1978)

Treatment	S. W. monsoon season			N. E. monsoon season			Perennial grasses continued							
	May' 77 to July' 77			Aug' 77 to Oct' 77			Nov' 77 to April 1978							
	grass/ cereal 1st cut	Legume 1st crop	Total (3+4)	grass/ cereal 2nd + cut	Legume 2nd crop	Total (6+7)	grass/ 3rd cut	grass/ 4th cut	grass/ 5th cut	grass/ 6th cut	Total grass cereal yld (3+ 6+9+ 10+11 +12)	Total tal le- gume yld (2+ 5)	Total grass/ cereal +legu- me yld in the yr. (13 +14)	Total crude protein yld in the yr.
H N	68.0	—	68.0	59.4	—	59.4	55.3	25.8	7.4	12.2	228.1	—	228.1	2,281
G G	44.1	—	44.1	29.9	—	29.9	23,8	5,6	3.1	13.8	120,3	—	120.3	1.564
H N+C P	43.2	15.5	58.7	58.1	0,8	58.9	59,7	22,9	6,7	13,2	203.8	16.3	220.1	2.527
G G+C P	21.9	15.7	37.6	32.3	1.3	33.6	25.9	5.8	3,4	15,1	104.4	17.0	121.4	1.867
M-M	23.4	—	23.4	23.8	—	23.8	—	—	—	—	47.2	—	47.2	0.944
S-S	18.2	—	18.2	11.5	—	11.5	—	—	—	—	29.7	—	29.7	0.327
(M+CP)-(M+CP)	15.8	17.5	33.3	23.5	6.3	29.8	—	—	—	—	39.3	23.8	63.1	1.502
(S+CP)-(S+CP)	17.2	8.2	25.4	9,3	11.7	21.0	—	—	—	—	26.5	19.9	46.4	0.889
M-CP	15.9	—	15.9	—	15.5	15.5	—	—	—	—	15.9	15.5	31.4	0.783
S-CP	17.0	—	17.0	—	14.6	14.6	—	—	—	—	17.0	14.6	31.6	0.625
F test			sig			sig							sig	
S E.±			4.4			2.3							8.4	
C D (0.05)			13.1			6.9							24.9	

H. N.—Hybrid napier
G.G.—Guinea grass
M-Maize
S-Sorghum
C P-Cowpea

Table-2. Green forage yield at different harvests and crude protein yield during 1978-1979 and total forage yield and crude protein yield during 1977-1979) (t/ha)

Treatment	S. W. monsoon season May' 78 to July' 78			N. E. monsoon season Aug' 78 to Oct' 78			Perennial grasses continued Nov' 78 to April 1979						Total for the period May 77 to April 79				
	Grass/cereal 7th cut	Legume	Total (3+4)	grass/cereal 8th cut	Legume	Total (6+7)	grass/cereal 9th* cut	grass/cereal 10th* cut	grass/cereal 11th* cut	Total grass/cereal yld 78-79 (3+6+9+10 +11	Total legume yld 78-79 (4+7)	Total grass cereal+legume yld 78-79 (12+13)	Total crude protein yld 78-79	Total grass/cereal yld	Total legume yld	Total forage yld in 2yrs.	Total crude protein yld in two yrs.
H N	77.0	—	77.0	60.6	—	60.6	15.0	6.7	9.3	168.6	—	168.6	1.686	396.7	—	396.7	3.967
G G	37.8	—	37.8	31.8	—	31.8	5.0	1.9	6.7	83.2	—	83.2	1.082	203.5	—	203.5	2.646
H N+C P	82.6	1.2	83.8	65.4	0.8	66.2	17.2	6.2	10.3	181.7	2.0	183.7	1.877	385.5	18.3	403.8	4.404
G G+C P	41.3	1.1	42.4	29.1	1.2	30.3	6.3	1.9	9.3	87.9	2.3	90.2	1.212	192.3	19.3	211.6	3.079
M-M	9.7	—	9.7	3.1	—	3.1	—	—	—	12.8	—	12.8	0.256	60.0	—	60.0	1.200
S-S	3.3	—	3.3	1.2	—	1.2	—	—	—	4.5	—	4.5	0.050	34.2	—	34.2	0.376
(M+CP)-(M+CP)	6.7	4.4	11.1	1.9	15.8	17.7	—	—	—	8.6	20.2	28.8	0.770	47.9	44.0	91.9	2.278
(S+CP)-(S+CP)	7.6	5.6	13.2	1.7	12.7	14.4	—	—	—	9.3	18.3	27.6	0.651	35.8	38.2	74.0	1.158
M-CP	9.5	—	9.5	—	9.4	9.4	—	—	—	9.3	9.4	18.9	0.472	25.2	24.9	50.3	1.255
S-CP	3.3	—	3.3	—	11.9	11.9	—	—	—	3.3	11.9	15.2	0.392	20.3	26.5	46.8	1.018
F test				sig				sig			sig					sig	
S Em.±				2.3				2.1			2.0					10.9	
C D (0.05)				6.8				6.3			5.9					32.0	

H. N.—Hybrid Napier M-Maize C P-Cowpea *in the case perennial grasses only

G.G.—Guinea Grass S-Sorghum