evident. Gopalakrishnan (1986) in bittergourd reported reciprocal difference in various plant characters. According to Russian scientists Lysenko and Prezent, reciprocal difference is one of the contradicting principle on Mendalism. Topham (1966) suggested that fenetic interaction in parents and hybrids were found to be responsible for the reciprocal differences. Hansen and Bagett (1977) explained that the reciprocal differences was an outcome of a small plant to plant difference at genotypic level within the Inbred.

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FORAGE PRODUCTION IN SOLE AND MIXED STAND OF CEREALS AND LEGUMES UNDER RAINFED CONDITIONS

S.MANOHARAN, S.SUBRAMANIAN

ABSTRACT

Field experiments were conducted during 1984-85 and 1985-86 under rainfed vertisols at Regional Research Station, Aruppukottai to identify the suitable cereal, and legume fodders either alone or with cereals viz., maize (African tall), sorghum (K 7) and Pearl millet (Co.6), legume cowpea (Co.4) and soybean (Co.1). Performance of cereal legume combination was better than pure stand. Maize + cowpea (2:1) with high fodder and protein production was the most suitable combination.

Sustainability in agriculture alone could usher in continued prosperity without environmental hazard. Integrated farming ~~animal, tree and other~~ components besides cropping is the solution for sustainability especially in dryland. Livestock enterprise offer great scope for combinati n with cro husbandry. The

Table 1. Rainfall and number of rainy days during the cropping season - Aruppukkottai

Month	1984			
	Rainfall (mm)	No. of rainy days	Rainfall (mm)	No. of rainy days
September	175.0	9	29.0	6
October	63.0	6	59.0	4
November	76.0	5	145.0	8
December	10.0	2	26.0	3
Total	324.0	22	259.0	21

livestock needs fooder in sufficient quantity and good quality. However research information on the performance of crop varieties for fodder production under rainfed situations is rather scanty. Certain cereals of C 4 plants provide adequate forage even under rainfed system. However, their forage quality is not adequate to the livestock need. Inclusion of legumes along with cereals is likely to improve the forage quality, since legumes are rich in protein. They also contain considerable amount of phosphorus and calcium. Such cereal-legume combinations have been well documented (Mamedov and Mirizade, 1975; Taneja *et al.*, 1980; Sukanya Subramanian and Govindasamy, 1985).

Table 2. Performance of cereal and leguminous fodder crops under rainfed condition - Aruppukkottai

	Treatments	Green fodder (t/ha)			Dry matter (t/ha)			Crude protein (kg/ha)		
		1984-85	1985-86	Pooled mean	1984-85	1985-86	Pooled mean	1984-85	1985-86	Pooled mean
T1	Maize	31.0	14.2	22.6	7.8	4.4	6.1	560	430	500
T2	Sorghum	23.5	12.9	18.2	7.4	3.5	5.5	500	330	420
T3	Cumbu	10.6	11.8	11.2	3.0	2.8	3.0	330	320	330
T4	Soybean	2.3	1.4	1.9	0.4	0.1	0.3	70	20	45
T5	Cowpea	15.7	8.3	12.0	4.0	0.8	2.4	680	170	430
T6	Maize + Sorbean (1:1)	29.2	12.9	21.0	7.1	4.2	5.7	520	310	420
T7	Maize + Sorbean (2:1)	29.6	14.0	21.8	7.2	4.3	5.8	530	570	550
T8	Maize + Cowpea (1:1)	29.7	13.2	21.5	7.4	3.2	5.3	630	420	530
T9	Maize + Cowpea (2:1)	32.3	16.1	24.2	8.2	4.8	6.5	710	530	620
T10	Sorghum + Soybean (1:1)	19.3	8.6	14.0	6.1	3.0	4.6	410	300	360
T11	Sorghum + Soybean (2:1)	19.5	11.0	15.3	6.1	3.1	4.6	420	370	400
T12	Sorghum + Soybean (1:1)	21.9	11.6	16.8	6.7	3.2	5.0	500	310	410
T13	Sorghum + Soybean (2:1)	22.8	12.5	17.7	7.1	4.0	5.6	510	400	460
T14	Cumbu + Soybean (1:1)	9.0	11.5	10.3	2.4	2.6	2.5	280	300	290
T15	Cumbu + Soybean (2:1)	9.3	12.0	10.7	2.5	2.7	2.6	290	310	300
T16	Cumbu + Soybean (1:1)	11.3	10.8	11.0	2.9	2.5	2.7	380	290	340
T17	Cumbu + Soybean (2:1)	12.4	11.3	11.8	3.1	2.8	3.0	400	370	390
	SED	1.63	3.0	1.71	0.45	1.11	-	35	110	-
	CD 0.05	3.31	6.1	3.41	0.91	2.26	-	74	220	-

Table 3. Economics of cereal and legume fodder cropping system

	Treatments	Net income (Rs/ha)			Benefit-cost ratio		
		1984-85	1985-86	Pooled mean	1984-85	1985-86	Pooled mean
T1	Maize	4420	1360	2900	3.5	1.6	2.6
T2	Sorghum	2930	1030	2000	2.6	1.5	2.0
T3	Cumbu	420	760	600	1.2	1.4	1.3
T4	Soybean	-1070	-1500	-1280	0.4	0.2	0.3
T5	Cowpea	2930	500	1720	2.6	0.6	1.6
T6	Maize + Sorbean (1:1)	3160	1330	2250	2.8	1.5	2.2
T7	Maize + Sorbean (2:1)	4000	1050	2530	3.3	1.6	2.5
T8	Maize + Cowpea (1:1)	4500	1120	2800	3.5	1.5	2.6
T9	Maize + Cowpea (2:1)	4650	1860	3260	4.0	1.8	2.9
T10	Sorghum + Soybean (1:1)	2130	360	1250	2.2	0.1	1.2
T11	Sorghum + Soybean (2:1)	2160	540	1350	2.2	1.2	1.7
T12	Sorghum + Soybean (1:1)	2800	730	1770	2.6	1.3	2.0
T13	Sorghum + Soybean (2:1)	2900	970	1940	2.6	1.4	2.0
T14	Cumbu + Soybean (1:1)	340	580	460	1.0	1.2	1.1
T15	Cumbu + Soybean (2:1)	400	670	540	1.1	1.3	1.2
T16	Cumbu + Soybean (1:1)	950	720	830	1.4	1.3	1.4
T17	Cumbu + Soybean (2:1)	1100	720	960	1.5	1.4	1.5
	SED	441	NS	6354	–	–	–
	CD 0.05	897		12645	–	–	–

MATERIALS AND METHODS

Field experiment was conducted at the Regional Research Station, Aruppukkottai during rabi 1984 and 1985 in vertisols under rainfed conditions. The soil is sandy clay loam with low available nitrogen (145.8 kg/ha), medium available phosphorus (12.63 kg P_2O_5/ha) and high available potassium (402.7 kg K_2O/ha). Soil pH was 8.4, EC less than 0.4 mm hos/cm, soil depth of 80-150 cm and water holding capacity of 140 mm/m depth. Maize (African tall), sorghum (K 7) and pearl millet (Co 6) alone and in combination with the legume cowpea (Co 4) or soybean (Co.1) were tried at 1:1 as well as 2:1 rations. Cowpea and soybeanwere also grown in pure stand. The seventeen treatmental combinations were tried in a randomised block design replicated thrice. Fertilizer was applied at 30 : 40 : 20 and 30 : 60 : 0 kg N : P_2O_5 : K_2O/ha for cereals and legumes respectively. No extra fertilizer dose was given for mixed stands. A seed rate of 40 kg/ha for maize and sorghum and 12 kg/ha for pearl millet and 30 kg/ha for legumes was adopted. An inter row spacing of 30 cm and intra row spacing of 100 cm was adopted both for cereals and legumes. The fodder crops were harvested at 50 per cent flowering. The

yield particulars and economics are presented in Tables 2 and 3 respectively.

RESULTS AND DISCUSSION

The data received during the experimental period of 1984-85 and 1985-86 are presented in Table 1. Year to year variation was distinct. First year which enjoyed adequate rain with favourable distribution recorded high fodder yields, whereas in the second year, the production was affected due to ill distribution, coupled with poor rainfall. During the first year (1984-85), maize-cowpea 2:1 recorded the highest green yield from sole crop of maize. The yield was distinctly higher than that of others. During the second year (1985-86) also the same combination recorded high green fodder production (16.1 t/ha) which was marginally higher than others except sole crop of soybean whose yield was very low. The yield of soybean during the favourable as well as unfavourable years was very poor both in pure and mixed stands. Taneja *et al.*, (1980) reported high yield with sorghum - cowpea mixture compared sorghum - soybean mixture. Soybean as an intercrop was not suitable due to its susceptibility to leaf miner which devasted almost the whole crop. Growing soybean in vertisols does not show promise.

The low, uneven distribution of rainfall experienced in the initial crop growth period (60 mm in 4 rainy days) during 1985-86 caused moisture stress resulting in low green fodder yields. However during 1984-85, the rainfall was well distributed throughout the crop period and ensured adequate soi moisture availability for securing high green fodder yield.

The mean yield of two years (1984-85 and 1985-86) showed that maize grown mixed with cowpea at 2:1 ratio recorded the highest green fodder production of 24.2 t/ha/year comparable with the sole crop yield of maize and significantly higher than the other combinations/sole crop.

Similar trend was observed with dry matter yield and the highest (8.2 t/ha) being in maize and cowpea 2:1 mixture during the first year (1984-85) and 4.8 t/ha during the second year (1985-86) with a mean of 6.5 t/ha/year (Table 2). The crude protein yield was also highest in both the years, 710 kg/ha (1984-85) and 530 kg/ha (1985- 86) with a mean of 620 kg/ha/year (Table 2).

ECONOMICS

Maize and cowpea combination (2:1) recorded the highest net income of Rs.3260/ha/year with a return of Rs.2.90 per rupee invested (Table 3). To conclude it is advantageous to grow maize along with cowpea in 2:1 combination for high green fodder production and high income in rainfed vertisols. This combination provides and additional income of Rs.360/ha over the sole crop income from maize (Table 3) besides providing nutritious fodder.

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