

Nitrogen management for production of sorghum (*Sorghum bicolor*) and cowpea (*Vigna unguiculata*) forage under intercropping system

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ABSTRACT

An experiment was conducted during the rainy (*kharif*) season of 1998 and 1999 on nitrogen management in sorghum [*Sorghum bicolor* (L.) Moench] and cowpea [*Vigna unguiculata* (L.) Walp.] intercropping system. The highest green and dry-forage yields were observed in sorghum + cowpea intercrop (4:2 row ratio) with 100 kg N/ha, which was on a par with its 75 kg N/ha treatment in respect of green forage yield. The highest benefit : cost ratio and land-equivalent ratio were recorded in sorghum + cowpea with 100 kg N/ha in 4:3 row proportion during the first season. However, these values were more with sorghum + cowpea with 100 kg N/ha in 4:2 row ratio during the second year.

Key words : Nitrogen, Sorghum, Cowpea, Intercropping, Forage

The fodder requirement of the livestock are generally met through poor quality available crop residues which are in short supply and not enough for maintenance of health, efficiency and productivity of Indian animals. Under these situation, fodder cereals + legume intercropping assumes great importance to provide stability in fodder production. This system is an effective approach for boosting the production and quality of fodder crops (Rao and Willey, 1980).

Intercropping of grass and legumes not only increases the yield and quality of herbage but also economises the use nitrogen (Singh *et al.*, 1985) and enrichment of the soil fertility (Bezbaruah and Thakuria, 1996). In this aspect sorghum can successfully be grown along with legume fodder, especially cowpea to obtain higher yield of quality forage (Sood and Sharma, 1992). The present investigation was therefore undertaken to study the production potential of sorghum and cowpea forage involving nitrogen management under intercropping system for Chhattisgarh region.

MATERIALS AND METHODS

A field experiment was conducted during monsoon (*kharif*) season of 1998 and 1999 at Anjora (Durg). The soil was clay loam with pH 7.6, having 250 kg N, 6 kg P and 292 kg K/ha. Eleven treatments (Table 1) were laid out in randomized block design with 3 replications. In addition to N (as per treatment), 'MP Chari' sorghum was fertilized @ 50 kg P_2O_5 /ha, while a dose of 30 kg N and

60 kg P_2O_5 /ha was applied basal to 'Pusa Komal' cowpea forage. Crops were sown in the first week of August in both the years. The spacing adopted for sorghum and cowpea between row to row and plant was to plant 30 cm and 10 cm respectively.

RESULTS AND DISCUSSION

Forage yield

Natural vegetation (control) gave significantly lowest forage and dry-matter yields compared to all other treatments (Table 1). Sorghum sole with 100 kg N/ha and 75 kg N/ha, being at par, recorded significantly higher mean green and dry forage yields than sole sorghum with 50 kg N/ha and cowpea forage. In case of intercropping systems, sorghum + cowpea in 4:2 row ratio with 100 kg N/ha yielded the maximum mean green-forage (51.94 tonnes/ha) compared to others, except sorghum + cowpea with 75 kg N/ha (4:2 row ratio). However, the mean dry-matter yield was the maximum in sorghum + cowpea with 100 kg N/ha (4:2 row ratio) followed by the same treatment with 75 kg N/ha. The total green fodder yield recorded with sorghum + cowpea with 100 kg N/ha (4:2 row ratio) was 50.27 tonnes/ha and 53.26 tonnes/ha in 1998 and 1999 respectively. The respective values of dry-matter yield were 9.15 tonnes/ha and 9.51 tonnes/ha in first and second seasons. Results further indicated that all the intercrop combinations of sorghum + cowpea gave higher green forage yield, ranging from 6.2 to 13.7% in 1998 and 2.2 to 11.6% in 1999 over sole sorghum. Similar effect was ob-

Table 1. Green forage and dry-matter yields as affected by various treatments

Treatment	Green forage yield (tonnes/ha)						Mean	Dry-matter yield tonnes/ha)						Mean
	1998			1999				1998			1999			
	Sorghum	Cowpea	Total	Sorghum	Cowpea	Total		Sorghum	Cowpea	Total	Sorghum	Cowpea	Total	
Natural vegetation			7.15			6.59	6.87			1.49			1.37	1.43
Sorghum sole with N ₁	40.95		40.95	44.17		44.17	42.56	7.77		7.77	8.39		8.39	8.08
Sorghum sole with N ₂	43.11		43.11	46.55		46.55	44.83	8.14		8.14	8.68		8.68	8.41
Sorghum sole with N ₃	44.22		44.22	47.73		47.73	45.97	8.22		8.22	8.81		8.81	8.51
Cowpea sole		18.52	18.52		19.88	19.88	19.20		2.95	2.95		3.15	3.15	3.05
S+C with N ₁ (4:2R)	37.56	6.01	43.57	39.75	6.36	46.11	44.84	6.97	0.96	7.93	7.37	1.00	8.37	8.15
S+C with N ₂ (4:2R)	42.83	5.72	48.55	45.37	6.14	51.51	50.03	7.96	0.90	8.86	8.42	0.96	9.38	9.12
S+C with N ₃ (4:2R)	44.73	5.54	50.27	47.38	5.88	53.26	51.94	8.19	0.96	9.15	8.50	1.00	9.50	9.32
S+C with N ₁ (4:3R)	36.24	7.25	43.49	37.65	7.50	45.15	44.32	6.76	1.12	7.88	7.01	1.16	8.17	8.02
S+C with N ₂ (4:3R)	40.63	7.07	47.71	42.22	7.38	49.60	48.65	7.51	1.16	8.67	7.80	1.21	9.01	8.84
S+C with N ₃ (4:3R)	42.31	6.96	49.27	44.01	7.17	51.18	50.22	7.81	1.08	8.89	8.12	1.12	9.24	9.06
CD(P=0.05)			1.80			1.76	1.78			0.12			0.12	0.12

S+C, Sorghum and cowpea intercropping; N₁, 50 kg N/ha basal; N₂, 75 kg N/ha (50 kg basal + 25 kg after first cut); N₃, 100 kg N/ha (50 kg basal + 50 kg after first cut); 4:2 and 4:3 R, row ratio of S+C respectively

Table 2. Cost of the cultivation, gross and net return, benefit : cost ratio and land-equivalent ratio (LER) as influenced by different treatments

Treatment	Mean cost of cultivation (Rs/ha)	Gross return (Rs/ha)			Net return (Rs/ha)			Benefit : cost ratio			LER		
		1998	1999	Mean	1998	1999	Mean	1998	1999	Mean	1998	1999	Mean
Natural vegetation	1,500	2,145	1,979	2,062	645	479	562	0.43	0.32	0.37	1.00	1.00	1.00
Sorghum sole with N ₁	6,210	12,285	13,251	12,768	6,075	7,041	6,558	0.98	1.13	1.05	1.00	1.00	1.00
Sorghum sole with N ₂	6,410	12,934	13,964	13,449	6,524	7,554	7,039	1.02	1.18	1.10	1.00	1.00	1.00
Sorghum sole with N ₃	6,610	13,266	14,320	13,793	6,656	7,710	7,183	1.01	1.17	1.09	1.00	1.00	1.00
Cowpea sole	6,060	11,113	11,928	11,520	5,053	5,868	5,460	0.83	0.97	0.90	1.00	1.00	1.00
S + C with N ₁ (4:2 R)	6,160	14,877	15,741	15,309	8,716	9,581	9,149	1.4	1.55	1.48	1.36	1.22	1.29
S + C with N ₂ (4:2 R)	6,293	16,284	17,295	16,789	9,991	11,002	10,496	1.59	1.75	1.67	1.41	1.28	1.34
S + C with N ₃ (4:2 R)	6,427	16,742	17,742	17,242	10,315	11,315	10,815	1.60	1.76	1.68	1.42	1.29	1.35
S + C with N ₁ (4:3 R)	6,145	15,224	15,799	15,511	9,079	9,654	9,366	1.48	1.57	1.52	1.42	1.23	1.32
S + C with N ₂ (4:3 R)	6,260	16,435	17,097	16,766	10,175	10,837	10,506	1.63	1.73	1.68	1.46	1.27	1.36
S + C with N ₃ (4:3 R)	6,374	16,869	17,508	17,188	10,495	11,134	10,814	1.65	1.74	1.69	1.47	1.28	1.37

S+C, Sorghum and cowpea intercropping; N₁, 50 kg N/ha basal; N₂, 75 kg N/ha (50 kg basal + 25 kg after first cut); N₃, 100 kg N/ha (50 kg basal + 50 kg after first cut); 4:2 and 4:3 R, row ratio of S + C respectively

served in dry-matter yield also. This is in accordance with the observation of Jeyaraman *et al.* (1988) and Gupta and Sharma (1989). The possible reason for higher yield of sorghum + cowpea intercropping might be due to the supplementation of nitrogen synthesized in the root nodules of cowpea by the process of N-fixation. This has been resulted in the additive enrichment and enhanced soil fertility which increases the overall herbage yield. Further the better utilization of solar radiation enhanced the photosynthetic activities resulting in the higher yield of biomass (Tripathy *et al.*, 1987).

Economic analysis

The mean cost of cultivation was the highest (Rs 6,610/ha) in sole sorghum with 100 kg N/ha, followed by sorghum + cowpea with 100 kg N/ha in 4:2 row ratio and it was lowest under natural vegetation (Table 2). Similarly, the maximum gross monetary return was obtained in sorghum + cowpea intercropping with 100 kg N/ha sown in 4:3 row proportions in 1998, while it was highest (Rs 17,742/ha) in its 4:2 row ratio in 1999 as well as in mean data (Rs 17,242/ha). The net return also followed the similar pattern. These findings are in agreement with those of Jayaraman *et al.* (1988), who reported the highest profits from mixed biomass system than cultivation of single forage crops. Data (Table 2) further revealed that benefit : cost ratio was more (1.65) in sorghum + cowpea with 100 kg N/ha (4:3 row ratio), followed by same treatment sown

with 75 kg N/ha (1.63) in the first year. However, benefit : cost ratio was maximum (1.76) under sorghum + cowpea with 100 kg N/ha (4:2 row ratio), followed by its 75 kg N/ha (1.75) in second year. But the mean value was maximum (1.69) under sorghum + cowpea with 100 kg N/ha in 4:3 row ratio.

Intercropping yield and advantage

In general, the land-equivalent ratio (LER) was higher (>1.00) under all the intercropping treatments (Table 2). Sorghum + cowpea with 100 kg N/ha (4:3 row ratio) recorded the highest LER (1.47) in the first year as well as in mean data (1.37), while it was the maximum (1.29) with its 4:2 row ratio in second year. Similar observation was also made by Verma *et al.*, (1997).

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