

Nitrogen requirement of fingermillet (*Eleusine coracana*) + pulse intercropping system

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ABSTRACT

A field experiment was conducted during rainy (*kharif*) season of 1995 and 1996 under rainfed conditions to study N requirement of fingermillet [*Eleusine coracana* (L.) Gaertn.] + pulse intercropping system. Three levels of N (50, 75 and 100% of recommended dose) were tested in fingermillet intercropped with each of soybean [*Glycine max* (L.) Merr.], rice bean [*Vigna aconitifolia* (Jacq.) Marechal] and French bean or *rajma* (*Phaseolus radiatus* L.). The highest total grain yield (28.64 q/ha) was obtained under finger millet + soybean with 75% application. The land-equivalent ratio (1.31), fingermillet-equivalent yield (33.71 q/ha), net return (Rs 6,892/ha) and benefit : cost ratio (2.12) were also recorded higher in the same treatment.

Key words: Finger millet + pulse intercropping, N, LER, Economics

In hills of Uttar Pradesh fingermillet is mostly grown under rainfed conditions on soils of poor fertility. It is generally grown mixed with different legumes. Finger millet along with soybean is a better intercropping system (Singh and Arya, 1988). Ricebean, horsegram, French bean or *rajma* and cowpea as intercrop increase the grain yield of fingermillet (Thaware *et al.*, 1989). Legumes in intercropping also improve the fertilizer-use efficiency (De, 1980). Since information on N requirement of various intercropping systems in hills of Uttar Pradesh is very scanty, the present study was undertaken to find out the nitrogen schedule for fingermillet + rainy (*kharif*) season pulses in intercropping system.

MATERIALS AND METHODS

A field experiment was conducted at Hill Campus, Ranichauri, Tehri Garhwal, Uttar Pradesh, during the rainy (*kharif*) season of 1995 and 1996 under rainfed conditions. Thirteen treatments consisting of combination of 3 levels of N (50, 75 and 100% of recommended N (60 kg N/ha), 3 intercropping systems (fingermillet + soybean, fingermillet + ricebean and fingermillet + *rajma* in 90 : 10% seed rate) and sole crop of fingermillet, soybean, ricebean and *rajma* were tested in randomized block design with 3 replications.

The soil was silty clay loam. It was low in available N (210-218 kg/ha) and P (13.5-14.5 kg/ha), but rich in available K (410-418

kg/ha) during both the years, with pH 5.5–5.6. Finger millet ('VL 149'), soybean ('Bragg'), ricebean ('Local') and *rajma* ('VL 63') were sown broadcast on 25 and 18 June in 1995 and 1996 respectively. *Rajma* was harvested on 22 and 20 September, soybean on 11 November and 30 October, finger millet on 4 and 5 November and ricebean on 12 and 22 November in 1995 and 1996 respectively. The experimental site was situated at 1,850 m mean sea-level on north facing. The rainfall received during 1995 and 1996 was 993.80 and 821.7 mm respectively. The levels of N were calculated on the basis of recommendation of main crop of finger millet (60 kg N and 40 kg P₂O₅/ha). The sole crops of soybean, ricebean and *rajma* received 20 kg N and 40 kg P₂O₅/ha. Land-equivalent ratio was worked out (Willey, 1979).

RESULTS AND DISCUSSION

Yield-contributing characters

Application of N had a significant effect on all yield-contributing characters except 1,000-grain weight during both the years and effective tillers in 1996 (Table 1). The maximum effective tillers, ear weight and 1,000-grain weight were recorded under the pure crop of finger millet which were at par with those of finger millet + soybean, finger millet + ricebean and finger millet + *rajma* each at 75 and 100% of N during both the years. While comparing the different intercropping systems, finger millet + soybean, ricebean and *rajma* with 100% N gave the highest effective tillers and ear weight of finger millet, followed by 75% N during both the years. Application of N had significant effect on number of plants of pulse crop. The maximum plants of pulse was recorded in pure stand of soybean, ricebean and *rajma*, while in intercropping the higher number of plants were obtained at 50 and 75% of N. It may be due to the fact that at 100% N the population of

finger millet was higher which suppressed the plant stand of intercrops.

Grain yield

The grain yield of finger millet was highest in pure stand applied with 100% N dose (Table 2). In intercropping system also the highest grain yield of finger millet was obtained with 100% N. The grain yield decreased with the decrease in N from 100 to 50% in all the 3 systems. However, the grain yield recorded with 75% recommended N was at par with that recorded under 100% recommended N. Similar yield-contributing characters recorded in 75 and 100% N application also showed the above trend for grain yield.

The grain yield of intercrops (soybean, ricebean and *rajma*) were adversely affected by different levels of N in finger millet (Table 2). The pure crop of soybean, ricebean and *rajma* gave significantly maximum grain yield on mean basis. Among intercrops, soybean recorded the higher grain yield with 50% N, followed by soybean at 75% and *rajma* at 50% N.

Intercropping of finger millet with soybean fertilized with 75% of recommended N gave the highest grain yield on mean basis which were 12.5, 13.6 and 13.0% higher than pure crop of finger millet. While in other system also the total grain yield was increased significantly up to 75% of N. Similar results were obtained in barnyardmillet with soybean by Singh and Arya (1995). The next best treatments in this regard were finger millet + soybean and finger millet + *rajma* with 100% N.

Economic productivity

Application of N in intercropping system proved remunerative in terms of finger millet equivalent (Table 3). The highest value of finger millet equivalent was recorded in intercropping combination of finger millet along

Table 1. Effect of different treatments on yield-contributing characters of fingermillet and pulse crops

Treatment	Fingermillet						Plants/m (pulse)		
	Effective tillers (m)		Ear weight (g)		1,000-grain weight (g)		1995	1996	Mean
	1995	1996	1995	1996	1995	1996			
Fingermillet pure (FM)	31.8	34.8	5.3	4.3	2.7	2.6			
Soybean pure (S)							7.7	7.9	7.8
Ricebean (Rb)							6.2	5.4	5.8
<i>Rajma</i> (R)							7.2	7.0	7.1
FM + with 50% N	27.8	28.9	4.2	4.2	2.4	2.6	2.3	2.4	2.4
FM + with 75% N	27.7	33.4	4.9	4.4	2.6	2.6	2.7	2.7	2.7
FM + with 100% N	31.2	32.5	5.2	4.5	2.6	2.4	2.5	2.1	2.3
FM + Rb with 50% N	26.8	30.7	3.5	4.0	2.5	2.4	2.0	2.0	2.0
FM + Rb with 75% N	28.3	31.2	4.2	4.2	2.4	2.5	2.2	2.2	2.2
FM + Rb with 100%N	30.3	33.5	4.7	4.3	2.7	2.5	1.8	2.0	1.9
FM + R with 50%N	25.7	31.4	3.8	4.0	2.6	2.3	2.0	2.1	2.1
FM + R with 75%N	27.3	33.8	4.9	4.1	2.5	2.5	1.3	2.2	1.8
FM + R with 100%N	29.2	34.4	4.5	4.1	2.7	2.6	1.2	2.1	1.7
CD (P = 0.05)	2.7	NS	1.1	0.3	NS	NS	0.6	1.0	

Table 2. Effect of different treatments on yield of fingermillet and pulse crops

Treatment	Fingermillet						Plants/m (pulse)		
	Effective tillers (m)			Ear weight (g)			1995	1996	Mean
	1995	1996	Mean	1995	1996	Mean			
Fingermillet pure (FM)	26.12	24.56	25.34				26.12	24.56	25.34
Soybean pure (S)				13.89	13.11	13.50	13.89	13.11	13.50
Ricebean (Rb)				10.28	9.17	9.73	10.28	9.17	9.73
<i>Rajma</i> (R)				9.61	10.55	10.08	9.61	10.55	10.08
FM + with 50% N	17.50	16.00	16.75	5.67	5.00	5.34	23.17	21.00	22.09
FM + with 75% N	24.44	23.06	23.75	4.95	4.83	4.89	29.39	27.89	28.64
FM + with 100% N	25.00	22.78	23.89	3.61	4.00	3.80	28.61	26.78	27.70
FM + Rb with 50% N	16.67	15.56	16.12	4.28	3.89	4.09	20.95	19.45	20.20
FM + Rb with 75% N	20.28	20.00	20.14	4.06	3.71	3.89	24.34	23.71	24.03
FM + Rb with 100%N	21.39	21.67	21.53	3.89	3.60	3.75	25.28	25.27	25.28
FM + R with 50%N	15.84	16.95	16.40	4.78	4.46	4.62	20.62	21.39	21.01
FM + R with 75%N	20.83	20.56	20.70	3.83	4.17	4.00	24.66	24.73	24.70
FM + R with 100%N	24.78	21.95	23.37	3.06	4.00	3.53	27.84	25.95	26.90
CD (P = 0.05)	4.78	3.66	3.33	1.26	1.67	1.05	4.17	3.66	3.52

Table 3. Effect of different treatments of finger millet equivalent yield, land-equivalent ratio, net return and benefit : cost ratio

Treatment	Finger millet equivalent yield (q/ha)			LER		Mean	Cost of cultivation (Rs/ha)*	Net return (Rs/ha)*	B : C ratio*
	1995	1996	Mean	1995	1996				
Finger millet (FM) pure	26.12	24.56	25.34	1.00	1.00	1.00	3,350	4,542	1.34
Soybean (S) pure	28.29	26.70	27.50	1.00	1.00	1.00	3,150	4,675	1.48
Ricebean (Rb)	20.94	18.68	19.81	1.00	1.00	1.00	2,900	2,749	0.93
Rajma (R)	24.91	27.35	26.13	1.00	1.00	1.00	3,050	4,306	1.39
FM + with 50% N	29.05	26.19	27.62	1.08	1.04	1.06	3,060	5,310	1.71
FM + with 75% N	34.52	32.90	33.71	1.30	1.31	1.31	3,210	6,892	2.12
FM + with 100% N	32.25	30.93	31.64	1.22	1.24	1.23	3,360	6,183	1.82
FM + Rb with 50% N	25.39	23.48	24.44	1.07	1.04	1.06	3,060	4,438	1.43
FM + Rb with 75% N	28.55	27.56	28.06	1.19	1.22	1.21	3,210	5,364	1.64
FM + Rb with 100% N	29.31	29.00	29.16	1.21	1.28	1.25	3,360	5,513	1.62
FM + R with 50% N	28.23	28.51	28.37	1.10	1.11	1.11	3,150	5,404	1.68
FM + R with 75% N	30.76	31.37	31.07	1.23	1.25	1.24	3,250	6,138	1.86
FM + R with 100% N	32.71	32.32	32.52	1.26	1.27	1.27	3,410	6,370	1.84
CD (P = 0.05)				0.18	0.15	0.12			

Finger millet, Rs 270/q; soybean and ricebean, Rs 550/q; rajma, Rs 700/q

*Cost of cultivation, net return and B : C ratio are average of 2 years

with soybean fertilized with 75% of N, which was 33.0% higher than pure crop of finger millet followed by finger millet + rajma and finger millet + soybean at 100% N. The application of 75% of N in finger millet + soybean gave maximum net return, followed by finger millet + rajma with 100% N. The benefit : cost ratio also recorded higher (2.12) in the same treatment.

Land-equivalent ratio

Intercropping system of finger millet with different kharif pulses was found significantly more productive than that of sole crops of finger millet, soybean, ricebean and rajma. The highest land-equivalent ratio was obtained with finger millet + soybean at 75% of N. Similar results were obtained by Singh and Arya (1995) in barnyard millet intercropping system.

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