Indian J. Agron. **40** (3) : 366–370 (September 1995)

Effect of seed ratio on performance of fingermillet (*Eleusine coracana*)-based mixed-cropping systems

R.V. SINGH AND M. P. S. ARYA

Govind Ballabh Pant University of Agriculture and Technology. Hill Campus, Ranichauri, Uttar Pradesh 249 199

Received: February 1994

ABSTRACT

A field experiment on mixed cropping in fingermillet [*Eleusine coracana* (L.) Gaertn.] was conducted under rainfed condition during rainy (*kharif*) season of 1991 and 1992. Grain yield of fingermillet was highest (17.55 q/ha) in sole crop. It was decreased in all the mixed-cropping patterns except in fingermillet + soybean [*Glycine max* (L.) Merr.] in 9 : 1 row ratio which recorded the highest total grain yield of 21.94 q/ha. The land-equivalent ratio (1.35) and higher fingermillet-equivalent yield (30.30 q/ha) were also recorded in same treatment.

Fingermillet [*Eleusine coracana* (L.) Gaertn.] is a common crop of rainfed conditions in hills of Uttar Pradesh. A number of other crops, i.e. pulses and pseudocereals, are grown mixed with it. Fingermillet along with soybean [*Glycine max* (L.) Merr.] is a better intercropping system (Singh and Arya, 1988; Prakash and Sharma, 1988). Ricebean [*Vigna umbellata* (Thunb.) Ohwi & Ohashi], horsegram [*Macrotyloma uniflorum* (Lam.) Verd.], Frenchbean (*Phaseolus vulgaris* L.) and cowpea as intercrop also increase the grain yield of fingermillet (Hegde *et al.*, 1980; Thaware *et al.*, 1989). In view of the nature of feeding and growth pattern of both the main and mixed crops plant population especially seed ratio may be one of the major factors for increasing the yield of each crop. The present study was therefore undertaken to find but the proper seed ratio for mixed cropping of fingermillet with pulses.

MATERIALS AND METHODS

A field experiment was conducted at Ranichauri during the rainy (*kharif*) season of 1991 and 1992 under rainfed conditions. Fourteen treatment combinations, consisting of 4 seed rate ratios of 4 crops (Table 1) were tested in randomized block design with 3 replications.The soil of experimental field was silty clay-loam in texture with pH 5.5–5.6. It was low in available nitrogen (170–180 kg/ha) and phosphorus (8.0–8.5 kg/ha), and rich in available potassium (410–430 kg/ha) during both the years. The general recommended seed rates for fingermillet, soybean, horsegram and ricebean were 10,70,30 and 30 kg/ha respectively. 'VL 204' fingermillet was sown mixed with 'Bragg' soybean, 'VL Gahet 1' horsegram and 'Local' ricebean on June 21 and 24 in 1991 and 1992 respectively. Soybean was harvested on 10 and 6 November, horsegram on 11 and 6 November, fingermillet on 15 and 11 November and ricebean on 28 and 21 November in 1991 and 1992 respectively. The experimental site was situated at 1,850 m mean sea-level

on north facing. The rainfall received during 1991 was 529.0 mm and during 1992 it was 520.6 mm. Recommended doses of fertilizers were applied as basal dressing to each of the sole crop of fingermillet (40, 20 and 20 kg N, P and K/ha) and pulse crops (20, 40 and 20 kg N, P, and K/ha). The mixed-cropping treatments were also supplied with 20, 40 and 20 kg N, P and K/ha. However, an additional dose of N @ 20 kg N/ha was side-dressed in the rows of fingermillet at tillering to the mixed-cropping treatments. The mixture of all crops were sown in the rows at 30 cm apart. Land-equivalent ratio of fingermillet and pulse was worked out as per procedure proposed by Willey (1979). Fingermillet equivalent was calculated on the support prices of all the crops in respective years.

RESULTS AND DISCUSSION

Yield-contributing characters

The seed ratio of fingermillet and the mixed crops had significant effect on all the yield-contributing characters of fingermillet except 1,000-grain weight (Table 1). The maximum number of effective tillers, ear weight and grain weight/ year were recorded in the sole crop, followed by seed ratio of 9 : 1 of main and either of the mixed crops. Narrowing the seed ratio from 9 : 1 to 7 : 3 had an adverse effect on almost all the characters.

Seed ratios under mixed cropping had significant effect on the yield-contributing characters of different mixed crops during both the years (Table 2). The maximum number of pods, pod weight and grain

Table 1. Effect of different mixed-cropping treatments on yield-contributing characters of fingermillet

Treatment	Effective tillers/m		Ear weight (g)		Grain weight/ear (g)		1,000-grain weight (g)	
	1991	1992	1991	1992	1991	1992	1991	1992
FM pure	35.0	33.7	6.1	5.1	4.6	4.5	3.7	3.9
S pure								
H pure								
Rb pure								
FM 90% + S 10%	30.6	30.5	5.7	5.0	4.4	4.3	3.9	3.6
FM 90% + H 10%	31.4	29.2	5.3	4.9	3.0	3.4	3.4	3.5
FM 90% + Rb 10%	32.0	25.7	5.6	4.2	3.7	3.6	3.5	3.4
FM 80% + S 20%	27.6	22.3	4.5	4.4	3.1	3.4	3.5	3.1
FM 80% + H 20%	27.0	25.6	4.9	4.0	3.6	3.0	3.7	3.7
FM 80% + Rb 20%	24.6	21.1	5.2	4.4	4.2	3.6	3.9	3.3
FM 70% + S 30%	24.0	18.5	3.6	4.6	3.0	3.2	3.7	3.7
FM 70% + H 30%	24.0	22.5	3.9	4.0	3.1	3.4	3.6	3.5
FM 70% + Rb 30%	21.6	24.8	3.2	4.0	2.8	3.2	3.9	3.2
FM 70% + S 10% + H 10% + Rb 10%	18.0	19.0	3.6	4.0	3.0	2.8	3.4	3.5
CD (P = 0.05)	5.4	4.4	1.4	NS	0.9	0.8	NS	NS

FM, Fingermillet; S, soybean; H, horsegram; Rb, ricebean

Table 2. Effect of different mixed-cropping treatments on yield-contributing characters of pulse

Treatment	Pods/plant			Pod weight/plant (g)			Grain weight/plant (g)		
	1991	1992	Mean	1991	1992	Mean	1991	1992	Mean
FM pure									
S pure	31.7	30.7	31.2	21.7	23.0	22.4	10.6	10.0	10.3
H pure	53.3	52.2	52.8	11.9	16.1	14.0	4.3	5.3	4.8
Rb pure	42.4	44.0	43.2	31.6	26.1	28.9	10.0	10.5	10.3
FM 90% + S 10%	25.4	21.9	23.7	17.3	18.1	17.7	7.5	7.8	7.7
FM 90% + H 10%	36.4	27.9	32.2	10.0	7.2	8.6	6.1	3.7	4.9
FM 90% + Rb 10%	43.7	36.1	39.9	23.3	16.1	19.7	8.6	11.3	10.0
FM 80% + S 20%	21.1	20.8	21.0	20.4	16.1	18.3	6.9	7.2	7.1
FM 80% + H 20%	41.1	35.0	38.1	11.1	10.9	11.0	5.1	5.4	5.3
FM 80% + Rb 20%	32.8	40.9	36.9	32.2	21.8	27.0	13.9	18.9	16.4
FM 70% + S 30%	20.8	24.8	22.8	16.6	13.3	15.0	9.1	7.8	8.5
FM 70% + H 30%	38.9	21.9	30.4	16.5	10.0	13.3	8.5	7.2	7.9
FM 70% + Rb 30%	31.1	38.8	35.0	20.0	21.1	20.6	15.0	17.2	16.1
FM 70% + S 10% + H 10% + Rb 10%	29.8	34.7	32.3	13.3	13.9	13.6	13.7	12.7	13.2
CD (P = 0.05)	11.8	10.0		9.6	4.2		3.7	3.0	

FM, Fingermillet; S, soybean; H, horsegram; Rb, ricebean

weight/plant were recorded in sole crops, viz. soybean, horsegram and ricebean, with recommended seed rate. Among the mixed cropping treatments, the maximum pod weight/plant was recorded in fingermillet + soybean in 9 : 1 seed ratio, whereas the maximum pod weight/plant and grain weight/plant were recorded under the seed ratio of 8 : 2 of fingermillet : ricebean, followed by same combination of crops under 7 : 3 seed ratio.

Grain yield

The grain yield of fingermillet was the highest in sole crop (Table 3). The grain yield of fingermillet was decreased in all the mixed-cropping patterns except fingermillet + ricebean (9 : 1) in 1991. In general, the decrease was of higher order in fingermillet + pulse in 7 : 3 seed rate ratio. Among the different mixed-cropping systems, the maximum grain yield was obtained in fingermillet + soybean in 9 : 1 seed ratio during both the years, followed by fingermillet + ricebean in 9 : 1 seed ratio. The higher grain yield of fingermillet with soybean in 9 : 1 seed ratio, may be owing to maximum effective tillers/plant, ear weight and grain weight/ear (Table 1). Singh and Arya (1988) also reported higher grain yield of fingermillet with soybean.

The mixed cropping adversely affected the grain yield of soybean, horsegram and ricebean. The sole crop of soybean, horsegram and ricebean gave higher grain yields than their mixed cropping (Table 3). In the mixed-cropping treatment the grain yield increased with the increasing ratio of

Table 3. Effect of different mixed-cropping treatments on yield of sole as well as mixed crops and total yield of fingermillet

Treatment	Fingermillet yield (q/ha)		Pulse yield (q/ha)		Total grain yield (q/ha)		
	1991	1992	1991	1992	1991	1992	Mean
FM pure	18.44	16.67			18.44	16.67	17.56
S pure			13.33	14.22	13.33	14.22	13.78
H pure			7.22	9.89	7.22	9.89	8.56
Rb pure			12.78	12.22	12.78	12.22	12.50
FM 90% + S 10%	16.67	15.11	5.55	6.55	22.22	21.66	21.94
FM 90% + H 10%	13.33	11.67	3.66	5.11	16.99	16.78	16.89
FM 90% + Rb 10%	15.11	12.99	3.89	6.11	19.00	19.10	19.05
FM 80% + S 20%	12.22	10.22	6.11	9.77	18.33	19.99	19.16
FM 80% + H 20%	11.33	9.00	3.88	7.78	15.21	16.78	16.00
FM 80% + Rb 20%	11.89	9.78	7.78	9.22	19.67	19.00	19.34
FM 70% + S 30%	10.44	9.44	7.78	9.55	18.22	18.99	18.61
FM 70% + H 30%	9.11	7.55	4.56	8.00	13.67	15.55	14.61
FM 70% + Rb 30%	8.44	8.89	9.33	9.44	17.77	18.33	18.05
FM 70% + S 10% + H 10% + Rb 10%	5.11	5.99	8.33	9.11	13.44	15.10	14.27
CD (P = 0.05)	4.61	2.45	3.81	2.86	4.97	3.96	

pulse crop in each combination and the maximum grain yield was recorded with fingermillet + soybean (8 : 2) in 1992 and fingermillet + ricebean (7 : 3) in 1991).

Total grain yield

Mixed cropping of fingermillet with different rainy-season pulses showed significant differences in the total grain production during both the years (Table 3). Total grain yield was the highest in fingermillet + soybean in 9 : 1 seed ratio, though the differences among sole crop of fingermillet, fingermillet + soybean in 8 : 2 seed ratio and fingermillet + ricebean in 8 : 2 seed ratio were non-significant. However, it was found significantly superior to fingermillet + horsegram in 9 : 1, 8 : 2 and 7 : 3 seed ratios and to fingermillet + soybean + horsegram + ricebean in 7 : 1 : 1 : 1 seed ratio.

Economic productivity

The economic productivity (fingermillet equivalent) was found to be increased with different pulses in sole and mixed-cropping patterns (Table 4). The highest value of fingermillet equivalent (30.30 q/ha) was recorded under mixed cropping in combination of fingermillet + soybean in 9 : 1 seed ratio. It was 172.55% higher than the fingermillet in pure stand. Similar results were also obtained by Pradhan and Ghosh (1988) and Thaware *et al.* (1989).

Land-equivalent ratio

Mixed cropping of fingermillet with soybean was found more remunerative than of sole cropping of fingermillet, soybean, horsegram and ricebean. The highest land-equivalent ratio was obtained with fingermillet + soybean in 9 : 1 seed ratio,

Table 4. Effect of different mixed-cropping treatments on fingermillet equivalent and land-equivalent ratio

Treatment	Fingermillet equivalent (q/ha)			Land-equivalent ratio		
	1991	1992	Mean	1991	1992	Mean
FM pure	18.44	16.67	17.56	1.00	1.00	1.00
S pure	31.74	33.86	32.80	1.00	1.00	1.00
H pure	17.19	25.90	21.55	1.00	1.00	1.00
Rb pure	29.21	29.10	29.16	1.00	1.00	1.00
FM 90% + S 10%	29.88	30.71	30.30	1.32	1.37	1.35
FM 90% + H 10%	22.04	23.84	22.94	1.23	1.23	1.23
FM 90% + Rb 10%	24.00	26.96	25.48	1.12	1.30	1.21
FM 80% + S 20%	26.77	33.48	30.12	1.12	1.30	1.21
FM 80% + H 20%	20.57	29.37	24.97	1.14	1.33	1.24
FM 80% + Rb 20%	29.67	30.85	30.26	1.25	1.36	1.31
FM 70% + S 30%	28.97	31.17	30.07	1.15	1.25	1.20
FM 70% + H 30%	19.97	28.50	24.24	1.12	1.25	1.19
FM 70% + Rb 30%	29.76	30.46	30.11	1.18	1.33	1.26
FM 70% + S 10% + H 10% + Rb 10%	24.63	27.39	26.01	1.09	1.12	1.11
CD (P = 0.05)				0.17	0.15	

Support prices (Rs/q): Fingermillet, 210 and 210; soybean, 500 and 500; horsegram, 500 and 500; and ricebean, 480 and 480 in 1991 and 1992 respectively

followed by fingermillet + ricebean in 8 : 2 seed ratio. Similar results were obtained by Prakash and Sharma (1988).

REFERENCES

Hegde, B. R., Reddy, N. M. and Havangi, G. V. 1980. Intercropping with ragi in Karnataka. *Indian Journal of Genetics and Plant Breeding* **40** A : 130–135.

Pradhan, A. C. and Ghosh, D. C. 1988. Mixed cropping of fingermillet with blackgram and greengram. *Indian Journal of Agronomy* **33** (3) : 318–320.

Prakash, V. and Sharma, B.R. 1988. Intercropping in fingermillet: small Millets Research at VPKAS, Almora, *Technical Report*, 1–88, pp. 17–19.

Singh R. V. and Arya, M. P. S. 1988. Intercropping of fingermillet with soybean under rainfed conditions of U.P. hills. *Millets News Letter* **7** : 40.

Thaware, B. L., Birari, S. P. and Majgaonkar, S. V. 1989. Studies on fodder legumes intercrops in kharif ragi. *Annals of Agricultural Research* **10** (4) : 426–428.

Willey, R. W. 1979. Intercropping—its importance and research needs. I. competition and yield advantages. *Field Crop Abstracts* **32** : 1–10.