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Nitrogen requirement of barnyard millet (*Echinochloa frumentacea*) + pulse intercropping systems

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ABSTRACT

A field experiment was conducted during rainy seasons of 1990–92 to study nitrogen need of barnyard millet [*Echinochloa frumentacea* (L.) Link] + pulse intercropping system. Three levels of nitrogen (50, 75 and 100% of recommended dose) were tested in barnyard millet intercropped with each of horsegram [*Macrotyloma uniflorum* (Lam.) Verd.], rice bean [*Vigna umbellata* (Thumb.) Ohwi & Ohasi] and Frenchbean (*Phaseolus vulgaris* L.). The highest barnyard millet-yield equivalent (30.11 q/ha) was obtained in barnyard millet + ricebean intercropping with 75% of recommended N. The land-equivalent ratio (1.40) was also found higher in the same treatment compared with other treatments.

Barnyard millet [*Echinochloa frumentacea* (L.) Link] is generally grown mixed with different legumes. It along with soybean [*Glycine max* (L.) Merr.] is a better intercropping system (Prakash and Korane, 1987; Singh and Arya, 1988). Legume as an intercrop improves the fertilizer-use efficiency (De, 1980). However, an information on nitrogen requirement of various intercropping systems of Uttar Pradesh hills is very scanty. Hence the present study was undertaken to find out the N schedule for barnyard millet + rainy-season *(kharif)* pulses intercropping systems.

MATERIALS AND METHODS

A field experiment was conducted during rainy seasons of 1990, 1991 and 1992 at Ranichauri, Uttar Pradesh, under rainfed conditions. Thirteen treatments consisting of combination of 3 levels of N (50, 75 and 100% of recommended N) and 3 intercropping systems, viz. barnyard millet + horsegram [*Macrotyloma uniflorum* (Lam.) Verd.], barnyard millet + ricebean [*Vigna unguiculata* (L.) Walp.] and barnyard millet + Frenchbean (*Phaseolus vulgare* L.), along with pure stand of each of the 4 crops were tested in randomized block design with 3 replications.

The soil of experimental field was silty clay-loam in texture with pH 5.6 to 5.7. It was low in available N (175–190 kg/ha) and phosphorus (8.2–8.7 kg/ha), while rich in available potassium (405–114 kg/ha) during all the 3 years. Barnyard millet ('VL 8'), horsegram ('Gahet 1'), Frenchbean ('VL 163') and ricebean ('Local') were sown on 28, 20 and 17 June in 1990, 1991 and 1992 respectively. Frenchbean was harvested on 7, 8 and 1 October; barnyard millet on 15, 25 and 28 October; horsegram on 12, 1 and 6 November; and ricebean on 30, 27 and 6

November in 1990, 1991 and 1992 respectively. The experimental site was situated at 1,850 m mean sea-level on north facing. The rainfall received during 1990, 1991 and 1992 was 572.5, 711.5 and 520.6 mm respectively. The levels of N were calculated on the basis of recommendation of main crop of barnyard millet. The pure stand of each of the crops was supplied with their full requirement of fertilizer based on recommendations. Land-equivalent ratio of barnyard millet and pulse was worked out as per procedure proposed by Willey (1979). Barnyard millet-yield equivalent was calculated on the support prices of all the crops in respective years.

RESULTS AND DISCUSSION

Yield-contributing characters

Barnyard millet: Application of various levels of N had significant effect on all the yield-contributing characters of barnyard millet except 1,000-grain weight (Table 1). The maximum number of effective tillers (43.2/m) was recorded in the pure crop, which was at par with barnyard millet + ricebean and barnyard millet + Frenchbeen each at 75 and 100% recommended levels of N. Barnyard millet + Frenchbean with 100% nitrogen gave the maximum effective tillers (42/m). This was followed by barnyard millet + ricebean at 75% N level.

Pulse crops: Application of N had significant effect on yield-contributing characters of different intercrops. The maximum number of pods/plant was recorded in pure stand of horsegram, ricebean and Frenchbean with recommended fertilizer doses. However, the differences in the pure stand and intercrops were not significant. The number of pods/plant was maximum

Table 1. Effect of different treatments on yield-contributing characters in sole and intercropping systems of barnyard millet and pulses (pooled data of 3 years)

Treatment	Barnyard millet		Pods/plant (pulse)
	Effective tillers/m	1,000-grain weight (g)	
Barnyard millet pure	43.2	4.10	
Horsegram pure			19.5
Ricebean pure			17.8
Frenchbean pure			9.2
Barnyard millet + horsegram with 50% N	33.1	4.06	14.2
Barnyard millet + horsegram with 75% N	33.6	4.24	13.6
Barnyard millet + horsegram with 100% N	36.7	4.05	11.7
Barnyard millet + ricebean with 50% N	31.6	4.11	16.1
Barnyard millet + ricebean with 75% N	40.1	3.94	14.3
Barnyard millet + ricebean with 100% N	36.8	3.97	13.1
Barnyard millet + frenchbean with 50% N	32.7	3.85	10.0
Barnyard millet + frenchbean with 75% N	38.4	3.86	8.2
Barnyard millet + frenchbean with 100% N	42.0	4.00	7.4
CD (P = 0.05)	6.4	NS	3.8

Table 2. Effect of different treatments on yield and land-equivalent ratio (LER) of barnyard millet and pulse sole and intercropping systems (pooled data of 3 years)

Treatment	Grain yield (q/ha)		Barnyard millet-yield equivalent (q/ha)	LER
	Barnyard millet	Pulse		
Barnyard millet pure	16.42		16.42	1.00
Horsegram pure		7.51	25.96	1.00
Ricebean pure		9.28	31.10	1.00
Frenchbean pure		7.96	32.74	1.00
Barnyard millet + horsegram with 50% N	9.45	4.04	23.40	1.15
Barnyard millet + horsegram with 75% N	11.00	3.67	24.00	1.20
Barnyard millet + horsegram with 100% N	12.52	3.39	24.31	1.25
Barnyard millet + ricebean with 50% N	10.29	5.30	28.02	1.20
Barnyard millet + ricebean with 75% N	13.46	4.96	30.11	1.40
Barnyard millet + ricebean with 100% N	14.14	3.65	26.52	1.29
Barnyard millet + Frenchbean with 50% N	10.41	3.63	25.46	1.09
Barnyard millet + Frenchbean with 75% N	12.82	3.13	25.10	1.19
Barnyard millet + Frenchbean with 100% N	13.94	2.73	25.32	1.21
CD (P = 0.05)	3.18	1.59		

with 50% N, which was reduced with increase in N from 50 to 100%. However, the maximum number of pods/plant was recorded in pure stand of ricebean.

Grain yield

The grain yield of barnyard millet was the highest in pure stand receiving 100% N (Table 2). In intercropping system also, the highest grain yield of barnyard millet was obtained with 100% N during all the 3 years. The grain yield decreased with decease in N level from 100 to 50% in all the 3 systems. However, the grain yield recorded with 75% N level was at par with that recorded under 100% recommended N level. Yield-contributing characters recorded in 75 and 100% N application also reflected the similar trend as in grain yield.

The grain yields of intercrops, i.e. horsegram, ricebean and Frenchbean, were adversely affected by the application of different levels of N in barnyard millet (Table 2). The pure crop of horsegram, ricebean and Frenchbean gave the maximum grain yield of 7.51, 9.28 and 7.96 q/ha respectively on mean basis. Among the intercrops, ricebean recorded the highest grain yield with 50% N, followed by ricebean with 75% N.

Economic productivity

Application of N in intercropping system proved remunerative in terms of barnyard millet-yield equivalent during all the 3 years and on the mean basis (Table 2). The highest value of barnyard millet-yield equivalent was recorded in intercropping system of barnyard millet + ricebean fertilized with 75% N, which was 83.37% higher than sole crop of barnyard millet.

Land-equivalent ratio

Intercropping system of barnyard millet with different pulses was found more productive than that of sole crop of barnyard millet and of different pulses. Application of 75% N in barnyard millet + ricebean intercropping system recorded highest land-equivalent ratio. Willey (1979) observed that higher land-equivalent ratio in legume–non-legume intercropping system was mainly due to the impact of legume component. The next best treatment in this regard was barnyard millet + ricebean with 100% N.

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