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Integrated nutrient management in direct sown rainfed fingermillet (*Eleusine coracana* Gaertn.)

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Abstract: Field experiments were conducted at Tamil Nadu Agricultural University, Colmbatore during rainy seasons (July-November) of 1997 and 1998 on direct sown finger millet to study the integrated effect of inorganic fertilizers, organic manure and biofertilizers. The results revealed that application of recommended N (50% through FYM and 50% through urea) and 50% of recommended P and K (15 kg each ha^{-1}) along with seed inoculation of biofertilizer (Azospirillum and Aspergillus each @ 25 g per kg of seed) recorded higher values of yield attributes and yield. Integrated nutrient management for ragi increased the benefit : cost ratio over the farmers practice (application of complex fertilizer) by 74% and 37% in 1997 and 1998, respectively.
(Key words: Finger millet, Nutrient management, Yield, Benefit cost ratio, Economics).

Among the millets fingermillet ranks third in the country in area and production after sorghum and pearl millet. Finger millet is normally grown on poor, marginal soils and balanced nutrient management is lacking. Earlier works have revealed that finger millet responds well to application of manures like farm yard manure (Chellamuthu and Kothandaraman, 1980). The role of farm yard manure is multi dimensional ranging from building up of organic matter, maintaining favourable soil physical properties and balanced supply of nutrients (Gupta *et al.* 1983; Prihar and Sandhu, 1987). In the long term experiments conducted on alfisols it was observed that higher yield levels could be maintained when FYM and recommended fertilizers were combined and applied (Minhas and Sood, 1994). Continuous application of FYM over a period of 17 years improved the yield level significantly while in plots where NPK alone was applied, there was significant yield decline. Use of biofertilizer as a seed inoculant is also beneficial in fingermillet production (Krishne Gowda *et al.* 1997). Hence with a view to study the integrated effect of organic manures, inorganic fertilizers and biofertilizers in direct sown rainfed finger millet, the present study was undertaken.

Materials and Methods

Field experiments were conducted at Millet Breeding Station, Tamil Nadu Agricultural University, Coimbatore on a clay loam soil with a pH of 8.3 and EC of 0.38 dSm^{-1} during rainy seasons of 1997 and 1998. The soil was low in available nitrogen (166 kg ha^{-1}), medium in available phosphorus (12.3 kg ha^{-1}) and medium in available potassium (243 kg ha^{-1}). In 1997, the crop was sown on 5.8.1997 and harvested on 8.11 1997. In 1998, the crop was sown on 20.7.1998 and harvested on 9.11.1998. During the cropping period in 1997, a total rainfall of 599 mm was received in 42 rainy days and during 1998, 581 mm was received in 22 rainy days. The experiment was laid out in factorial randomised block design with three replications with the following treatments.

Nutrient sources

N_1 - Composted FYM to provide recommended N (60 kg ha^{-1})

N_2 - Recommended N (50% through FYM and 50% through urea) + P and K 50% of recommended dose (15 kg each ha^{-1})

N_3 - Recommended dose (60:30:30 kg NPK ha^{-1})

N_4 - Farmers practice (Complex fertilizers of 17:17:17 grade)

N_5 - 75% recommended NPK (45:22.5:22.5 kg NPK ha^{-1})

Biofertilizers

B_1 - Without biofertilizers

B_2 - With blofertilizers (seed inoculation of *Azospirillum* and *Aspergillus awamori* each @ 25 g kg^{-1} of seed)

Table 1. Effect of treatments on yield attributes of finger millet

Treatment	Plant height (cm)		Productive tillers plant^{-1}		Fingers plant^{-1}		Finger length (cm)	
	1997	1998	1997	1998	1997	1998	1997	1998
N_1B_1	103.1	97.2	2.8	3.1	6.3	5.7	8.6	7.6
N_2B_1	103.9	103.7	3.4	4.1	9.6	6.6	10.8	8.7
N_3B_1	104.7	98.0	3.5	3.8	9.0	6.3	9.9	8.3
N_4B_1	104.1	110.8	3.6	6.5	7.7	5.0	9.1	7.7
N_5B_1	106.8	103.1	3.7	4.0	8.0	5.6	9.7	8.6
N_1B_2	104.9	100.7	4.0	4.3	7.6	7.0	8.9	8.9
N_2B_2	110.3	96.3	5.3	6.2	11.0	9.0	11.5	11.1
N_3B_2	104.7	102.3	5.3	5.2	10.0	8.3	10.8	10.5
N_4B_2	108.4	106.9	3.3	3.5	8.6	7.7	9.7	9.6
N_5B_2	107.5	105.0	4.5	4.0	10.3	8.0	10.4	10.0
CD N	1.6	3.11	0.54	0.45	1.0	0.69	0.5	0.52
B	1.0	1.96	0.34	0.29	0.6	0.44	0.3	0.33
N x B	2.3	4.40	0.78	0.64	1.5	0.98	0.8	0.74

Table 2. Effect of INM treatments on yield and economics of finger millet

Treatment	Grain yield (kg ha^{-1})		Straw yield (kg ha^{-1})		Net returns (Rs. ha^{-1})		Benefit / cost ratio	
	1997	1998	1997	1998	1997	1998	1997	1998
N_1B_1	1044	1751	4999	3932	3023	7752	1.56	2.44
N_2B_1	2022	2448	6259	5787	10395	13267	3.02	3.58
N_3B_1	1859	2196	6118	5312	9992	12175	3.29	3.79
N_4B_1	1370	1825	5911	4273	5448	8241	2.00	2.52
N_5B_1	1733	2151	5926	4526	8573	11191	2.77	3.30
N_1B_2	1637	2671	5503	5431	7294	14510	2.36	3.69
N_2B_2	3289	3606	7118	6915	19433	21603	4.76	5.18
N_3B_2	2696	3324	6896	6455	15993	20323	4.65	5.04
N_4B_2	1941	2686	6303	5876	9521	14648	2.74	3.68
N_5B_2	2429	2979	6710	6099	13609	17327	3.79	4.55
CD N	244	267	325	578	-	-	-	-
B	155	163	207	371				
N x B	348	385	467	831				

FYM, biofertilizers and fertilizers were applied as per the treatment schedule. Entire dose of P and K was applied basally while 50% nitrogen was applied as basal and the remaining 50% in two equal splits at tillering and flowering stages. The experimental field was well ploughed, beds and channels were formed and fingermillet seeds (Variety Co 13) were dibbled in lines at 22.5 cm apart. Observations on plant height, yield attributes and yield were recorded at harvest.

Results and Discussion

In general, the yield of finger millet was high in both the years of study because of high and well distributed rainfall during the cropping season.

Application of recommended N (50% through FYM and 50% through Urea) with 50% of P and K and seed inoculation of *Azospifillum and Aspergillus awamori* (N_2B_2) had significantly greater growth and yield parameters over farmers practice (Table 1). The increased yield recorded in this treatment could be due to the addition of FYM which in turn improved the nutrient status of the soil, increased the nutrient uptake and as a result, had positive influence on crop yields (Duraisamy, 1992; Krishne Gowda *et al.* (1997). Singh *et al.* (1983) and Que *et al.* (1986) have also reported that addition of FYM and organics increased the available potassium and phosphorus status of the soil, which led to increased nutrient uptake and yield. Since grain yield was significantly higher in this treatment (3289 and 3606 kg ha^{-1} during 1997 and 1998, respectively), it also resulted in the highest net returns (Rs.19,433 and Rs.21,603, respectively in 1997 and 1998) and benefit cost ratio (4.76 and 5.18), compared to all other treatments (Table 2). Application of recommended dose of fertilizers (60:30:30 kg NPK ha^{-1}) along with biofertilizers also had significantly greater yield over other remaining treatments but inferior to N_2B_2. Thus the present study revealed that for direct sown finger millet under rainfed conditions, application of recommended N (50% through FYM and 50% through urea) and 50% of recommended P and K (15 kg each ha^{-1}) along with seed inoculation of biofertilizer (Azospirillum and Aspergillus each 25 g per kg seed) recorded significantly higher values of yield attributes and yield. The benefit : cost ratio was increased by 74% and 37% in 1997 and 1998, respectively over the farmers practice (application of complex fertilizer).

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