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Original Research Article

Biological efficiency of intercropping in finger millet (*Eleusine coracana* L. Gaertn) under rainfed condition

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A B S T R A C T

K e y w o r d s

Finger millet; intercropping; biological efficiency etc.

Field experiments were conducted at S.G College of Agriculture and Research Station, Jagdalpur (C.G.) during 2005 and 2006. Finger millet (Cv. *Ratnagiri*) was sown at 30 cm spacing in association with five intercrops viz., *Sesamum indicum* (Selection5), *Vigna mungo* (Pant U 4), *Cajnus cajan* (Asha), *Glycine max* (JS 335), *Macrotyloma uniflorum* and *Gyzoitia abyssinica* (BK 1). Finger millet + pigeon pea (4:1) recorded the significantly highest LER, LEC, and ATER during course of two years experimentation along with The highest net return of Rs 36444 and Rs 19410/ha in couple of years.

Introduction

Intercropping ensures efficient utilization of light and other resources available at crop circumstances, reduces soil erosion, suppresses weed growth, and thereby helps to maintain stability the crop yields. It also makes sure the land occupancy and thereby higher net returns. The main crop, however, should be amenable to growing additional crops in the interspaces in additive series. Although some researchers (Kalarani, 1995; Balan, 1998) have evaluated the effects of intercropping, there is still paucity of information on finger millet. In particular, information on finger millet intercropping is not available from Chhattisgarh, despite the crop is grown at recommended spacing (30 cm) in consideration to all crops taken as intercrop. An experiment was, therefore, undertaken to assess the feasibility of raising intercrops with finger millet to suit the region.

Materials and Methods

Two year field experiments were conducted at S.G College of Agriculture and Research Station, Jagdalpur (C.G.) during 2005 and 2006. The experimental site is subtropical climate with a sandy clay soil. Finger millet (Cv. *Ratnagiri*) was sown at 30 cm spacing in association with five intercrops viz., *Sesamum indicum* (Selection5), *Vigna mungo* (Pant U 4), *Cajnus cajan* (Asha), *Glycine max* (JS 335), *Macrotyloma uniflorum* and

Gyzoitia abyssinica (BK 1). The ten treatment combinations were: sole crop of finger millet, sesame, soybean, pigeonpea, blackgram and niger, intercropped in finger millet. In intercropping treatments, however, all intercrops were sown together at the distance of 30 cm as finger millet and one row of intercrops were sown after four rows of finger millet. The experiment was laid out in randomized block design with three replications. Plant size was 30 m^2. In 2005, crop were sown on 28th June whereas 20th June in 2006, and management practices were adopted as recommended for the region.

At maturity, the fresh weights of main crop and intercrops were estimated on per plot basis after uprooting the plants, besides their economic yields. The yield and biomass production values were then scaled up to as per ha basis. Net returns were also worked out to evaluate the economics of the system. Intercropping efficiency was evaluated by comparing the productivity of a given area of intercropping with that of sole crops using the competition functions described below.

Land Equivalent Ratio (LER) =Yab/Yaa + Yba/Ybb

Where, Yab and Yba are the individual crop yields in intercropping and Yaa and Ybb ar their yields as sole crop (Willey, 1979).

Land Equivalent Coefficient (LEC) = LA X LB

Where, LA = LER of main crop and LB = LER of intercrop (Adetiloye *et al*., 1983).

Area Time Equivancy Ratio (ATER) = (Rya X ta) + (Ryb X tb)/T

Where, Ry=relative yield of species "a" or "b" i.e., yield of intercropping/yield of main crop, t = duration (days) for species "a" or "b" and T = duration (days) of the intercropping system (Heibsch and McCollum, 1987).

Aggressivity (Aab) = [Yba/Ybb X Zba – Yab/Yaa X Zab]

Where, Yab and Yba are the individual crop yields in intercropping and Yaa and Ybb are their yields as sole crop. Zab and Zba proportion of land area occupied on intercropping when compared to sole crop for species "a" and "b" respectively (Mc Gilchrist. 1965).

Relative Crowding Coefficient (RCC) = Kab X Kba

Where, **Kab =Yab/Yaa-Yab** and **Kba = Yba/Ybb-Yba**

Kab and Kba are the RCC for species "a" and "b" respectively (de Wit, 1960). Finger millet yield equivalent was calculated as fallows (Prasad and Shrivastava, 1991).

Finger millet equivalent yield (Q/ha) = Yield intercrop/marketable price of finger millet Market price of intercropping

Results and Discussion

Intercropping with four row of finger millet and their interaction effects significantly influenced LER, LEC and ATER during course of two years experimentation (Table 1, 2). All treatments combined with base and intercrops except finger millet sole was greater than unity, thus indicating yield advantages for intercropped plots. In particular, finger millet + pigeon pea (4:1)

Table.1 Effect of different finger millet intercrops on PLER, LER, LEC, RCC, Aggressivity and ATER

Treatments	PLER for FM		PLER for intercrops		ATER		LER	
	2005	2006	2005	2006	2006	2006	2005	2006
Finger millet	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FM + Sesame (4:1)	1.20	1.14	0.98	2.32	1.52	1.90	1.38	1.39
	(0.95)	**(0.81)**	**(0.46)**	**(4.89)**	**(1.80)**	**(3.11)**	**(1.41)**	**(1.43)**
FM + Soybean (4:1)	1.14	1.20	0.98	0.99	2.03	1.85	1.33	2.49
	(0.80)	**(0.93)**	**(0.47)**	**(0.48)**	**(3.62)**	**(2.93)**	**(1.26)**	**(5.69)**
FM + Blackgram (4:1)	1.20	1.16	1.03	1.07	1.37	1.37	1.42	1.41
	(0.95)	**(0.85)**	**(0.55)**	**(0.64)**	**(1.38)**	**(1.39)**	**(1.50)**	**(1.49)**
FM + Horse gram (4:1)	1.16	1.09	1.06	0.87	1.63	1.56	1.40	1.20
	(0.84)	**(0.69)**	**(0.63)**	**(0.26)**	**(2.16)**	**(1.94)**	**(1.47)**	**(0.94)**
FM + Pigeon pea (4:1)	1.20	1.21	1.11	1.29	1.82	2.01	1.47	1.61
	(0.93)	**(0.96)**	**(0.74)**	**(1.17)**	**(2.81)**	**(3.54)**	**(1.67)**	**(2.11)**
Fm + Niger	1.13	1.11	0.87	0.89	1.62	1.78	1.23	1.23
	(0.79)	**(0.72)**	**(0.26)**	**(0.30)**	**(2.13)**	**(2.68)**	**(1.03)**	**(1.01)**
CD at 5 %	**0.05**	**0.06**	**0.03**	**NS**	**0.23**	**0.12**	**0.04**	**NS**

*Figures in parenthesis denote original values.

Table.2 Effect of different finger millet intercrops on LEC, RCC, Aggressivity, FYEY and ATER

Treatments	LEC		RCC		Aggressivity		FM EY	
	2005	2006	2005	2006	2005	2006	2005	2006
Finger millet	1.00	1.00	1.00	1.00	1.00	1.00	-	-
FM + Sesame (4:1)	0.97	2.16	1.37	2.85	0.72	0.77	3.79	3.30
	(0.44)	**(4.16)**	**(1.37)**	**(7.60)**	**(0.02)**	**(0.09)**	**(13.90)**	**(10.38)**
FM + Soybean (4:1)	0.93	0.98	0.84	3.23	0.77	0.68	3.37	7.94
	(0.37)	**(0.47)**	**(0.21)**	**(9.96)**	**(0.09)**	**(-0.04)**	**(10.89)**	**(62.57)**
FM + Blackgram (4:1)	1.01	1.03	2.75	2.94	0.73	0.74	4.93	5.28
	(0.52)	**(0.56)**	**(7.06)**	**(8.12)**	**(0.03)**	**(0.05)**	**(23.80)**	**(27.37)**
FM + Horse gram (4:1)	1.01	1.30	1.78	2.58	0.76	0.74	4.38	5.16
	(0.52)	**(1.18)**	**(2.67)**	**(6.17)**	**(0.07)**	**(0.05)**	**(18.69)**	**(26.16)**
FM + Pigeon pea (4:1)	1.08	0.82	1.08	2.01	0.75	0.73	3.12	4.50
	(0.68)	**(0.17)**	**(0.66)**	**(3.54)**	**(0.07)**	**(0.04)**	**(9.26)**	**(19.79)**
Fm + Niger	0.83	0.85	-1.91	0.89	0.74	0.75	6.61	4.08
	(0.19)	**(0.22)**	**(-3.15)**	**(0.28)**	**(0.04)**	**(0.06)**	**(43.15)**	**(16.12)**
CD at 5 %	**0.08**	**NS**	**NS**	**0.11**	**0.03**	**0.04**	**0.56**	**2.72**

*Figures in parenthesis denote original values.

Table.3 Total biomass, net returns and B:C ratio influenced by different intercropping systems

Treatments	Total Biomass (q/ha)		Net returns (Rs)		B:C ratio	
	2005	2006	2005	2006	2005	2006
Finger millet	-	-	-	-	-	-
FM + Sesame (4:1)	17.73	18.89	6017	8922	2.23	2.83
FM + Soybean (4:1)	20.22	21.62	17819	21384	3.97	4.58
FM + Blackgram (4:1)	19.74	21.58	13214	20680	3.41	2.40
FM + Horse gram (4:1)	18.56	22.77	4302	14835	1.86	3.99
FM + Pigeon pea (4:1)	20.57	17.64	36444	9410	6.43	4.79
Fm + Niger (4:1)	7.64	12.76	-120	870	0.97	1.19
CD at 5%	**2.15**	**2.05**	**-**	**-**	**-**	**-**

gave the highest LER of 1.67 in 2005, implying that 66% more land would be required as role crops to produce the yield obtained under intercropping situations. It was, however, statistically on par with finger millet + blackgram (4:1), during 2006, finger millet + pigeon pea (4:1) recorded the highest LER of 2.11, followed by intercropping with soybean and blackgram, albeit the differences were not significant and finger millet + niger was found in lower values of 1.33 and 1.01 i.e. no more effective advantage over sole cropping. LEC and ATER values followed a trend similar to that of LER (Table1 and 2). The finding of intercropping is similar with the work of Ofori and Stem (1987).

Positive aggressivity values (Table 2) were obtained for all treatments except finger millet + Soybean (4:1) in 2006, signifying that soybean growth was dominant over finger millet while finger millet in this combination was dominated. This may be due to the different growth habit of the associated species. In addition, the aggressivity values of finger millet + soybean (0.091) in 2005 and finger millet + sesame (0.094) in 2006 was higher, conversely, the lowest values were obtained for finger millet + sesame (0.02) and finger millet + blackgram (0.05) and horse gram (0.048) in 2006. The negative RCC values observed for finger millet + niger (-3.153) combination (Table 2) and in all combinations in intercropped treatments implies potential yield enhancement in the intercropping situations compared to that of the sole cultivation and statistically differed in same manner.

A competition of the data presented in the Table 3 also show that total biomass production, yield equivalent and net returns were significantly greater for the finger millet combined with pigeonpea in 4:1 ratio, which is consistent with general trend in competition in the finger millet + niger intercropping system was lower (7.64 and 12.76 q/ha in 2005 and 2006, respectively). This was, however, statistically at par with finger millet + horse gram (19.74 q/ha) and finger millet soybean (21.62 q/ha) and finger millet + blackgram (21.58 q/ha) in 2006.

As regards to yield levels, among the different treatments, finger millet + pigeonpea gave the highest (23.80 and 27.37 q/ha finger millet equivalent in 2005

and 2006, respectively). During both the years, the lowest finger millet equivalent yield was recorded by finger millet + niger (9.26 and 10.38 q/ha), implying the general unsuitability of niger as in intercrop in finger millet based production systems. The highest net return was also obtained from the finger millet + pigeon pea intercropping system (Rs 36444 and Rs 19410/ha in couple of years). A plausible experimentation for this better utilization of site resources and higher economic value of pigeon pea can be emphasized as a promising intercrop in finger millet based production system.

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