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EVALUATION OF PEARL MILLET AND MUNGBEAN INTERCROPPING SYSTEMS IN ARID REGION OF RAJASTHAN (INDIA)

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Abstract

A field experiment was conducted during *kharif* season, 2011 to evaluate different row ratio of pearl millet with mungbean in the arid region of Rajasthan. The treatments comprised of sole pearl millet at 45 cm spacing, one sole mungbean and ten pearl millet with mungbean treatments row in different ratio. The intercropping of pearl millet with mungbean in 1 : 7, followed by 2 : 6 and 1: 3 row ratio produced maximum pearl millet equivalent yield (PMEY), land equivalent ratio (LER), aggresivity , net returns,benefit cost (B : C) ratio and also better nutrient uptake by these treatments compared to sole and other intercropping treatments. Aggressivity values showed that inter crop mungbean did not offer any competition to pearl millet in different row ratio, while relative crowding coefficient (RCC) values indicated was a yield disadvantage in mungbean in all the intercropping system except 1: 7 row ratio.

Farmers in the arid and semi arid regions practices generally mix/intercrop pearl millet (*Pennisetum glaucum* (L.) Br. Emend Stuntz) with legumes to increase productivity per unit area or avoid risk of failure of crops as the legume crops, especially mungbean are more stable in grain yields in arid region. The spatial arrangement in intercropping has important effects on the balance of competition between component crops, productivity, economics, energetics and soil fertility status which varies with region and crop (Kumar *et al*. 2006). Information regarding geometrical requirement of intercropping that suits to the farmer's of arid region was scanty, particularly with pearlmillet. In the research work various combinations of pearlmillet and mungbean with row ratios were studied.

Field experiment on pearl millet and mungbean intercropping was conducted during *kharif* season of 2011 at Agronomy Farm, College of Agriculture, Bikaner, Rajasthan (India). The soil of the experimental site was loamy sand and having 156.33 kg/ha alkaline permanganate oxidizable N (Subbiah and Asija 1956), 16.05 kg/ha available P (Olsen *et al.* 1954), 221.0 kg/ha 1 *N* ammonium acetate exchangeable K (Stanford and English 1949) and 0.80% organic carbon (Jackson 1973). The pH of soil was 8.4 (1 : 2.5 soil and water ratio). Field capacity, permanent wilting point and bulk density recorded were 8.4.0 (w/w), 1.1.83% (w/w) and 1.66 Mg/m3, respectively in 0-30 cm soil depth. Plant to plant spacing was 10 cm in all treatments, the treatments comprised of sole pearlmillet sowing at 45 cm row to row spacing. In intercropping treatments row to row distance maintained was 30 cm and sowing was done by *"pora"* (Indigenous plough) method in open furrow on 15 July, 2011.one sole mungbean and ten pearlmillet with mungbean treatments (1 : 3, 1 : 7, 2 : 2, 2 : 6, 3 : 1, 3 : 5, 4 : 4, 5 : 3, 6 : 2 and 7 : 1 row ratio) replicated four in randomized block design (RBD). Crop received 216.9 mm of rainfall in 10 days in the growing season. 20 kg each of N and P_2O_5/ha was applied as uniform basal dose at the time of sowing. Remaining 20 kg N/ha was applied as top dressed in the pearlmillet rows only at 30 days after sowing. All the data were statistically analyzed using the F-test (Gomez and Gomez 1984).

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Table 1. Effect of different intercropping treatments on yield attributes, yield, yield indices and economics of pearl millet and mungbean

Treatment	Pearl millet					Mungbean		PMEY (kg /ha)	LER	Agg.	RCC		Total N uptake (kg /ha)	Total P uptake (kg /ha)	Cost of cultiva-tion	Net return (₹ /ha)	B:C ratio
	Effective tillers /plant (No.)	Test wt. (g)	Grain yield (kg /ha)	Stover yield (kg /ha)	Harvest index (%)	Grain yield (kg /ha)	straw yield (kg /ha)				PM	MB					
PM	2.58	8.23	1427	2990	32.30	-	-	1427	1.00	-	-	-	43.83	8.57	8548	15968	2.87
MB	-	-	-	-	-	1010	3536	3897	-	-	-	-	-	-	9683	34353	4.55
PM+MB 1:3	2.50	8.11	839	2031	29.56	661	999	3390	1.25	1.48	4.27	0.63	27.20	5.24	9428	29789	4.16
PM+MB 1:7	2.55	8.18	521	1271	29.10	911	2792	4036	1.28	1.77	3.85	1.38	16.42	3.24	9535	36380	4.81
PM+MB 2:2	2.40	8.03	1052	2443	30.30	495	682	2990	1.26	0.54	3.13	0.96	33.18	6.38	9174	26974	3.94
PM+MB 2:6	2.45	8.09	698	2073	26.24	736	1573	3538	1.23	0.98	2.87	0.90	24.52	4.79	9428	32061	4.40
PM+MB 3:1	2.40	8.08	1253	2760	31.22	249	293	2213	1.13	0.19	2.40	0.98	39.68	7.49	8919	21600	3.42
PM+MB 3:5	2.40	8.04	870	2146	28.82	614	1161	3236	1.23	0.68	2.66	0.91	28.37	5.42	9280	29268	4.16
PM+MB 4:4	2.40	7.99	937	2177	30.07	458	778	2705	1.12	0.41	1.91	0.83	29.89	5.61	9174	24848	3.71
PM+MB 5:3	2.45	7.89	1172	2781	29.53	346	490	2506	1.16	0.38	2.70	0.89	37.99	7.24	9026	24082	3.67
PM+MB 6:2	2.33	8.03	1250	2958	29.69	223	329	2110	1.10	0.29	2.35	0.85	40.52	7.69	8919	21343	3.39
PM+MB 7:1	2.28	8.00	1375	2969	31.63	110	184	1799	1.07	0.27	3.94	0.82	43.17	8.11	8792	18898	3.15
SEm ±	0.15	0.16	53	127	1.73	33	76	128	1.00	-	-	-	1.27	0.22	-	6191	-
CD (p = 0.05)	NS	NS	154	367	NS	94	218	368	-	-	-	-	3.94	0.70	-	2229	-

PM = Pearl millet, MB = Mungbean, PMEY = Pearl millet equivalent yield, LER = Land equivalent ratio, Agg. = Aggressivity, RCC = Relative crowding coefficient.

Sole pearl millet (45 cm) recorded maximum higher number of effective tillers/plant. The grain yield of sole pearl millet was significantly higher (1427 kg/ha) as compared to all other intercropping systems while remained at par with intercropping treatments of 7 : 1 row ratio. However, 7 : 1 row ratio (Table 1 (was significantly higher than all other row ratio except that of 3 : 1 and 6 : 2 row ratio treatments. Stover yield was significantly higher observed (2990 kg/ha) of sole pearl millet as compared to all other intercropping treatments which remained at par with intercropping treatments of 3 : 1, 5 : 3, 6 : 2 and 7 : 1 row ratio. Among intercropping treatments, row ratio of 7: 1 was significantly higher over all other row ratio except that of 3: 1, 5: 3 and 6: 2 row ratio treatments. The reduction in yield of pearlmillet and mungbean in the intercropping system was mainly due to reduction in plant stand of pearlmillet and mungbean in different intercropping treatments as replacement type of intercropping system was followed in the present study. These results are similar to those of Kumar *et al*. (2006) and Kuri *et al*. (2012).

The maximum and higher mean pearlmillet grain equivalent yield (4036 kg /ha) was obtained under pearlmillet with mungbean 1: 7 row ratio compared to all other intercropping treatments and it was statistically at par with sole mungbean This might be because of additional yield of pearlmillet and mungbean was recorded in 1: 7 row ratio intercropping system as 12.5 per cent plant population of pearlmillet produced 36.5 per cent of sole pearlmillet yield. Similarly 87.5 per cent plant population of mungbean recorded 90.19 per cent of sole mungbean yield in this row ratio. This was further confirmed by relative crowding coefficient value (RCC) of these row ratios (Table 1) which indicated that there was no yield disadvantage in mungbean in 1: 7 row ratio. Whereas in case of pearlmillet there is yield advantage in all intercrop combinations. Mungbean had yield advantage only in 1: 7 row ratio treatments Tetarwal and Rana (2006) also recorded similar observations. The land equivalent ratio (LER) of all intercropping treatments were higher than sole pearlmillet and there was maximum, 28 percentage in 1 : 7 row ratio treatments respectively followed by 2 : 2, 1 : 3 and 2 : 6 row ratio treatments (Table 1). This indicated that highest yield advantage of mixing of crops in these treatments. Aggressivity of the intercropping treatments have positive sign value which indicates that in pearl millet + mungbean intercropping system, mungbean did not offer any competition to pearl millet in different row ratios studied (Table 1).

The total uptake of nitrogen sole pearlmillet was significantly higher over all other intercropping treatments but remained at par with 7 : 1 and 6 : 2 row ratio. Total P uptake was obtained in sole pearlmillet was statistically at par with 7 : 1 row ratio but significantly higher than all other treatments. These results confirmed the findings of those of Tetarwal and Rana (2006) who have reported that the total uptake of N and P was significantly higher with sole pearlmillet. The total uptake of nitrogen and phosphorus recorded under sole mungbean and 1 : 7 row ratio was maximum. Singh (1992) also reported similar results. The intercropping treatment gave significantly higher net return and B:C ratio (Table 1) over sole crop obviously due to higher grain and stover/ straw yield obtained with these treatments. In pearl millet + Mungbean at 1 : 7 row ratio observed maximum net return (₹36380/ha) but statistically at par with sole mungbean (₹34353/ha), while B : C ratio observed maximum in pearl millet + mungbean at 1 : 7 row ratio. Hooda *et al*. (2004), Kuri *et al*. (2012) also reported that intercropping of pearlmillet with greengram recorded highest net return and B : C ratio over sole pearlmillet.

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