



Evaluation of pear millet (*Pennisetum glaucum*) and mothbean (*Vigna acconitifolia*) intercropping systems in hyper arid partially irrigated north-western plains zone*

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Received: 19 May 2011; Revised accepted: 21 September 2012

Key words: Intercropping, Row ratio, Yield, Indices

Farmers in the arid and semi arid regions, generally mix/intercrop pearl millet [*Pennisetum glaucum* (L.) R. Br. Emend Stuntz] with other legumes to increase productivity per unit area or avoid risk of failure of crops. As compared to pearl millet, the legume crops such as greengram, mothbean and clusterbean are more stable in their grain yields (Patel and Kalyanasundaran 1988) in arid region. Hence intercropping of legume may help in insulating the farmer's income. Among the major crops mothbean [*Vigna acconitifolia* (L.) Jacq.] is compatible with pearl millet as intercrops.

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 crops. The area of polygonal space occupied by the plant in a crop influences yield of an individual plant in a non-linear fashion (Willey 1979) and biological advantage due to intercropping may result from complementary use of growth resources, or when inter specific competition for growth resources is less than intra specific competition. Since information regarding geometrical requirement of intercropping that suits to the farmer's of arid region was scanty particularly with pearl millet. Hence various combinations of pearl millet and mothbean with row ratios were studied.

Field experiment on pearl millet and mothbean intercropping was conducted during *kharif* season of 2008 at Agronomy Farm, College of Agriculture, Bikaner, Rajasthan. The soil was loamy sand with pH 8.2, available N 78.8 kg/ha, P₂O₅ 16.3 kg/ha and K₂O 180.4 kg/ha. The

treatments comprised three sole pearl millet sowing at 30, 40 and 60 cm spacing, one sole mothbean and 11 pearl millet + mothbean treatments [1:3, 1:7, 2:2, 2:6, 3:1, 3:5, 4:4, 5:3, 6:2, 7:1 and 2:1 (check) row ratio] replicated thrice in Randomized block design (RBD). Crop received 134.4 mm of rainfall in 7 days in the growing season. In intercropping treatments row to row distance maintained was 30 cm and sowing was done by "kera" method in open furrow on 12 July 2008. 20 kg each of N and P₂O₅/ha was applied as uniform basal dose at the time of sowing. Remaining 20 kg N/ha was top dressed in the pearl millet rows only at 30 days after sowing. One life saving irrigation with sprinkler was given during dry spell. The harvesting of pearl millet and mothbean was done on 30 September 2008 and 23 September 2008 respectively.

Sole pearl millet (60 cm) recorded significantly higher number of effective tillers/plant to all other pearl millet + mothbean intercropping treatments except that of pearl millet + mothbean at 1:3 and 1:7 row ratios (Table 1). Among intercropping treatments, 1:7 row ratio gave significantly higher number of effective tillers/plant to other intercropping treatments except that of 1:3, 2:6 and 3:5 row ratios at harvest. Higher number of effective tillers in treatments with thinner pearl millet density may be due to wider space availability for better growth and development.

The grain yield (Table 1) of sole pearl millet (30 cm) was significantly higher as compared to all other intercropping systems except that of sole pearl millet at 40 and 60 cm and intercropping treatments of 7:1 and 3:1 row ratios. Among intercropping treatments, row ratio of 3:1 recorded significantly higher seed yield than all other pearl millet + mothbean row ratios except that of 5:3, 6:2, 7:1 and 2:1. However, stover yield of pearl millet under sole planting at 30 cm spacing was significantly higher than all the treatments except sole planting at 40 cm spacing. The grain and straw yields of sole mothbean was also significantly higher as compared to all other intercropping systems except row ratio of 1:7 where grain yield was at par to sole mothbean treatment.

*Short note

Based on part of M Sc thesis submitted to SKRAU, Bikaner during 2009

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Table 1 Effect of different intercropping treatments on yield attributes and yield of pearl millet and mothbean and PMEY

Treatment	Pearlmillet					Mothbean		PMEY (kg/ha)
	Effective tillers/plant (nos.)	Test weight (g)	Grain yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)	Grain yield (kg/ha)	Straw yield (kg/ha)	
PM-30 cm	1.10	8.05	1574	5 189	23.18			1 574
PM-40 cm	1.23	8.48	1438	4 535	24.16			1 438
PM-60 cm	1.65	8.92	1388	3 968	25.89			1 388
MB						692	1 857	2 029
PM+MB 1:3	1.47	8.83	540	1 590	24.81	480	1 133	1 949
PM+MB 1:7	1.58	8.91	379	1 120	25.14	653	1 471	2 294
PM+MB 2:2	1.28	8.62	940	2 839	25.17	253	603	1 682
PM+MB 2:6	1.39	8.78	561	1 737	25.18	515	1 096	2 071
PM+MB 3:1	1.26	8.34	1363	4 372	23.61	83	169	1 607
PM+MB 3:5	1.36	8.63	917	2 785	24.81	351	782	1 947
PM+MB 4:4	1.30	8.63	992	3 073	24.53	325	778	1 945
PM+MB 5:3	1.26	8.52	1213	3 576	25.41	182	379	1 746
PM+MB 6:2	1.20	8.29	1213	3 903	23.81	161	323	1 685
PM+MB 7:1	1.15	8.16	1338	4 378	23.54	57	110	1 505
PM+MB 2:1	1.26	8.43	1239	3 954	23.17	71	162	1 447
SEm +	0.08	0.32	96	259	1.22	26	75	119
CD ($P = 0.05$)	0.23	NS	279	752	NS	76	221	345

PM, Pearl millet; MB, mothbean; PMEY, pearl millet equivalent yield

However, among intercropping systems, pearl millet + mothbean 1:7 was significantly higher to over all other treatments. The reduction in yield of pearl millet and mothbean in the intercropping system was mainly due to reduction in plant stand of pearl millet and mothbean 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) who obtained the highest grain and stover yields of pearl millet in sole system compared to inter and strip cropping systems.

The maximum pearl millet grain equivalent yield (PMEY) (2 294 kg/ha) was obtained under pearl millet + mothbean at 1:7 and was statistically at par with pearl millet + mothbean at 1:3 and 2:6 row ratios and sole mothbean treatments but significantly higher than all other treatments. This might be because of additional yield of pearl millet and mothbean was recorded in 1:7 row ratio intercropping system as 12.5% plant population of pearl millet produced 24.08% of sole pearl millet yield. Similarly 87.5% plant population of mothbean recorded 94.4% of sole mothbean yield in this row ratio. This was further confirmed by relative crowding coefficient value (RCC) of these row ratios (Table 2) which indicated that there was no yield disadvantage in mothbean in 1:7 row ratio. In case of pearl millet, there is yield advantage in all intercrop combinations and higher advantage was observed in 3:5, 1:7, 3:1 and 5:3 row ratios. Tatarwal and Rana (2006) also recorded similar observations. The land equivalent ratio (LER) of 1:7, 4:4, 2:6, 3:5, 1:3 and 5:3 row ratio treatments was higher than sole pearl millet (Table 2).

This indicated that highest yield advantage of mixing of crops in these treatments. Willey (1979) and Oferi and Stern (1986) also observed that in row ratios in which intercrop (In this study mothbean) plant population was higher those row ratios always recorded higher LER values. This might be due to less competition between component crop (In this study pearl millet) and intercrop because of less shading effect on intercrop. Competition ratio also indicated (Table 2) that ratios in which lower space available to intercrop such as 3:1 and 2:1 row ratio had high competition ratio which leads to lower yield of intercrop and had lower LER values. These results are in agreement with those of Kumar *et al.* (2006). Aggressivity of the intercropping treatments have positive sign value which indicates that in pearl millet + mothbean intercropping system, mothbean did not offer any competition to pearl millet in different row ratios studied (Table 2).

In intercropping system total N uptake by pearl millet and mothbean was significantly higher in 1:7 and 4:4 row ratio over sole cropping of pearl millet and 7:1 and 2:1 row ratio but remained at par with all other treatments (Table 2). The treatments in which legume intercrop (mothbean) had higher share recorded higher total N uptake as legumes had higher N content in seed and stover. The total P uptake in 4:4 row ratio and sole pearl millet at 30 cm was significantly higher to sole mothbean and row ratio of 1:3, 1:7 and 2:6, but remained at par with other intercropping treatments. The K uptake was also significantly higher in sole pearl millet and 3:1 and 7:1 row ratio over other treatments. This may due to

Table 2 Effect of different intercropping treatments on LER, aggressivity, competition ratio, RCC, net returns and total nutrient uptake

Treatment	LER	Agg	Comp. ratio	RCC		Net returns (₹/ha)	Total N uptake (kg/ha)	Total P uptake (kg/ha)	Total K uptake (kg/ha)
				PM	MB				
PM – 30 cm						9 534	54.6	11.2	90.4
PM – 40 cm						7 967	50.0	10.1	82.0
PM – 60 cm						7 133	47.6	9.5	73.5
MB						8 484	67.6	6.5	34.7
PM+MB 1:3	1.03	0.45	1.27	1.56	0.75	9 036	63.0	8.4	50.7
PM+MB 1:7	1.18	0.85	1.78	2.22	2.39	11 349	70.6	8.6	51.2
PM+MB 2:2	0.96	0.46	1.63	1.48	0.58	8 032	58.1	9.3	62.4
PM+MB 2:6	1.10	0.43	1.44	1.66	0.97	10 062	64.2	8.6	51.6
PM+MB 3:1	0.98	0.67	2.39	2.15	0.41	8 845	58.0	10.8	83.8
PM+MB 3:5	1.09	0.74	1.91	2.32	0.62	10 009	65.2	9.8	64.5
PM+MB 4:4	1.10	0.33	1.34	1.70	0.88	10 415	70.0	11.1	68.2
PM+MB 5:3	1.03	0.53	1.76	2.01	0.59	9 171	61.0	10.3	72.3
PM+MB 6:2	1.00	0.09	1.10	1.12	0.91	9 117	60.4	10.7	75.4
PM+MB 7:1	0.93	0.32	1.47	0.80	0.63	8 174	54.9	10.4	83.1
PM+MB 2:1	0.89	0.88	3.84	1.85	0.23	7 155	51.7	9.3	74.1
SEm ±						769	4.7	0.7	6.5
CD (P=0.05)						2 229	13.6	2.1	19.1

LER, Land equivalent ratio; Agg, aggressivity; RCC, relative crowding coefficient

higher seed and stover yields of pearl millet in these treatments which increased the total uptake of nutrients while in treatments 1:3, 1:7 and 2:6 row ratios, the pearl millet yields were very low and nutrient uptake was also low. Singh (1992) also reported similar results.

Pearl millet + mothbean at 1:7, 4:4, 2:6 and 3:5 row ratio provided the higher mean net returns and B:C ratio (Table 3) and were statistically at par with each other. This may be due to better growing environment provided by these row ratios, particularly to mothbean (intercrop) which leads to higher grain/straw yield of mothbean and pearl millet which ultimately converted into better returns. However cost of cultivation was somewhat higher in mothbean and in intercropping treatments in which higher proportion of mothbean such as sole mothbean and 1:7 row ratio etc. due to higher seed price of mothbean. Hooda *et al.* (2004) also reported that intercropping of pearl millet with greengram recorded highest net return over sole pearl millet.

SUMMARY

A field experiment was conducted during *kharif* 2008 to evaluate different row ratio of pearl millet + mothbean in the arid region of Rajasthan. The treatments comprised three sole pearl millet at 30, 40 and 60 cm spacing, one sole mothbean and eleven pearl millet + mothbean treatments [1:3, 1:7, 2:2, 2:6, 3:1, 3:5, 4:4, 5:3, 6:2, 7:1 and 2:1 (check) row ratio]. The intercropping of pearl millet + mothbean in 1:7 row ratio closely followed by 4:4, 2:6 and 3:5 row ratio, produced maximum pearl millet equivalent yield (PMEY),

Table 3 Effect of different intercropping treatments on cost of cultivation, net return and B:C ratio

Treatment	Cost of cultivation	Net returns (₹/ha)	B:C ratio
PM – 30 cm	7 457	9 534	2.28
PM – 40 cm	7 349	7 967	2.08
PM – 60 cm	7 241	7 133	1.99
MB	8 589	8 484	1.99
PM+MB 1:3	8 306	9 036	2.09
PM+MB 1:7	8 447	11 349	2.34
PM+MB 2:2	8 023	8 032	2.00
PM+MB 2:6	8 306	10 062	2.21
PM+MB 3:1	7 748	8 845	2.14
PM+MB 3:5	8 164	10 009	2.23
PM+MB 4:4	8 023	10 415	2.30
PM+MB 5:3	7 881	9 171	2.16
PM+MB 6:2	7 748	9 117	2.18
PM+MB 7:1	7 598	8 174	2.08
PM+MB 2:1	7 811	7 155	1.92
SEm ±		769	
CD (P=0.05)		2 229	

LER and net returns and also better nutrient uptake by these treatments compared to sole and other intercropping treatments. Aggressivity values showed that intercrop mothbean did not offer any competition to pearl millet in different row ratio, while RCC values indicated that there was a yield disadvantage in mothbean in all the intercropping

system except 1:7 row ratio. Competition ratio indicated that row ratios such as 3:1 and 2:1 which offer less space to mothbean (intercrop) that leads to lower yield of intercrop as component crop (pearl millet) offer greater competition for mothbean in these row ratios.

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