Indian Journal of Agronomy **62** (2): 170–173 (June 2017)

Research Paper

Evaluation of intercropping systems involving pearlmillet (*Pennisetum typhoides*) and mungbean (*Vigna radiata*) as intercrop in pigeonpea (*Cajanus cajan*)

N.K. BAROD[1], SATISH KUMAR[2], A.K. DHAKA[3] AND RAJESH KATHWAL[4]

Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana 125 004

Received : May 2016; Revised accepted : June 2017

ABSTRACT

The experiment was carried out at Hisar during rainy (*kharif*) and winter (*rabi*) seasons of 2011–12 and 2012–13 for evaluation of different intercrops in pigeonpea [*Cajanus cajan* (L.) Millsp.]. Based on the investigation it was found that intercropping systems influenced the number of pods, which was maximum in pigeonpea (90 cm) + mungbean [*Vigna radiata* (L.) Wilezek] (1:1) (99.30) and number of effective tillers (25.90) and grains/spike (2368) was highest in pigeonpea 90 cm + pearlmillet [*Pennisetum glaucum* (L.) R. Br. Emend. Stuntz] (1:1) in pearlmillet. In case of mungbean, number of pods (44.96) recorded the maximum when mungbean planted one row in pigeonpea at 90 cm. Grain and biological yields were significantly the highest in sole crop i.e. pigeonpea (2.02 and 6.02 t/ha) respectively, pearlmillet (2.12 and 8.27 t/ha) respectively, and mungbean (1.36 and 5.41 t/ha) respectively. The maximum land-equivalent ratio (LER) (1.56) and land equivalent coefficient (LEC) (0.60) were recorded with pigeonpea (75 cm) + pearlmillet (1:2) during both the years. Pigeonpea planted at 75 cm spacing along with 2 rows of mungbean, resulted maximum pigeonpea equivalent yield (PEY) (2.63 t/ha) and monetary advantage index (MAI) (₹28,325/ha).

Key word : Intercropping index, Intercropping systems, Pigeonpea, Pearlmillet, Mungbean

Pigeonpea also known as *arhar, tur* or red gram is one of the most important rainy season (*kharif*) pulse crop in India. It is next to only chickpea in area and production among all the pulse crops grown in India. The cultivation of a short duration intercrop like mungbean, blackgram, pearlmillet etc. between the pigeonpea rows help in utilization of available resources without affecting its productivity. The main advantage of the intercropping is that the component crops are able to use the growth resources more efficiently (Willey, 1979).

Intercropping with short duration crops like mungbean and cereals in pigeonpea has been found remunerative (Sharma *et al.,* 1995). Mungbean being short duration crop fits well in various multiple and intercropping systems (Pujari and Sheelvantar, 2002). Pearlmillet requires more nutrients especially nitrogen for its growth but if intercropped in legume, requirement of nitrogen may be reduced up to some extent due to transfer of some of the fixed nitrogen by legumes during the growing season. In intercropping systems, selection of compatible crops with different growth pattern and their suitable planting geometries are very important because, it helps to minimize inter and intra specific competitions for resources. A lot of work has been done on nutrient management in pigeonpea, mungbean and pearlmillet crops alone. However, very less information is available on the effect of pearlmillet, mungbean intercropping in pigeonpea. Therefore, in view of the above, the present investigation was planned with the objective to find out the suitable intercrop and row ratio in pigeonpea

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Research Farm, Chaudhary Charan Singh Haryana Agricultural University, Hisar during rainy (*kharif*) seasons of 2011–12 and 2012–13. Hisar is situated at (29°10' N, 75°46' E and at an 215.2 m above mean sea-level). Soil of the experimental unit was sandy loam and the soil *p*H was 7.8, while the electric conductivity (EC) was 0.39 dS/m.

Based on a part of Ph.D. Thesis of the first author, submitted to Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana during 2016 (Unpublished)

[4]**Corresponding author's Email:** kt1977rajesh@gmail.com
[1]Ph.D. Student, Department of Agronomy, Chaudhary Charan Singh Haryana Agricultural University, Hisar 125 004; [2]Principal Scientist, [3]Scientist, [4]Assistant Scientist (Agronomy), Regional Research Station (Horticulture), Buria, District Yamunanagar, Haryana 135 003

The organic carbon of the soil was 0.41 per cent during both the years of study. Soils was slightly alkaline in reaction having poor organic matter (0.41) and low in available nitrogen (163 kg/ha), medium in available phosphorus (25 kg/ha) and high in available potassium (305 kg/ha). The experiment was laid out in randomized block design with 3 replications. The rainy season pigeonpea was sown as sole and in combinations with pearlmillet and mungbean at different spacing and rows in the 12 treatments. In the pigeonpea 'Manak', pearlmillet 'HHB 67 Improved' and mungbean 'Basanti' was sown on 17 June during 2011 and 18 June during 2012. Pigeonpea was fertilized with 20 kg N and 40 kg P_2O_5/ha. In case of intercropping system involving pearlmillet as intercrop 125 kg N/ha was applied as per proportion of area. Soil fertility status was recorded after the harvest of the main crop during both years of study.

RESULTS AND DISCUSSION

Yield attributes and yield of pigeonpea

The different intercropping systems failed to produce significant variation in number of braches per plant, number of grains and 1,000-grain weight during 2011–12 and 2012–13 (Table 1). Planting of pigeonpea at 90 cm row spacing intercropped either with pearlmillet or mungbean resulted in significantly higher values of pods/plant as compared to different intercropping systems at 75 cm row spacing of pigeonpea. This might be due to more availability of nutrients and less competition due to which translocation of available nutrients toward reproductive parts occurred, moreover, after harvesting of intercrop sufficient intra row space was left as a result competition was less. Similar result was reported by Sharma *et al*., 2012. Among the different intercropping systems, grain, straw and biological yields of pigeonpea varied significantly with the sole pigeonpea (Table 1). Pigeonpea planted as paired row (30:60 cm) produced statistically similar grain yield as compared to pigeonpea sole planted at 45 cm row spacing. Paired row sowing of pigeonpea produced 7.96% higher grain yield as compared to pigeonpea at 45 cm row spacing (Table 1). Under different intercropping systems, the higher grain yield of pigeonpea was recorded from pigeonpea (75 cm) + mungbean (1:2) system, however, it was at par with the intercropping system involving pigeonpea (75 cm) + mungbean (1:1). It might be due to synergistic effect of component crop. Similar result was obtained by Kumar *et al*., 2005 and Kumar *et al*., 2012.

Yield attributes and yield of pearlmillet

Number of effective tillers and number of grains/spike of pearlmillet was significantly influenced by intercropping treatments (Table 2). All intercropping treatments resulted in significantly higher number of effective tillers and number of grains/spike. This might be owing to more spacing between rows, which provided large space for pearlmillet with pigeonpea. Its synergetic effect was found in number of grains/spike.

Pearlmillet sole crop produced significantly higher grain, straw and biological yield as compared to different intercropping systems during 2011–12 and 2012–13. It was 22.1 and 29.6% higher as compared to pigeonpea (75 cm) + pearlmillet (1:2) and pigeonpea (90 cm) + pearlmillet (1:2). Irrespective of pigeonpea row spacing, 2 rows of intercrop produced higher grain, straw and biological yields as compared to single row, though the difference were non-significant among them during both the years (Table 2). The grain and straw yields were recorded to be significantly higher in sole system over intercropping

Table 1. Effect of intercropping systems on yield attributes and yields of pigeonpea (mean data of 2 years)

Treatment	Branches/ plant	Pods/plant	Grains/pod	1,000-grains weight (g)	Grain yield (t/ha)	Biological yield (t/ha)
PP sole (45 cm)	19.8	80.8	3.20	66.9	1.87	7.30
PP – Paired row (30: 60 cm)	20.2	79.1	3.30	68.4	2.02	6.02
PP (75 cm) + PM (1:1)	22.1	83.9	3.30	69.1	1.50	6.10
PP (75 cm) + PM (1:2)	21.3	83.1	3.25	68.0	1.47	5.97
PP (75 cm) + MB (1:1)	23.3	86.9	3.60	71.2	1.56	6.05
PP (75 cm) + MB (1:2)	22.9	84.9	3.80	75.6	1.64	6.37
PP (90 cm) + PM (1:1)	24.5	93.8	3.50	69.2	1.40	5.60
PP (90 cm) + PM (1:2)	23.3	92.9	3.45	67.9	1.35	5.37
PP (90 cm) + MB (1:1)	25.1	99.3	3.60	69.0	1.41	5.70
PP (90 cm) + MB (1:2)	23.9	96.9	3.50	70.0	1.45	5.94
SEm±	1.7	1.4	0.10	1.9	0.07	0.11
CD (P=0.05)	NS	4.0	NS	NS	0.21	0.33

PP, pigeonpea; PM, pearlmillet and MB, mungbean systems, which might be due to higher plant population of pearlmillet in sole crop as compared to intercropping systems. Lower yield of pearlmillet was recorded from other intercropping treatments because of less number of plants per hectare. Choudhary and Gautam, 2006 and Kuri *et al*., 2012 also reported similar results.

Yield attributes and yields of mungbean

The number of pods per plant was significantly higher when mungbean (1:1) was intercropped with pigeonpea at 90 cm compared to rest of the intercropping systems during 2011–12 and 2012–13 (Table 2). This may be due to more availability of nutrients and less competition, due to which more nutrients were translocated towards reproductive parts. Similar finding was reported by Sharma *et al*., 2010. Numbers of grains per pod and 1,000-grain weight of mungbean were not influenced significantly. In case of mungbean the grain, straw and biological yields were recorded maximum in sole crop, which was due to more number of plants and better yield attributes of the crop in one side and better interception of sunlight and more photosynthesis resulting into more production of photosynthates and translocation to the economic parts on the other side. Kumar *et al*., 2005, and Sharma *et al.,* 2010 also reported similar results (Table 2). The higher yield of mungbean in pigeonpea (75 cm) + mungbean (1:2) system was because of more number of rows of mungbean and reduced competition between and within crop plants due to more availability of space (Kumar *et al*., 2005).

Competitive indices

Land equivalent ratio of all intercropping systems was recorded >1, indicating the superiority of intercropping systems as compared to the sole crop of pigeonpea, pearlmillet and mungbean. Land equivalent ratio values and land equivalent coefficient were recorded higher when pearlmillet was used as an intercrop in pigeonpea (Table 3) as compared to mungbean as an intercrop. Pigeonpea equivalent yield and monetary advantage index with one or two rows at either of the row spacing *i.e.*75 cm or 90 cm of pigeonpea produced higher values of pigeonpea equivalent yield and monetary advantage index as compared to the sole pigeonpea grain yield. The maximum pigeonpea equivalent yield (2.63 t/ha) was recorded with pigeonpea (75 cm) + mungbean (1:2), which was 40.6% higher than the pigeonpea sole (45 cm). Corroborative findings were reported by Guggari and Kalaghatagi (2005) and Kumar *et al.,* (2005).

Available nutrients (N, P and K) in soil after harvest of kharif crop

After the harvest of the experimental crop in 2011–12 and 2012–13, available nitrogen in soil increased under various treatments involving sole, intercropping of grain legumes and pearlmillet except pearlmillet sole. Thus, improvement in available N recorded under various crop system involving grain legumes either in sole or intercropping systems. This might be ascribed to the fact that grain legume improve the available nitrogen content of the soil through the process of symbiotic nitrogen fixation (Heldt, 1987). Such effects were, however, not apparent in respect to P and K after the harvest of experimental crop in individual year (Table 3). Similar result was found by Kujur *et al*., 2010.

Table 2. Effect of intercropping systems on yield attributes and yields of pearlmillet and mungbean (mean data of 2 years)

Treatment	Pearlmillet					Mungbean				
	Effective tillers/m row length	Grains/ spike	1,000-grains weight (g)	Grain yield (t/ha)	Biological yield (t/ha)	Pods/ plant	Grains/ pod	1,000-grains weight (g)	Grain yield (t/ha)	Biological yield (t/ha)
PM sole (45 cm)	22.8	1704	7.64	2.10	8.27					
GGsole (30 cm)						40.9	11.1	25.61	1.36	5.41
PP (75 cm) + PM (1:1)	23.8	2081	8.95	1.57	6.01					
PP (75 cm) + PM (1:2)	22.3	1989	8.25	1.72	6.53					
PP (75 cm) + MB (1:1)						43.9	10.5	25.57	0.74	3.08
PP (75 cm) + MB (1:2)						42.3	10.7	25.18	0.90	3.71
PP (90 cm) + PM (1:1)	25.9	2368	9.30	1.46	5.51					
PP (90 cm) + PM (1:2)	23.1	2029	8.55	1.62	6.15					
PP (90 cm) + MB (1:1)						45.0	11.2	28.12	0.66	2.78
PP (90 cm) + MB (1:2)						41.5	10.7	26.07	0.82	3.24
SEm±	0.8	91	0.45	0.07	0.41	0.6	0.4	0.99	0.04	0.08
CD (P=0.05)	2.6	304	NS	0.25	1.36	1.9	NS	NS	0.14	0.26

PP, Pigeonpea; PM, pearlmillet; and MB, mungbean

Table 3. Effect of intercropping systems on land equivalent ratio, pigeonpea equivalent yield, monetary advantage index and land equivalent coefficient of pigeonpea and soil fertility status after harvesting of rainy (*kharif*) crops (mean data of 2 years)

Treatment	LER	PEY (t/ha)	MAI (× 10^3 ₹/ha)	LEC	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
PP sole (45 cm)	1	1.87	–	–	187	18.7	302
PM sole (45 cm)	1	0.66	–	–	172	14.6	297
GGsole (30 cm)	1	1.48	–	–	191	19.6	305
PP – Paired row (30: 60 cm)	1	2.02	–	–	187	17.7	302
PP (75 cm) + PM (1:1)	1.50	1.98	21.1	0.56	176	16.4	300
PP (75 cm) + PM (1:2)	1.56	2.00	22.8	0.60	174	16.3	300
PP (75 cm) + MB (1:1)	1.35	2.37	19.7	0.44	188	18.3	302
PP (75 cm) + MB (1:2)	1.51	2.63	28.3	0.56	189	18.7	303
PP (90 cm) + PM (1:1)	1.39	1.84	16.6	0.48	178	15.6	299
PP (90 cm) + PM (1:2)	1.44	1.84	18.1	0.52	177	15.6	298
PP (90 cm) + MB (1:1)	1.22	2.14	12.4	0.36	184	16.5	301
PP (90 cm) + MB (1:2)	1.35	2.35	19.4	0.45	186	16.9	302
SEm±	–	–	–	–	2.78	1.2	2.7
CD (P=0.05)	–	–	–	–	8.20	NS	NS

LER, Land equivalent ratio; PEY, pigeonpea equivalent yield; MAI, monetary advantage index; and LEC, land equivalent coefficient; PP, pigeonpea; PM, pearlmillet; and MB; mungbean

Based on the study it can be concluded that intercropping of pearlmillet and mungbean in pigeonpea irrespective of pigeonpea spacing and number of rows of intercrop was more remunerative as compared to sole pigeopea, mungbean and pearlmillet, however, pearlmillet as an intercrop in pigeonpea was more remunerative than mungbean as pegionpea at 75 cm + 2 rows of pearlmillet.

REFERENCES

Choudhary, R.S. and Gautam, R.C. 2006. Influence of cropping systems and nutrient management on nutrient uptake, protein content, yield, productivity and net returns of pearlmillet (*Pennisetum glaucum*). *Annals of Agricultural Research, New Series* **27**(4): 302–305.

Guggari, A.K. and Kalaghatagi, S.B. 2005. Effect of fertilizer and bio-fertilizer on pearlmillet (*Pennisetum glaucum*) and pigeonpea (*Cajanus cajan* L.) intercropping system under rain-fed conditions. *Indian Journal of Agronomy* **50**(1): 24–26.

Heldt, H.W. 1987. Plant biochemistry and molecular biology. Oxford University Press. pp. 277.

Kujur, S.A., Srivastava, S.G.P. and Singh, C.S. 2010. Performance of pigeonpea (*Cajanus cajan* L.) intercropping as influenced by row ratio and duration of finger millet (*Elusine coracana*) cultivars. *Indian Journal of Agronomy* **55**(3): 209–214.

Kumar, P., Rana, K.S. and Rana, D.S. 2012. Effect of planting systems and phosphorus with bio-fertilizers on the performance of sole and intercropped pigeonpea (*Cajanus cajan*) under rainfed conditions. *Indian Journal of Agronomy* **57**(2): 127–132.

Kumar, S., Singh, R.C. and Kadian, V.S. 2005. Compatibility of pigeonpea and greengram intercropping systems in relation to row ratio and row spacing. *Legume Research* **28**(3): 213–215.

Kuri, B.R., Yadav, R.S. and Kumawat, A. 2012. Evaluation of pearlmillet (*Pennisetum glaucum*) and mothbean (*Vigna acconitifolia*) intercropping systems in hyper-arid partially irrigated north-western plain zones. *Indian Journal of Agricultural Sciences* **82**(11): 993–996.

Pujari, B.T. and Sheelvantar, M.N. 2002. Dry matter accumulation in plant parts of mungbean (*Vigna radiata*) as influenced by cropping system, row proportion and mungbean population levels. *Indian Journal of Agricultural Sciences* **72**(3): 156–161.

Sharma, A., Pandit. S.R., Dharmaraj, P.S. and Chavan, M. 2012. Response of pigeonpea to bio-fertilizers in pigeonpea based intercropping systems under rainfed conditions. *Karnataka Journal ofAgricultural Sciences* **25**(3): 322–325.

Sharma, A., Rathod, P.S. and. Basavaraj, K. 2010. Agronomic management of pigeonpea *(Cajanus cajan)* based intercropping systems for improving productivity under rainfed conditions. *Karnataka Journal of Agricultural Sciences* **23**(4): 570–574.

Sharma, N.N., Sharma, D. and Paul, S.R. 1995. Intercropping of mungbean (*Vigna radiata*), blackgram (*Vigna mungo*) and sesamum *(Sesamum indicum)* and pigeonpea *(Cajanus cajan*) under different seeding methods. *Indian Journal of Agronomy* **40**(3): 386–389.

Willey, R.W. 1979. Intercropping, importance and research need competition and yield advantages. *Field Crops Research* **32**(1): 1–10.