Legume Research, 42(6) 2019: 834-837
Print ISSN:0250-5371 / Online ISSN:0976-0571

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com

Yield and Yield Attributes as Influenced by Nutrient Management Practices in Pigeonpea and Clusterbean Intercropping System

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Received: 02-12-2016 Accepted: 06-06-2018 DOI: 10.18805/LR-3841

ABSTRACT

A filed experiment was conducted at College of Agriculture Farm, Gwalior on sandy clay loam soil during *Kharif*-2012 and 2013 to study the influence of nutrient management practices in pigeonpea and clusterbean intercropping system. On the basis of two year pooled data, results revealed that sole pigeonpea and clusterbean recorded significantly higher seed and stalk yield, harvest index, number of pods/plant, test weight, protein content, protein yield, dry matter/plant. Among the intercropping treatments T_4(125% RDF to pigeonpea and no fertilizers to clusterbean) recorded significantly higher seed yield, stalk yield, harvest index, protein content, protein yield, yield attributes, pigeonpea equivalent yield and net return over other treatments except T_3 and T_5 which were onpar with T_4 treatment.

Key words: Intercropping, Nutrient management, Yield attributes.

INTRODUCTION

The main concept of intercropping is to get increased total productivity per unit area and time, besides equitable and judicious utilization of land resources and farm inputs including labour, not to mention of insurance against failure of one or the other crops could be achieved. Willey (1979) has explained the fertility relationship as a major category of agronomic studies and is necessary to maximize the yield in intercropping system provided all other production factors are taken care of. There are ample evidences to show that, the total yield can be increased with intercropping over sole cropping. The demands of these two crops complement each other in time and space. In intercropping system, structure of canopy makes better utilization of light, nutrients and water. Pigeonpea [*Cajanus cajan* (L.) Millsp.] and clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] both are leguminous crops. Thus, there can be likely advantage of enriching the soil fertility due to biological nitrogen fixation in the soil. Therefore, fertilization to component crops could reduce competition between them for nutrient to a maximum extent and allow the system to utilize the growth resources from different strata very efficiently and result in greater yield advantage. Hence,the present investigation was carried out to assess the performance of different combination of fertilizers.

MATERIALS AND METHODS

A filed experiment was conducted during *Kharif*-2012 and 2013 at Agriculture College Farm Gwalior on sandy loam soil. There were nine treatments (seven inter cropped and two sole crop treatments). The experiment was laid out in randomised block design with three replications. Pigeonpea (JKM 189) and clusterbean (HG563) were sown in 1:1 row ratio by giving a common row spacing of 45cm and a spacing of 90cm x30cm for sole pigeonpea and 45cmx20cm for sole clusterbean. In the intercropping system, 30cm was given as intra row space for pigeonpea and 20cm for clusterbean. The fertilizer application was followed on the basis of plant population occupied by each crops. The nutrients viz., nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate and muriate of potash, respectively. Recommended dose of fertilizers were applied for the sole crops of pigeonpea (20:50:20kg N, P_2O_5 and K_2O/ha, respectively) and clusterbean (20:40:20kg N, P_2O_5 and K_2O/ha, respectively). In the intercropping system, the fertilizers were applied to the component crops according to the treatment details. The entire quantities of fertilizers were applied to both the crops at the time of sowing as basal.Pods from each net plot were threshed, cleaned and the seed weight was recorded. From this, seed yield/ha was calculated. Harvest index was calculated by using the formula suggested by Donald(1962). Nitrogen content in seeds of pigeonpea and clusterbean was estimated by Kjeldahl method (Jackson, 1967). The protein per cent in the seed was calculated by multiplying the nitrogen content by a factor of 6.25.Protein yield per hectare was worked on the basis of seed protein content and seed yield of pigeonpea and clusterbean. The rainfall received 768mm during crop growth period was adequate and well distributed. The crops were harvested at their physiological maturity.

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RESULTS AND DISCUSSION

On the basis of two years pooled data, the results showed that sole crops of pigeonpea and clusterbean gave significantly higher seed yield as compared to intercropping treatments which ranged between 9.31 to 11.93 q ha^{-1} and 8.25 to 10.75 q ha^{-1}, respectively (Table 1). Among the intercropping treatments T_4(125% RDF to pigeonpea and no fertilizer to clusterbean) recorded significantly higher seed yield over T_6, T_7, T_8, T_9 in respect of both the crops. However, the seed yield obtained under T_3 and T_5 were on par with that realised with T_4 treatment. Further T_6 (100% RDP of pigeonpea to all rows of both the crops through FYM and nitrogen through inorganic fertilizer) recorded significantly lower seed yield as compared to T_8 and T_9 and was found on par with T_7 under both the crops (pigeonpea and clusterbean).

Similarly, the sole pigeonpea and clusterbean with 100% RDF (T_1 and T_2) recorded significantly higher stalk yield and harvest index as compared to intercropping treatments. Among the intercropped treatments T_4 obtained significantly higher stalk yield and harvest index over T_6, T_7, T_8 and T_9 treatments. However, the stalk yield and harvest index of pigeonpea and clusterbean recorded under T_3 and T_5, respectively were on par with that recorded under T_4 treatment. Further T_6 recorded significantly lower stalk yield and harvest index as compared to T_8 and T_9 and was found on par with T_7. The lower yield of pigeonpea and clusterbean under intercropping system may be attributed to increased plant population pressure of main and intercrop together resulting in increased competition for nutrients, water, space and light compared to their respective sole crops. Similar results of decreased intercrop yield were reported in pigeonpea and sunflower intercropping system (Vishwanath, 2009), pigeonpea and soybean intercropping system (Billore *et al*., 1993 and Paslawar *et al*., 1994). The higher seed yield in sole crops of pigeonpea and clusterbean over intercropped pigeonpea and clusterbean were due to superior yield attributing characters *Viz*., dry matter accumulation/plant number. of pods/plant, 100 seed weight which were significantly higher in sole crops of pigeonpea and clusterbean as compared to intercropping (Table 1). Similar reduction in the number of pods/plant, 100 seed weight of pigeonpea and clusterbean intercropped were reported by Prasad *et al*. (1991) and Singh and Jadhav (2003). The reduction in the yield of pigeonpea when intercropped with sesamum due to maximum reduction in the number of pods/ plant, 100 seed weight was recorded by Gupta and Rathore (1995). As regards to performance of intercropped pigeonpea and clusterbean under different combinations of fertilizer application, significantly higher seed yield of pigeonpea and clusterbean was obtained. The higher seed yield of pigeonpea and clusterbean in T_4, T_5, T_3, T_9 and T_8 over T_6 may be attributed to superior yield attributing characters of pigeonpea and clusterbean due to balanced and optimum nutrient through nutrient combination to pigeonpea which reduce the competition of clusterbean. The yield attributing characters which caused increase in yield were higher number of pods/plant and 100 seed weight under pigeonpea and clusterbean. This was due to optimum amount of nutrients being applied to the crops and subsequently higher translocation and dry matter accumulation in reproductive parts (Table1). The higher number of pods/plant and test weight in T_4, T_5, T_3, T_9 and T_8 over T_6 under both the crops. The increase in these yield attributes led to significantly higher seed yield of pigeonpea and clusterbean. Similar results were reported by Jain *et al* .(2001) and Padmavathi *et al*.(2003).

Protein content and its yield was significantly influenced due to different fertilizer treatments irrespective of sole or intercropping system (Table 2). Sole pigeonpea and clusterbean with 100% RDF (T_1&T_2) recorded significantly higher protein yield as compared to intercropped treatments (Table-2). Among the intercropped treatments, T_4 recorded significantly higher protein yield over T_6, T_7, and T_8 treatments. Treatments T_3 and T_9 recorded on par protein yield with that of T_4. The significantly lower protein yield was noticed under T_6 as compared to T_8, but it was on par with T_7. Treatment, T_6 received full dose of phosphorus in the form of organics (FYM). The organic sources are usually slow releasing and the lower quantity of phosphorus released might not have met the requirement of both the component crops, thereby creating a temporary shortage, at the peak requirement of both the crops. The shortage of vital nutrient like phosphorus might have limited the role of nitrogen resulting in reduced growth and development and ultimately caused reduced biological and economic yield.

The highest pigeonpea equivalent yield was obtainedwith 125% RDF to pigeonpea and no fertilizer to clusterbean (T_4) followed by 100% RDF to pigeonpea and 100% RDF to clusterbean (T_5) and 100% RDF to pigeonpea and no fertilizer to clusterbean (T_3) which were significantly superior over rest of the treatments and they were at par among themselves. The sole crops of pigeonpea and clusterbean gave significantly lowest pigeonpea equivalent yield as compared to intercropping. The highest net return was also obtained with application of 125% RDF to pigeonpea and no fertilizer to clusterbean (T_4) followed by T_3(100% RDF to pigeonpea and no fertilizers to clusterbean and T_5 (100% RDF to pigeonpea& 100% RDF to clusterbean). The higher pigeonpea equivalent yield was recorded in T_4, T_5 and T_3 due to better nutrient availability by way of mineralization of organic N, atmospheric N, fixation or solubilising fixed mineral forms of P and other nutrients Hegde *et al*. (2007).

Table 1 : Number of pods/plant, 100 seed weight, dry-matter/plant, seed and stalk yield as influenced by nutrient management practices in pigeonpea and clusterbean intercropping system (Pooled over two years data).

Treatment Symbol	Treatments	No. of pods per plant		100 seed weight(g)		Dry matter/plant		Seed yield (q /ha)		Stalk yield(q/ha)	
		Main crop	Inter crop	Main crop	Inter crop	Main crop	Inter crop	Main crop	Inter crop	Main crop	Inter crop
T_1	Sole pigeonpea with 100% RDF	98.60	—	12.10	—	34.65	—	14.11	—	33.54	—
T_2	Sole clusterbean with 100% RDF	—	86.41	—	12.41	—	33.43	—	13.23	—	31.63
T_3	100% RDF to pigeonpea and no fertilizer to clusterbean	87.68	76.23	10.31	11.32	29.22	28.33	11.52	10.41	27.72	25.35
T_4	125% RDF to pigeonpea and no fertilizer to clusterbean	89.56	76.62	10.62	11.74	29.65	28.72	11.93	10.75	27.95	25.66
T_5	100% RDF to pigeonpea and 100% RDF to clusterbean	85.44	83.51	10.74	11.68	29.57	28.65	11.82	10.62	27.86	25.58
T_6	100% RDP to pigeonpea to all rows of both crops through FYM and nitrogen through inorganic fertilizer	77.64	70.24	9.25	10.54	26.21	25.69	9.31	8.25	24.41	22.51
T_7	75% RDP of pigeonpea to all rows of both crops through FYM and rest of 25% RDP and N through inorganic fertilizer	79.32	74.40	9.65	10.62	27.10	26.24	9.86	8.68	24.65	22.61
T_8	50% RDP of pigeonpea to all rows of both crops through FYM and rest of 50% RDP and N through inorganic fertilizer	83.71	76.22	9.98	10.84	28.61	28.35	9.95	8.92	24.87	22.82
T_9	25% RDP of pigeonpea to all rows of both crops through FYM and rest of the 75% RDP and nitrogen through inorganic fertilizer.	84.92	76.32	10.41	11.35	28.92	28.87	10.45	9.35	25.75	23.78
	SEm±	0.51	0.43	0.15	0.13	0.52	0.48	0.24	0.21	0.38	0.33
	CD at 5%	1.53	1.29	0.45	0.38	1.55	1.44	0.73	0.62	1.14	0.99

Table 2 : Harvest index, protein content, protein yield, pigeonpea equivalent yield and net return as influenced by nutrient management practices in pigeonpea and clusterbean (1:1) inter cropping system (Pooled over two years data).

Treatments	Harvest index		Protein content (%)		Protein yield (qh^{-1})		Pigeonpea equivalent yield (qh^{-1})	Net Return (₹ 'h^{-1})
	Main crop	Inter crop	Main crop	Inter crop	Main crop	Inter crop		
T_1	0.296	—	20.52	—	2.89	—	14.11	34440
T_2	—	0.294	—	16.45	—	2.71	11.57	26305
T_3	0.293	0.291	20.44	16.22	2.35	1.68	20.62	44325
T_4	0.299	0.295	20.66	16.55	2.45	1.77	21.33	44346
T_5	0.297	0.293	20.22	16.38	2.39	1.74	21.11	42450
T_6	0.276	0.268	18.68	15.11	1.74	1.24	16.52	26115
T_7	0.285	0.277	18.95	15.22	1.86	1.32	17.45	28820
T_8	0.285	0.261	19.89	16.05	1.98	1.43	17.75	32020
T_9	0.288	0.282	20.69	15.88	2.16	1.48	18.63	32525
SEm±	0.013	0.012	0.18	0.16	0.27	0.25	0.23	—
CD at 5%	0.038	0.036	0.54	0.49	0.81	0.75	0.69	—

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