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Growth, yield and economics influenced by pigeonpea based vegetable intercrops under organic cultivation

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Abstract

The present investigation was conducted during 2021-22 at certified organic farm, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra). The soil of experimental site was medium black cotton soil, clayey in texture, medium in organic carbon, low in available nitrogen, very low in phosphorus and high in available potassium. The experiment was laid out in randomized block design (RBD) with seven treatments replicated thrice. The treatment comprise of sole pigeonpea, sole greengram, sole cowpea, sole clusterbean and pigeonpea intercropped with vegetables in 1:4 proportion. Numerically, Pigeonpea + Greengram (1:4) recorded maximum height of pigeonpea and maximum number of branches followed by Pigeonpea + Cowpea (1:4) and Pigeonpea + Clusterbean (1:4). Numerically higher pigeonpea seed yield was recorded in pigeonpea + greengram (1:4) (1052 kg ha⁻¹) intercropping system and it was followed by Pigeonpea + Cowpea (1:4) (1022 kg ha⁻¹). Significantly higher pigeonpea equivalent yield was recorded in Pigeonpea + Greengram (1:4) (2471 kg ha⁻¹) Land equivalent ratio was highest recorded in Pigeonpea + Greengram intercropping (1:4) by achieving LER (1.95).

Keywords: Intercropping, PEY, LER, economics

1. Introduction

Pigeonpea (*Cajanus cajan* L.) commonly as Redgram or Tur or Arhar is very old crop of this country. After gram, pigeonpea is the second most important pulse crop in the country. It is mainly eaten in form of split pulse as dal. Pigeonpea seed contains 23% protein, 1.7%, fats, 3.5% minerals and it is also rich in iron, iodine, essential amino acids lysine threonine etc. Intercropping with Pigeonpea has been an important practice under dryland conditions in many parts of India as it was considered as holistic farming designed to meet diverse domestic requirements. Pigeonpea is popular and widely used as intercrop under rainfed areas of Maharashtra. The initial slow growth rate and deep root system of pigeonpea offers a good scope for intercropping with fast growing early maturing and shallow rooted crops (Ramamoorthy *et al.* 2004) [6]. Pigeonpea is suitable for intercropping with different crops like cotton, sorghum, pearl millet, greengram, blackgram, maize, soybean and groundnut for increasing the system productivity and improving the soil health (Nandhini and Latha, 2016) [5]. Intercropping of pigeonpea with fast growing leguminous pulses, vegetables like cowpea, clusterbean and greengram. It will be helpful in utilization of space in between two rows of pigeonpea and vegetable crops generate a large amount of crop residues after harvesting of economic part. The embedded nutrients in the residues can be potential source of organic nutrition. This may result in increase soil fertility and also help in obtaining higher income from intercropping system. Vegetables act as a cover crops in between rows of pigeonpea also conserved moisture in soil. When pigeonpea is grown as a sole crop, it is relatively inefficient because of its slow initial growth rate and low harvest index (Willey *et al.* 1979) [8] therefore it is grown in intercropping system, which helps in efficient utilization of available resources for enhancing the productivity and profit.

2. Materials and Methods

The experiment was conducted on organically certified field at Centre for Organic Agriculture Research and Training (COART), Department of Agronomy, Dr. PDKV, Akola Maharashtra during *kharif* season of 2021-22 with the objective to study yield, growth and economics of pigeonpea, biomass addition through different intercrops and soil fertility status The experiment was laid out in randomized block design (RBD) with seven treatments replicated

thrice. The treatment comprise of sole pigeonpea, sole greengram, sole cowpea, sole clusterbean and pigeonpea intercropped with greengram, cowpea, clusterbean in 1:4 proportion. 100% RDN through vemicompost @ 2.5 t ha⁻¹ applied as basal dose @ 1.5 t ha⁻¹ and top dose @ 1 t ha⁻¹. Sowing was done last week of June and sowing of pigeonpea was done uniformly at 225 X 30cm spacing in all treatments. After harvesting of economic part of vegetable crops the residues of crops used as mulched. Application of bijamruth was done in all crops as seed treatment. Plant protection schedule was followed organically (IPM practices). Botanicals like, Neem oil, NSKE and bio-agents like *Verticillium lecani* were sprayed against the sucking pest, *Trichoderma asperellum* fungicide used against wilt disease in pigeonpea.

3. Results and Discussion

3.1. Growth attributes

Data pertaining to mean plant height of Pigeonpea recorded at 30, 60, 90, 120 DAS and at harvest and in intercrop recorded at 20, 30 and 60 DAS as influenced by different intercropping systems are presented in Table 1 mean plant height of pigeonpea at 30, 60, 90, 120 DAS and at harvest was 29.6 cm, 61.6 cm, 93.1 cm, 142.1 cm and 171.4 cm respectively.

The plant height of pigeonpea in general, under different intercropping systems was minimum at 30 DAS but increased rapidly up to At 120 DAS and thereafter the growth of crop was slow up to harvesting of crop in all the treatments. This might be due to uniform spacing in all treatments and sufficient space for growing the pigeonpea crop. Numerically, Pigeonpea + Greengram (1:4) showed maximum height of pigeonpea (30.3 cm, 62.5 cm, 95.5 cm, 144.8 cm, 174.4 cm respectively) followed by other intercropping system and Sole pigeonpea which might be due to complimentary effect of both the crops. Similar results were observed by A. Sharma *et al.* (2010) [7]

Among different intercropping system, lowest plant height of pigeonpea recorded in sole pigeonpea might be due to absence of intercropping effect.

3.2. Yield attributes, yield and growth indices

Data pertaining to seed yield per hectare in pigeonpea in Table 2 pigeonpea equivalent yield are presented in Table 4 Mean seed yield of pigeonpea per hectare as influenced by various intercropping systems was (1013 kg ha⁻¹).

From the results it was revealed that numerically higher pigeonpea seed yield was recorded in Pigeonpea + Greengram (1052 kg ha⁻¹) intercropping system and it was followed by treatments Pigeonpea + Cowpea (1022 kg ha⁻¹), Pigeonpea + Clusterbean (1004 kg ha⁻¹) in 1:4 row proportion and lowest seed yield recorded in Sole Pigeonpea (977 kg ha⁻¹). It was due to less competition of main crop pigeonpea with intercrop like greengram, Malik *et al.* (2013) [4] recorded intercropping of mungbean with pigeonpea did not show adverse effect on the

seed yield of pigeonpea also Kumawat *et al.* (2013) [2, 3] reported that pigeonpea + black gram did not affect the growth and yield attributes of pigeonpea as compared to sole pigeonpea.

Data pertaining to harvest index in pigeonpea is presented in Table 2 Mean harvest index of pigeonpea as influenced by various intercropping systems was 29.26%.

Pigeonpea equivalent yield recorded maximum in Pigeonpea + Greengram (1:4 ratio) intercropping (2471 kg ha⁻¹) among rest of the sole and intercropping treatments. While slight variation obtained in Pigeonpea + Cowpea (2265 kg ha⁻¹) intercropping. In sole treatment Sole cowpea recorded highest Pigeonpea Equivalent Yield (1864 kg /ha) it was due higher green pod yield of cowpea.

Significantly higher pigeonpea equivalent yield was recorded in treatment Pigeonpea + Greengram (1:4) (2471 kg ha⁻¹) than all other treatments. Garud *et al.* (2018) [1] recorded PEY by greengram found significantly superior over PEY by blackgram, soybean and cowpea.

Maximum value of Land Equivalent Ratio was recorded in Pigeonpea + Greengram intercropping by achieving LER of 1.95. However, its LER was followed by remaining intercropping systems i.e Pigeonpea + Cowpea and Pigeonpea + Clusterbean having the LER of 1.71 and 1.70 respectively this might be due to higher yield of pigeonpea and greengram in intercropping systems and also intercropping systems gave higher land utilization as compared to sole crops.

3.3 Economic Studies

The data pertaining to COC, GMR, NMR and B:C ratio as influenced by different intercropping systems are summarized in the Table 5

The data presented in Table 5 indicated that the higher cost of cultivation was recorded with Sole cowpea (1:4) (Rs.70261 ha⁻¹) among all the treatments. However, the minimum cost of cultivation was recorded with Sole pigeonpea (Rs.43739 ha⁻¹) intercropping system as compared to other cropping systems. Gross Monetary Returns in Rs.ha⁻¹ were significantly affected by various treatments. The Pigeonpea + Greengram (1:4) recorded significantly higher Gross Monetary returns (Rs.158181 ha⁻¹) over all other intercropping systems. Whereas, significantly lowest Gross Monetary returns was recorded under Sole pigeonpea (Rs. 63,911 ha⁻¹). The Pigeonpea + Greengram (1:4) intercropping system recorded significantly higher Net Monetary Returns (Rs.92886 ha⁻¹) over all other intercropping systems, Significantly lowest Net Monetary Returns was observed under Sole pigeonpea (Rs.20172 ha⁻¹)

Pigeonpea + Greengram (1:4) intercropping system gave maximum per rupees return (2.42) followed by Pigeonpea + Cowpea (1:4) (2.13). Minimum B:C ratio was observed under Sole Pigeonpea (1.46).

Table 1: Mean plant Height (cm) of Pigeonpea, Greengram, Cowpea and Clusterbean as influenced by various intercropping treatments

Treatments	Plant Height (cm)													
	20 DAS			30 DAS	40 DAS			60 DAS			90 DAS	120 DAS	At Harvest	
	Inter crop			Main crop	Inter crop			Main crop	Inter crop			Main crop	Main crop	Main crop
	GG	CP	CB	PP	GG	CP	CB	PP	GG	CP	CB	PP	PP	PP
T1 – PP Sole	-	-	-	28.9	-	-	-	60.6	-	-	-	91.7	139.3	168.3
T2 – GG Sole	10.2	-	-	-	32.8	-	-	-	54.6	-	-	-	-	-
T3 – CP Sole	-	11.5	-	-	-	28.0	-	-	-	42.4	-	-	-	-
T4 – CB Sole	-	-	9.89	-	-	-	22.5	-	-	-	65.7	-	-	-
T5 – PP + GG (1:4)	9.83	-	-	30.3	30.1	-	-	62.5	52.3	-	-	95.5	144.8	174.4
T6 – PP + CP (1:4)	-	10.9	-	29.9	-	27.3	-	61.9	-	40.8	-	92.9	143.3	172.5
T7 – PP + CB (1:4)	-	-	9.76	29.6	-	-	20.0	61.5	-	-	64.2	92.4	141.3	170.6
GM	10.0	11.2	9.82	29.6	31.4	27.6	20.7	61.6	53.4	41.6	64.9	93.1	142.1	171.4

Note: PP- Pigeonpea, GG- Greengram, CP- Cowpea, CB- clusterbean

Table 2: Seed yield (kg ha⁻¹), Stalk yield (kg ha⁻¹), Biological yield (kg ha⁻¹) and Harvest index (%) of Pigeonpea as influenced by intercropping treatments

Treatments	Seed yield (kg ha ⁻¹)	Stalk yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Harvest index (%)
Intercropping Systems	Main crop	Main crop	Main crop	Main crop
	PP	PP	PP	PP
T1 - PP Sole	977	2357	3334	29.33
T5 - PP+GG(1:4)	1052	2530	3582	29.41
T6 - PP+CP(1:4)	1022	2490	3512	29.21
T7 - PP+CB(1:4)	1004	2447	3450	29.10
GM	1013	2456	3469	29.26

Table 3: Green pod yield (kg ha⁻¹) of Greengram, Cowpea and Clusterbean intercropping treatments

Treatments	Green pod yield(kg ha ⁻¹)		
Intercropping Systems	Intercrop		
	GG	CP	CB
T2 - GG Sole	5106	-	-
T3 - CP Sole	-	7827	-
T4 - CB Sole	-	-	4638
T5 - PP+GG(1:4)	4469	-	-
T6 - PP+CP(1:4)	-	5219	-
T7 - PP+CB(1:4)	-	-	3184
GM	4787	6523	3911

Note: PP- Pigeonpea, GG- Greengram, CP- Cowpea, CB- Clusterbean

Table 4: Pigeonpea equivalent yield (kg ha⁻¹) and land equivalent ratio of Pigeonpea, Greengram Cowpea and Clusterbean as influenced by intercropping treatments

Treatments	PEY (kg ha ⁻¹)	LER
T1 – PP Sole	977	1.00
T2 – GG Sole	1621	1.00
T3 – CP Sole	1864	1.00
T4 – CB Sole	1472	1.00
T5 – PP + GG(1:4)	2471	1.95
T6 – PP + CP(1:4)	2265	1.71
T7 – PP + CB(1:4)	2014	1.70
SE(m)±	66.54	-
CD at 5%	205	-
GM	1812	1.33

Note: PP- Pigeonpea, GG- Greengram, CP- Cowpea, CB- Clusterbean

Table 5: Economics as influenced by pigeonpea based intercropping treatments

Treatments	COC (Rs ha-1)	GMR (Rs ha-1)	NMR (Rs ha-1)	B:C Ratio
T1 - PP Sole	43739	63911	20172	1.46
T2 – GG Sole	61024	102119	41095	1.67
T3 – CP Sole	70261	117405	47144	1.67
T4 – CB Sole	64470	92755	28285	1.44
T5 – PP + GG(1:4)	65295	158181	92886	2.42
T6 – PP + CP(1:4)	68027	145185	77158	2.13
T7 – PP + CB(1:4)	63752	129350	65598	2.03
SE(m)±	-	4222	4222	-
CD at 5%	-	13010	13010	-
GM	62367	115558	53191	1.83

Note: PP- Pigeonpea, GG- Greengram, CP- Cowpea, CB- Clusterbean

4. Conclusion

On the basis of data it could be concluded that the pigeonpea based intercropping system found to be better option in rainfed area under organic cultivation and also help to increase yield of pigeonpea and gave maximum per rupees return.

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