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Comparative performance of pigeonpea (*Cajanus cajan* (L). Millsp.) Based intercropping systems with short duration pulses and oilseed crops in gird region of Madhya Pradesh

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Abstract

The field experiment was conducted during kharif 2018 and 2019 at Research farm, RVSKVV, Gwalior, Madhya Pradesh. The 15 treatments consisted with eight sole crops i.e. pigeonpea, sesame, groundnut, soybean, greengram, blackgram, cowpea, cluster bean and seven intercropping treatments with 1:2 ratio pigeonpea + sesame, pigeonpea + groundnut, pigeonpea + soybean, pigeonpea + green gram, pigeonpea + blackgram, pigeonpea + cowpea and pigeonpea + clusterbean replicated thrice in a randomized block design. Results indicated that the grain yield of sole pigeonpea (1684 kg ha⁻¹) was significantly higher than intercropped pigeonpea (703 kg ha⁻¹). Whereas pigeonpea with groundnut resulted in maximum pigeonpea equivalent yield (1983 Kg ha⁻¹) followed by 1826 Kg ha⁻¹ with pigeonpea + cowpea intercropping system. Similarly the net returns was also maximum (82215 ₹ ha⁻¹) with pigeonpea + groundnut intercropping system.

Keywords: B:C ratio; Intercropping; Net returns; Pigeonpea; Yield

Introduction

Pigeonpea (*Cajanus cajan* (L). Millsp.) is the second important pulse crop after the chickpea and a major kharif crop in the country. More than 90% of production of pigeonpea comes from 8 states i.e. Maharashtra, Karnataka, Madhya Pradesh, Uttar Pradesh, Gujarat, Jharkhand, Telangana and Andhra Pradesh. In India the area and production of pigeonpea was 4.78 mha and 35.90 lakh tones respectively and in Madhya Pradesh it was 4.50 lakh ha and 5.80 lakh tones with the productivity of 1297 kg ha⁻¹ in 2018-19 (Anonymous, 2020) [1].

The Recommended Dietary Allowances (RDA) for adult male is 60g and for female is 55g per day but the availability of pulses is 42g/day/capita (Tiwari *et al.* 2016) [13]. To bridge this gap, there is an urgent need to increase the pulse production. Since there is limited scope for increasing pulse production by increasing area under pulses cultivation. The increasing demand can be met by increasing the productivity through adopting appropriate agronomic practices of which intercropping system is one of the best ways to increase the production in limited land area. Growing of more than one crop better utilizes resources in comparison to mono cropping system. Intercropping system helps in protecting the farmer from risks and are a good insurance option, since if one crop fails, the other may survive (Agegnehu *et al.*, 2008) [2].

Pigeonpea is a late maturing, tall growing, wide spaced crop with a deep root system which makes it suitable for intercropping system. Besides, its growth is very slow in the early stage, during which more rapidly growing short duration and short statured crops can be conveniently grown in appropriate row proportion to utilize the natural resources most efficiently in the early stages of pigeonpea. Because of its drought resistance it can be considered of utmost importance for food security in areas where rainfall is not reliable and droughts are likely to occur.

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.* 1980) [14]; therefore it is grown in intercropping system, which helps in efficient utilization of available resources for enhancing the productivity and profit.

Hence, viewing the above facts, an investigation was carried out to study the comparative performance of pigeonpea based intercropping systems with short duration pulses and oilseed crops in gird region of Madhya Pradesh.

Material and methods

A field experiment was conducted during kharif 2018 and 2019 at Research farm, RVSKVV, Gwalior, Madhya Pradesh. The soil of the experimental field was alluvial, sandy clay loam in texture. The 15 treatments consisted with sole crops i.e. pigeonpea, sesame, groundnut, soybean, greengram, blackgram, cowpea, cluster bean and seven intercropping treatments with 1:2 ratio pigeonpea + sesame, pigeonpea + groundnut, pigeonpea + soybean, pigeonpea + greengram, pigeonpea + blackgram, pigeonpea + cowpea and pigeonpea + clusterbean replicated thrice in a randomized block design, with a plot size of 5.0 m x 3.6 m. The variety of pigeonpea (ICPL 88039), sesame (TKG-308), groundnut (Mallika), soybean (RVS-2001-4), greengram (TJM-3), blackgram (Shekhar-3), cowpea (RC-101) and clusterbean (HG-2-20) were grown between two rows of pigeonpea with the spacing 45 cm x 10 cm in the first week of August, 2018 and 2019 respectively. The recommended dose of NPK for pigeonpea (20-50-20), sesame (40-30-20), groundnut and soybean (20-60-20), greengram, blackgram, cowpea and clusterbean (20-40-20) was applied but in intercropping systems base recommended dose of NPK for pigeonpea was used.

Due to short span of pulse crops like cowpea, greengram and blackgram were harvested at 75 DAS, clusterbean and oilseed crop like sesame at 90 DAS, soybean and groundnut at 120 DAS were harvested. However, the pigeonpea was harvested at 140 DAS both the years. All cultural practices were followed as per recommended procedures of each crop. The equivalent yield of pigeonpea was computed by converting the yield of intercrops to pigeonpea yield, based on their market prices.

Equivalent Yield (kg ha⁻¹) = [Seed Yield of main crop + {(Seed yield of intercrop × Price of intercrop)/(Price of main crop)}]

The data collected from the experimental site was subjected to statistical test by following 'Analysis of variance technique' and critical difference (CD) values at 5% level of probability were computed for making comparison between treatments. As per existing market prices, the input and output costs were computed treatment wise. Net returns and B:C ratio was also estimated. After statistical analysis pooled data of both the years were given in Table 1 & 2.

Results and discussion

The growth parameters viz; plant height, number of leaves, leaf area and total dry biomass of pigeonpea were significantly affected due to different intercropping systems.

The highest values of growth parameters was recorded with sole pigeonpea (Table 1). Intercropping of different pulses and oilseeds significantly decreased the growth parameters of pigeonpea. The highest reduction in growth parameters was noticed in intercropping system pigeonpea with sesame. These results were supported the findings of Rathod *et al.* (2004) [11] who recorded more plant height in sole pigeonpea. Shanmugam (2008) [12] also recorded more dry matter production in sole pigeonpea compared to intercropped pigeonpea.

The different cropping systems significantly reduced the number of pods per plant and thus yield ha⁻¹ of pigeonpea. Pods per plant was again highest in sole pigeonpea which was at par with the intercropping systems of pigeonpea with groundnut, cowpea, greengram, blackgram, cluster bean and soybean (table 1). Intercropping of pigeonpea with sesame gave statistically lowest pods per plant. Dutta *et al.* (2006) [3] and Shanmugam (2008) [12] also recorded higher pods per plant with sole pigeonpea.

The highest grain yield was recorded with sole pigeonpea (1684 kg ha⁻¹) this may be due to replacement series intercropping adopted in present investigation where sole plot have more rows of pigeonpea as compare to intercropped pigeonpea. Pigeonpea grain yield was decreased significantly with different intercropping systems. The highest reduction in yield was noticed by intercropping pigeonpea with sesame. Similar results were observed by Kumawat *et al.* (2015) [7], Kumar *et al.* (2013) [6] and Malik *et al.* (2013) [8].

The pigeonpea equivalent yield differed significantly among all the cropping systems (Table 2). Significantly highest pigeonpea equivalent yield was obtained where pigeonpea was intercropped with groundnut (1983 Kg ha⁻¹) followed by intercropped pigeonpea with cowpea (1826 Kg ha⁻¹). The higher pigeonpea equivalent yield was recorded due to higher yield of groundnut and higher market price of intercrops like cowpea and greengram etc. These results are in agreement with the findings of Jat and Ahlawat (2004) [4] and Prakash *et al.* (2000) [10] who recorded higher equivalent yield of pigeonpea by intercropped with groundnut. Koli *et al.* (2013) [5] and Pandey *et al.* (2013) [9] they also reported that intercropped pigeonpea gave significantly higher pigeonpea equivalent yield as compared to sole pigeonpea.

Among the sole and intercropping systems, pigeonpea + groundnut (82215 ₹ ha⁻¹) recorded higher net returns followed by pigeonpea intercropped with cowpea (79685 ₹ ha⁻¹). Whereas, pigeonpea+cowpea recorded higher B:C ratio (3.69) than rest of the treatments (Table 2).

Thus, it can be concluded that intercropping pigeonpea with cowpea and groundnut is more productive and profitable than other sole and intercropping systems under rainfed conditions in Gird region of Madhya Pradesh.

Table 1: Growth parameters, Yield attribute and yield of pigeonpea as influenced by different intercropping systems

	Treatments detail	Plant height (cm)	Plant dry weight (g)	Pods plant ⁻¹	Seed yield(Kg ha ⁻¹)
T ₁	sole pigeonpea	164.20	102.55	90.5	1684
T ₉	pigeonpea + Sesame	148.45	92.06	85.9	612
T ₁₀	pigeonpea + groundnut	156.97	97.67	90.4	701
T ₁₁	pigeonpea + soybean	155.70	96.96	90.2	676
T ₁₂	pigeonpea + greengram	156.37	97.59	90.3	694
T ₁₃	pigeonpea + blackgram	155.96	97.51	90.3	685
T ₁₄	pigeonpea + cowpea	156.91	97.62	90.4	703
T ₁₅	pigeonpea + Clusterbean	156.13	97.54	90.2	681
	S.Em.±	1.607	1.110	0.74	9.7
	LSD (P=0.05)	4.655	3.215	2.14	28.0

Table 2: Pigeonpea Equivalent Yield (Kg ha⁻¹), Net returns (₹ ha⁻¹) and B:C ratio of sole crops and different intercropping systems

Treatments detail		Pigeonpea Equivalent Yield (Kg ha ⁻¹)	Net returns (₹ ha ⁻¹)	B:C Ratio
T1	Sole Pigeonpea	1684	71948	3.30
T2	Sole Sesame	721	15589	1.57
T3	Sole Groundnut	1506	48873	2.14
T4	Sole Soybean	679	8264	1.25
T5	Sole Green gram	1129	38678	2.38
T6	Sole Blackgram	908	26034	1.93
T7	Sole Cowpea	1368	52982	2.83
T8	Sole Clusterbean	1015	30706	2.01
T9	Pigeonpea + Sesame (1 :2)	1114	39127	2.36
T10	Pigeonpea + Groundnut (1 :2)	1983	82215	3.14
T11	Pigeonpea + Soybean (1 :2)	1164	38972	2.20
T12	Pigeonpea + Green gram (1 :2)	1650	69528	3.37
T13	Pigeonpea + Blackgram (1 :2)	1446	57829	2.97
T14	Pigeonpea + Cowpea (1 :2)	1826	79685	3.69
T15	Pigeonpea + Clusterbean (1 :2)	1416	54994	2.79
S.Em.±		8.1	10.4	0.067
LSD (P=0.05)		22.9	29.4	0.190

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