Productivity and economic feasibility of pigeonpea base companion cropping under additive series planting system.

Abstract

An experiment was carried out during two consecutive *Kharif* seasons of 2016-2017 and 2017-18 at Soil Conservation and Water Management Farm, C.S. Azad University of Agriculture and Technology, Kanpur. The main objective was to work out the yields of main crop of pigeonpea, black gram and sesame and their economic in term of net profit. The soil of the experimental field was sandy loam, having pH 7.8, organic carbon 0.32%, available P_2O_5 17.3 kg/ha and available K_2O 181.2 kg/ha therefore, the fertility status was medium. The five treatments of companion cropping i.e. pigeonpea sole, black sole, sesame sole, pigeonpea + black gram (1+1) additive series and pigeonpea + sesame (1+1) additive series. The total productivity of pigeon pea + black gram was highest (23.53 q/ha) in comparison to pigeonpea + sesame (20.30 q/ha) and pigeonpea alone (17.34 q/ha). The pooled data display that maximum cost of cultivation Rs. 57876.00/ha observed under pigeonpea + black gram companion cropping followed by pigeonpea + sesame (Rs. 56191/ha). The highest gross return Rs. 134024/ha, net return Rs. 76148/ha and BCR 1:2.32 were also observed with pigeonpea + black gram (1+1) additive series followed by pigeonpea + sesame (1+1) additive series, while pigeonpea alone gave net return Rs. 50387/ha and BCR 1:2.01.

Keywords: BCR, Companion cropping, Net income, Pigeonpea base, Pooled data.

Introduction

Pigeonpea (*Cajanus cajan* L.) is an important grain legume crop of the semi-arid tropics cropping, about the area and production with 35% and 29% world, respectively available in this tract. Further, pigeonpea occupied second position after chickpea and contributed 4.2 mt. from an area of 4.43 mt. with average productivity of 960 kg/ha. In Uttar Pradesh, pigeonpea covered 2.85 lakh hectares and total production is 2.72 lakh tones during 2020 (Anonymous, 2021). Pigeonpea grown as single crop display in efficient utilization of resources especially the space because of its slow initial growth rate, therefore, cultivation of pigeonpea as a sale crop is reported less profitable due to higher

Comment [A1]: Over two consecutive Kharif seasons in 2016-2017 and 2017-18, a study was conducted at the Soil Conservation and Water Management Farm of C.S. Azad University of Agriculture and Technology in Kanpur. The study aimed to determine the yields and economic benefits (in terms of net profit) of the primary crops: pigeonpea, black gram, and sesame. The experimental field's soil was classified as sandy loam with a pH of 7.8, containing 0.32% organic carbon, 17.3 kg/ha of available P2O5, and 181.2 kg/ha of available K2O, indicating a medium fertility level. The experiment included five different cropping treatments: sole pigeonpea, sole black gram, sole sesame, a combination of pigeonpea and black gram (1+1) in an additive series, and a combination of pigeonpea and sesame (1+1) in an additive series. The combined cultivation of pigeon pea and black gram yielded the highest productivity at 23.53 quintals per hectare (q/ha), outperforming the pigeonpea and sesame combination at 20.30 q/ha and sole pigeonpea at 17.34 q/ha. The analysis of aggregated data revealed that the highest cultivation cost was Rs. 57,876.00 per hectare for pigeonpea and black gram, followed by pigeonpea and sesame at Rs. 56,191 per hectare. The greatest gross returns were observed with the pigeonpea and black gram combination at Rs. 134,024 per hectare, with a net return of Rs. 76,148 and a benefit-cost ratio (BCR) of 1:2.32. This was followed by the pigeonpea and sesame combination, whereas sole pigeonpea cultivation resulted in a net return of Rs. 50,387 and a BCR of 1:2.01.

duration and wider spacing (Sekhon *et al.* 2018). To make the cultivation of pigeonpea more viable, it is necessary to utilize the inter row space through companion cropping. Intercropping with short duration pulse like black gram, green gram, pearl millet like finger millet, foxtail millet in pigeonpea may enhance total productivity and may also provide early cash flow.Companion cropping also suppress the weed growth in between two rows of pigeonpea. Efficient of resource utilization can be increased by companion cropping and it also help in harnessing benefits of positive interaction in crop association. Growing a intercrop which produces the maximum cover, reduces soil loss, black gram is important cover crop for rainy season. The crop gives early and dense ground cover, which generally co-incidence with peak rate of runoff.

In areas where the annual rainfall is in the range of 600-850 mm companion cropping is being recommended and practiced. The different intercropping systems including sesame or oilseeds are followed in different parts of country. Sesame and pulse crop like black gram which are drought resistant and have a capacity to low level management conditions may be ideal combination for sustainable cropping system (Yadav *et al.,* 2013). Companion cropping is practiced as an insurance of crop failure under rainfed condition. The main objective is higher productivity per unit area in addition to stability in production. Companion cropping system utilizes resource efficiency and their productivity is increased.

The economic resources of rainfed area are the national treasure and need proper planning to make best use of them. Therefore, sustainable management practices are urgently needed all over the world to preserve the production potential of agricultural land. Efficient management and maintenance of soil health is the being to accomplish sustainable high productivity, food security and environment safety (Kumar *et al.,* 2017).

Therefore, productivity and profitability increases through companion cropping system is the subject matter of this manuscript.

Materials and Methods

An experiment was conducted under rainfed condition during two consecutive Kharif seasons of 2016-17 and 2017-18 at Soil Conservation and Water Management Farm, C.S. Azad University of Agriculture and Technology,

Kanpur. The five treatments were tested i.e., pigeonpea sole planted at 60 cm apart, black gram sole planted at 30 cm apart, sesame sole planted at 30 cm apart, pigeonpea + black gram (1+1) planted under additive series and pigeonpea + sesame (1+1) planted under additive series. The main crop was pigeonpea, while black gram and sesame were planted in the inter spaces of two rows of pigeonpea. The soil of experimental site was a typic eroded Gangetic alluvial representing Kanpur Type-1. The soil was sandy loam, having pH 7.7, organic carbon 0.33%, available N 172.00 kg/ha, available P_2O_5 17.50 kg/ha and available K_2O 183.00 kg/ha, therefore fertility status of plant nutrients was medium. The pH was determined by Electrometric glass electrode method as discussed by Piper (1966). The organic matter was analyzed by Walkley and Black's rapid titration method (Walkley and Black, 1934). The available P_2O_5 and available K_2O were analyzed by Olsen's method and Flame photometric method, respectively, (Muhr *et al.,* 1963). The available N was analyzed by Kjeldahl's method as suggested by Subhiah and Asija (1956). The cultivar Amar (KA-32-1) of pigeonpea, cv. Shekhar-2 (KU-300) of black gram and cv. Shekhar (SH-446) of sesame were shown under intercropping. The sole crops of pigeonpea and black gram were fertilized with 20 kg N + 40 kg P_2O_5/ha, while sole and intercropped sesame were fertilized with 40 kg N + 20 kg P_2O_5 + 20 kg K_2O/ha. The recommended methods of fertilizer application were applied for obtaining better response. The recommended conservation agronomical practices were followed for raising of experimental crops during two experimental seasons. The harvesting of crops was made at complete maturity stage. The treatments were replicated thrice in a split plot design. The obtained data analyzed by standard method as suggested by Cochran and Cox (1963). The economics computed and pooled to draw valid conclusion from the study, is the subject matter of this study.

Results and Discussion

The pooled data on seed yield of main and intercrops and economic studies are presented in Table-1 and discussed here under appropriate heads.

(A) **Total productivity:**Purusal of data available in Table1 make it clear that the highest total productivity was weighed under pigeonpea + black gram intercropping system by 23.53 q/ha, followed by inter cropping of

Comment [A2]: The aggregated data on seed yield for both the main crops and intercrops, along with the economic analysis, are shown in Table-1 and will be discussed below under relevant sections.

pigeonpea + sesame 20.30 q/ha. The order of performance of alone cropping system was pigeonpea alone (17.34 q/ha) >black gram alone (9.44 q/ha) and > sesame alone (6.32 q/ha).

(B) **Economic Study:** The maximum cost of cultivation was observed under pigeonpea + black gram (1+1) additive intercropping by Rs. 57876/ha. It might be attributed to total population adjustment under both component crops of the system and their total input requirements. The highest gross return (Rs. 134024/ha), net return (Rs. 76148/ha) and BCR (1:2.32) were observed under pigeonpea + black gram intercropping followed by pigeonpea + sesame (1+1) additive intercropping. It may due to higher total productivity of the planting system. These results are similar, with the findings of Reddy *et al.* (2007), Dudhade*et al.* (2009), Sharma *et al.* (2012) and Kumawat *et al.* (2013).

Conclusion and recommendation

Since, the cropping system of pigeonpea + black gram gave net return by Rs. 76148/ha and pigeonpea + sesame gave net profit by Rs. 54862/ha, therefore, farm families residing in the vicinity of rainfed area may be advocated for adoption of intercropping of pigeonpea + black gram and pigeonpea + sesame for higher total productivity and profitability and harvest the fruits of newly generated technology.

Comment [A3]: Given that the intercropping of pigeonpea with black gram yielded a net return of Rs. 76,148 per hectare and pigeonpea with sesame produced a net profit of Rs. 54,862 per hectare,

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Table-1: Yield and Economy of pigeonpea and intercrops under different treatments.(Pooled data of two years)

S.N.	Cropping system	Yield (q/ha)			Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	BCR
		Main crop	Inter crop	Total productivity				
1.	Pigeonpea alone	17.34	-	17.34	49861	100248	50387	2.01
2.	Black gram alone	09.44	-	09.44	32966	51025	18059	1.54
3.	Sesame alone	06.32	-	06.32	31561	34056	2495	1.07
4.	Pigeonpea + black gram (1+1) a.s.	19.34	4.19	23.53	57876	134024	76148	2.32
5.	Pigeonpea + sesame (1+1) a.s.	16.61	3.69	20.30	56191	116053	54862	2.07

Comment [A4]: Yield and Economic Outcomes of Pigeonpea and Intercropping Systems Across Various Treatments (Aggregated Over Two Years)