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Shilpa Kaushik
SMS, Department of Agronomy,
Krishi Vigyan Kendra,
Sarkanda, Bilaspur,
Chhattisgarh, India

Corresponding Author:
Shilpa Kaushik
SMS, Department of Agronomy,
Krishi Vigyan Kendra,
Sarkanda, Bilaspur,
Chhattisgarh, India

Effect of planting geometry, nutrient management and detopping on productivity and profitability of kharif pigeonpea (*Cajanus cajan* L. Millsp.) on economics

Shilpa Kaushik

Abstract
The field experiment of the present study was conducted at the farm of BTC College of Agriculture And Research Station, Bilaspur, under Agronomy Department, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) in years 2019-20 and 2020-21. The experiment was conducted in split plot design in *kharif* crop and split-split design in *rabi* ratoon crop with 03 replications. Nine treatments were allocatedin main *kharif* crop and 36 treatments were allocated in ratoon crop. There were two factors taken in main crop *i.e.* Main plot: planting geometry (P) and Sub-plot: nutrient management (N) whereas, three factors for ratoon crop *i.e.* Main plot: planting geometry (P), Sub-plot: nutrient management (N) and Sub-sub-plot: cutting management and foliar spray (CF). Among the different planting geometry in *kharif* pigeonpea, Significane the highest gross return, net returns and benefit: cost was found under P1 (60 cm x 15 cm), while the lowest economics were found under P3 (120 cm x15 cm). Among different nutrient management practices, significantly the highest gross return was found under N3 (125% of RDF) which remained at par with N2 (100% of RDF) during both the years and in mean respectively. However other economic parameters like net returns and B:C ratio were found non- significant among the treatments. Numerically, higher net returns and benefit: cost were found under N3 (125% of RDF).

Keywords: Pigeonpea, economics and benefit, cost ratio

Introduction
Pigeonpea (*Cajanus cajan* L.) is an important multi-use shrub legume of the tropics and subtropics. The crop originated from India and moved to Africa about 4,000 years ago. Unlike other grain legumes, pigeonpea production is concentrated in developing countries, particularly in a few South and Southeast Asia and Eastern and Southern African countries. It is the preferred pulse crop in dryland areas where it is intercropped or grown in mixed cropping systems with cereals or other short duration annuals (Ecocrop, 2016; van der Maesen, 1989) [10, 13].

Pulses form an integral part of vegetarian diet in Indian subcontinent. In India, pulses have been cultivated since time immemorial under rainfed situations which is characterized by poor soil fertility and moisture stress. These crops are energy rich but cultivated largely under energy starving situations. Unlike in cereals, varietal breakthrough in pulses has not been taken place. In India total pulse occupies 4.80 m ha area and contributes 4.32 m tonnes production with an average productivity of 900 kg ha^{-1} (Anonymous, 2021) [7]. During the last four decades, the total area under pulses remained virtually stagnant (1 to 1.2 million ha) with almost stable production (4 to 9 million tonnes), even though the population has been increased. As a result, per capita availability of pulses has been declined from 60.7 g per day in 1951-52 to 40 g per day (Indiastat, 2020) [11] as against FAO/WHO's recommendation of 80 g per day. It has led to the severe shortage of pulses in India, which has aggravated the problem of malnutrition in large section of vegetarian population.

India has a virtual monopoly in pigeon pea production by accounting 90 per cent of world's total production. Pigeon pea is one of the protein rich legume crops of semi-arid and sub-tropics and domestic requirement. This crop has the privilege of occupying the first place both in area and production among *kharif* grown legumes. Although pigeon pea ranks sixth in area and production in the world in comparison to other grain legumes such as beans, peas and

chickpeas, it is used in more diverse ways than others (Nene and Sheila, 1990) [12].

At the global level in 2019 total area, production and productivity of pigeon pea is around 93.54 million ha, 92.13 million tonnes and 994 kg ha^{-1}, respectively, (Anonymous 2019a) [1]. India stands first position in production of pigeon pea in the world.

Results and Discussion

Economics

Economics is the most important aspect of any research upon which the recommendation depends and tests the feasibility of the technology. Until and unless a farmer is well convinced about a purposeful gain from a particular package of practices, he would not be willing to adopt the same. It was, therefore, thought pertinent to undertake the studies on economic aspect of the present investigation. The data pertaining to cost of cultivation (Rs. ha^{-1}), gross return (Rs. ha^{-1}), net return (Rs. ha^{-1}) and B: C ratio as affected by different treatments have been calculated, summarized and presented in following Table no. 1 a, b, c &d.

Effect of planting geometry: Among different planting geometry in kharif pigeonpea, significantly highest gross return (Rs 98946 ha^{-1}, Rs 121001 ha^{-1} and Rs 109974 ha^{-1} in 2019-20, 2020-21 and in mean respectively), net returns (Rs 69686 ha^{-1}, Rs 90296 ha^{-1} and Rs 79991 ha^{-1} in 2019-20, 2020-21 and in mean respectively) and benefit: cost ratio (2.38, 2.94 and 2.66 in 2019-20, 2020-21 and in mean respectively) were found under P1 (60 cm x15 cm).

The lowest gross return (Rs 75826 ha^{-1}, Rs 92123 ha^{-1} and Rs 83975 ha^{-1} in 2019-20, 2020-21 and in mean respectively), net returns (Rs 47567 ha^{-1}, Rs 62517 ha^{-1} and Rs 55042 ha^{-1} in 2019-20, 2020-21 and in mean respectively) and benefit: cost ratio (1.68, 2.11 and 1.89 in 2019-20, 2020-21 and in mean respectively) were found under P3 (120 cm x 15 cm).

Effect of nutrient management

Among different nutrient management practices, gross return was found to be significant among the treatments. Higher gross return (Rs 90773 ha^{-1}, Rs 111348 ha^{-1} and Rs 101061 ha^{-1} in 2019-20, 2020-21 and in mean respectively) was found under N3 (125% of RDF) which remained at par with N2 (100% of RDF) during both the years and in mean respectively. However other economic parameters like net returns and B: C ratio were found non-significant among the treatments. Numerically, higher net returns (Rs 61255ha^{-1}, Rs 80358 ha^{-1}and Rs 70806 ha^{-1} in 2019-20, 2020-21 and in mean respectively) and benefit: cost ratio (2.07, 2.59 and 2.33 in 2019-20, 2020-21 and in mean respectively) were found under N3 (125% of RDF).

Summary and Conclusion

Significantly the highest gross return, net returns and benefit: cost was found under P1 (60 cm x15 cm), while the lowest economics were found under P3 (120 cm x15cm). Among different nutrient management practices, significantly the highest gross return was found under N3 (125% of RDF) which remained at par with N2 (100% of RDF) during both the years and in mean respectively. However other economic parameters like net returns and B: C ratio were found non-significant among the treatments. Numerically, higher net returns and benefit: cost were found under N3 (125% of RDF).

Table 1a: Effect of planting geometry and nutrient management on economics of pigeon pea during kharif season

Treatment	Cost of Cultivation (Rs ha-1)		Gross Returns (Rs ha-1)			Net Returns (Rs ha-1)			B:C		
	2019-20	2020-21	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean
Planting geometry											
P1-60 cm x 15 cm	29260	30706	98946	121001	109974	69686	90296	79991	2.38	2.94	2.66
P2-90 cm x 15 cm	28326	29679	88090	108411	98251	59764	78732	69248	2.12	2.66	2.39
P3-120 cm x 15 cm	28260	29606	75826	92123	83975	47567	62517	55042	1.68	2.11	1.89
Nutrient Management											
N1-75 % RDF	27600	28880	84180	102555	93367	56580	73675	65127	2.05	2.55	2.30
N2-100% RDF	28727	30119	87909	107633	97771	59182	77513	68348	2.06	2.57	2.31
N3-125% RDF	29519	30991	90773	111348	101061	61255	80358	70806	2.07	2.59	2.33

Table 1b): Two-way mean table of net returns of kharif pigeonpea in 2019-20

	N1	N2	N3
P1	64, 683	70, 468	73, 908
P2	63, 523	59, 660	56, 108
P3	41, 533	47, 419	53, 748

Table 1c): Two-way mean table of net returns of kharif pigeonpea in 2020-21

	N1	N2	N3
P1	85,120	90,139	95,628
P2	83,752	78,261	74,184
P3	52,151	64,140	71,261

Table 1d): Two-way mean table of net returns of kharif pigeonpea in mean

	N1	N2	N3
P1	74,902	80,304	84,768
P2	73,638	68,961	65,146
P3	46,842	55,780	62,505

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