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Evaluation of Pigeonpea + Pearl millet intercropping system

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Abstract
The field trial was carried out in the Kharif season of 2017 at the College of Agriculture's Experimental Farm, Agronomy Section, Parbhani (Maharashtra) to access performance of pigeonpea + pearl millet intercropping system under different row proportion and planting geometry. Among all the treatment the planting geometry of the sole treatments T_7 recorded higher yield and T_8 of pigeonpea and pearl millet was examined; the measurements were 90 cm x 20 cm and 45 cm × 15 cm, respectively. The sole pigeonpea (T_7) and sole pearl millet (T_8) treatments of the pigeonpea + pearl millet intercropping system yield the highest growth attributes. The investigation found that the Gross monetary return (119.492 × $10^{3`}$ ha$^{-1}$), net monetary return (85.916 × $10^{3`}$ ha^{-1}) and B: C (3.55) ratio were higher under sole pigeonpea with closer planting geometry (90 cm x 20 cm). Hence, it was suitable plant population and appropriate crop geometry.

Keywords: Pigeonpea, pearlmillet, intercropping, GMR, NMR, B:C ratio

Introduction

Farmers with limited resources frequently intercrop because it can increase yields over a single crop. By providing some yield even in the event that part of the component crops fail it lowers the chance of crop failure and ensures greater output stability. Intercropping has been demonstrated to give greater and more consistent yields in a variety of component combinations, despite some contradicting findings. By exploiting natural resources more effectively, intercropping raises returns and yields more per unit of land. Pigeonpea can be knitted into many cropping systems, *viz*., intercropping, mixed cropping and sequential cropping etc.

The dietary staple pigeonpea plays a significant role in our daily diets since it provides 19–23% protein, 1-2 percent fat, 45–55 percent carbs, 1–5% fibre, 3-5 percent soluble sugars, 1.5 percent water, and 16–18% energy (Lawn & Troedson, 1990) [2]. Pigeonpeas are suitable for a variety of cropping schemes, including sequential, mixed, and intercropping. It is a crop that is ideal for intercropping systems because of its deep roots system, initial slow growth, resistance to drought, and low soil moisture content. It is intercropped with many short duration legumes, cereals and commercial crops, With the complementary effect of pigeonpea on soil fertility, improvement, nutrient recycling, smothering of weeds and efficient utilization of soil moisture under different cropping systems it occupies more area in cropping systems than as a sole crop.

Among the pulses Rainfed conditions are the primary means of cultivation for the pigeon pea (*Cajanus cajan* L.), one of the principal grain legume crops of tropical and subtropical regions. As a soil ameliorant, pigeon peas are recognised to offer a number of advantages to the soil in which they are planted. Pigeon peas are generally inefficient when grown as a solitary crop due to their slow initial growth rate and low harvest index (Willey *et al*., 1980) [8]. As a result, they are produced as intercrops, which aid in the efficient use of available resources to increase productivity and profit. Pigeon pea is good for enhancing productivity and preserving soil fertility in a variety of crops, including cotton, sorghum, pearl millet, greengram, maize, soybean, and groundnuts. Intercropping pigeon peas with fast-growing, early-maturing, shallow-rooted crops is an excellent idea because of their deep roots and initially slow growth rate. (Ramamoorthy *et al*., 2004) [5].

Over a short period of time, short-duration intercrops of cereals, pulses, and oilseed crops have proven sustainable in terms of yield and revenue in a variety of rainfed agro ecologies in India. (Rao & associates, 2003) [6].

Under a range of biophysical (soil and rainfall types) and socioeconomic circumstances, pigeonpeas are grown in the Maharashtra shortage zone during the kharif season. In shallow to medium black soils, where abiotic factors often result in unsustainable yields and income, they are particularly vulnerable to in-season dryness.

It is thought that the Sahel region of West Africa, which stretches from Senegal to western Sudan, is where pearl millet first appeared. These days, it is widely grown all over the world. Pearl millet is a crop with two uses. Its grain is consumed by humans, while its straw is fed to cattle. The protein content of pearl millet grains ranges from 11.31 to 19.32%, making them relatively more nutritious than other cereal grains. Pearl millets survives in rainfed areas because of its drought escaping mechanism but still responds in well to all inputs. Pearl millet is consider as an ideal crop as an intercropping owing to comparative tolerance for drought.

Materials and Methods

"Studies on pigeonpea (*Cajanus cajan* L.) + pearl millet (*Pennisetum glaucum*. L) Intercropping system" is the name of the agronomic study that was carried out in the Department of Agronomy's Experimental Farm at Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani (M.S.) India during Kharif 2017. The experimental field was level and had sufficient drainage. The soil was clay-textured, with an alkaline pH of 8.2, was medium in phosphorus, high in potassium, and poor in nitrogen. 42 wet days throughout the crop-growing season brought in a total of 995.01 mm of rainfall during the trial. The environmental conditions were favourable for the intercropping systems of Bajra and pigeon pea to grow and mature normally during the study period.

A randomised block design (RBD) was used to set up the experiment. In total, there were eight treatments: two sole cropping treatments of pearl millet and pigeonpea at the suggested spacing of the corresponding crops added, together with three rows of pigeonpea spaced with two intra-row spacings. The pigeonpea + pearl millet intercropping system was tested with row proportions of 1:1, 1:1, 1:1, 1:1, 1:2, and 1:2 in planting geometries of 90 cm x 30 cm, 90 cm x 45 cm, 120 cm x 30 cm, 150 cm x 30 cm, and 150 cm x 45 cm, respectively. The planting geometries of sole treatments T_7 and T_8 of pearl millet and pigeonpea, which measured 90 cm × 20 cm and 45 cm × 15 cm, respectively, were examined. Pearl millet was spaced differently across rows and within rows in the intercropping treatments: 45 cm x 15 cm for T_1 and T_2, 60 cm x 15 cm for T_3 and T_4, and 50 cm x 15 cm for T_5 and T_6. On June 29, 2017, the dabbling method of sowing was used. Timely implementation of the suggested cultural practices and preventive plant protection measures was observed.

Results and Discussion

Dada on economic studies pertaining to cost of cultivation (x $10^{3`}$ ha$^{-1}$), mean gross monetary return (GMR) (x $10^{3`}$ ha^{-1}), mean net monetary return (NMR) (x $10^{3`}$ ha^{-1}) and mean benefit: cost ratio (B: C ratio) of pigeonpea + pearl millet intercropping production system shown in table 1.

Performance of intercropping system

Data on cost of cultivation (x $10^{3`}$ ha$^{-1}$), mean gross monetary return (GMR) (x $10^{3`}$ ha^{-1}), mean net monetary return (NMR) (x $10^{3`}$ ha^{-1}) and mean benefit: cost ratio (B: C ratio) of pigeonpea + pearl millet intercropping production system recorded at various stages of crop growth are presented in Table 1 and graphically depicted in Fig 1.

Data presented in Table 1 indicated that the cost of cultivation (x $10^{3`}$ ha$^{-1}$), mean values of gross monetary return (GMR) (x $10^{3`}$ ha^{-1}), mean net monetary return (NMR) (x $10^{3`}$ ha$^{-1}$) and mean benefit: cost ratio (B: C ratio) of pigeonpea + pearl millet intercropping production system affected by different treatments. Mean cost of cultivation (x $10^{3`}$ ha^{-1}), mean gross monetary return (GMR) (x $10^{3`}$ ha$^{-1}$), net monetary return (NMR) (x $10^{3`}$ ha^{-1}) and benefit: cost ratio (B: C ratio) were recorded 33.137 (x $10^{3`}$ ha$^{-1}$), 94.143 (x $10^{3`}$ ha^{-1}), 61.046. (x $10^{3`}$ ha^{-1}), and 2.80 respectively.

Cost of cultivation (×10^{3} `ha^{-1})

The data (Table 1) obtained of cost of cultivation is lower in treatment T_8 (45 cm x 15 cm) *i.e.* sole pearl millet 27.306 (x $10^{3`}$ ha$^{-1}$) and higher value of cost of cultivation in treatment $T_1$ *i.e.* having row proportion 1:1 (90 cm × 30 cm) 34.178 (x $10^{3`}$ ha^{-1}).

Gross return (x $10^{3`}$ ha^{-1})

It is evident from Table 1 that the mean gross monetary return (GMR) was recorded significantly superior as in the treatment T_7 (90 cm × 20 cm) *i.e.* sole pigeonpea 119.492 (x $10^{3`}$ ha^{-1}).

**Net return (x $10^{3`}$ ha$^{-1}$):** Table 1 revealed that the treatment $T_7$ *i.e.* sole pigeonpea (90 cm × 20 cm) recorded significantly higher mean value of net monetary return (NMR) (85.916 x $10^{3`}$ ha^{-1}) which was at par with treatment T_1 and T_3.

Benefit: cost ratio (B:C ratio)

Table. 1 also shows significantly higher B:C ratio in treatment T_7 (90 cm x 20 cm) *i.e.* sole pigeonpea (3.55) which was at par with treatment T_1 and T_3.

Table 1: Cost of cultivation (× $10^{3`}$ha$^{-1}$), gross monetary returns (GMR) (× $10^{3`}$ ha^{-1}), net monetary returns (NMR) (×$10^{3`}$ ha^{-1}), and benefit: cost ratio (B:C ratio) of pigeonpea + pearl millet intercropping production system as influenced by different treatments.

Tr. No	Treatment Pigeonpea +pearl millet	RP	GMR (× 10^{3} `ha^{-1})	COC (× 10^{3} `ha^{-1})	NMR (× 10^{3} `ha^{-1})	B:C
T_1	90 x 30 cm^2 + 45x 15cm^2	(1:1)	113.915	34.178	79.736	3.33
T_2	90 x 45 cm^2 + 45x 15cm^2	(1:1)	103.973	34.048	69.924	3.05
T_3	120 x 30 cm^2 + 60x15cm^2	(1:1)	108.037	34.002	74.034	3.17
T_4	120 x 45 cm^2 + 60x15cm^2	(1:1)	92.002	33.902	58.099	2.71
T_5	150 x 30 cm^2 + 50x15cm^2	(1:2)	105.244	34.096	71.147	3.08
T_6	150 x 45 cm^2 + 50x15cm^2	(1:2)	78.766	33.996	44.769	2.31
T_7	(Sole pigeonpea) 90cmx 20cm	--	119.492	33.575	85.916	3.55
T_8	(Sole Pearl millet) 45 cmx 15cm	--	31.722	27.306	4.416	1.16
SE(m) ±		--	3.81	1.50	4.21	0.14
CD at 5%		--	11.51	--	12.73	0.44
General mean		--	94.143	33.137	61.046	2.80

Economics of intercropping system

Costs of cultivation (34.178 x 10^{3}` ha^{-1}) were recorded maximum when pigeonpea + pearl millet crops were planted in narrow planting geometry i.e. (90 cm x 30 cm). It might be due to higher seed requirement of pigeonpea + pearl millet for sowing under respective treatment. These outcomes are consistent with the study conclusions reached by Ramamoorthy *et al.* (2004) [5].

The maximum gross monetary return (119.492 x 10^{3}` $ha^{-1}$) and net monetary return (85.916 x $10^{3}$` ha^{-1}) from sole pigeonpea were recorded in narrow planting geometry (90 cm x 20 cm) which was significantly higher than rest of the different row proportions and planting geometries (pigeonpea + pearl millet) which may be due to higher yield and absence of aggressivity of the intercrop. Among different pigeonpea and pearl millet row proportions, 1:1 recorded highest net returns (79.736 x 10^{3}` ha^{-1}). These results are in conformity with the research findings concluded by Anonymous (1997) [1].

Maximum B:C ratio was recorded with narrow planting geometry of sole pigeonpea (3.55) i.e. (90 cm x 20 cm), lowest with sole pearl millet (1.16) i.e. (45 cm x 15 cm) and intermediate (2.31-3.33) with different intercropping system, due to variation in gross monetary returns of different treatments. These results are in conformity with the research findings concluded by Yadav and Maurya (2012) [9], Nedunzhiyan and Reddy (1993) [3] and Tuppad *et al.* (2012) [7].

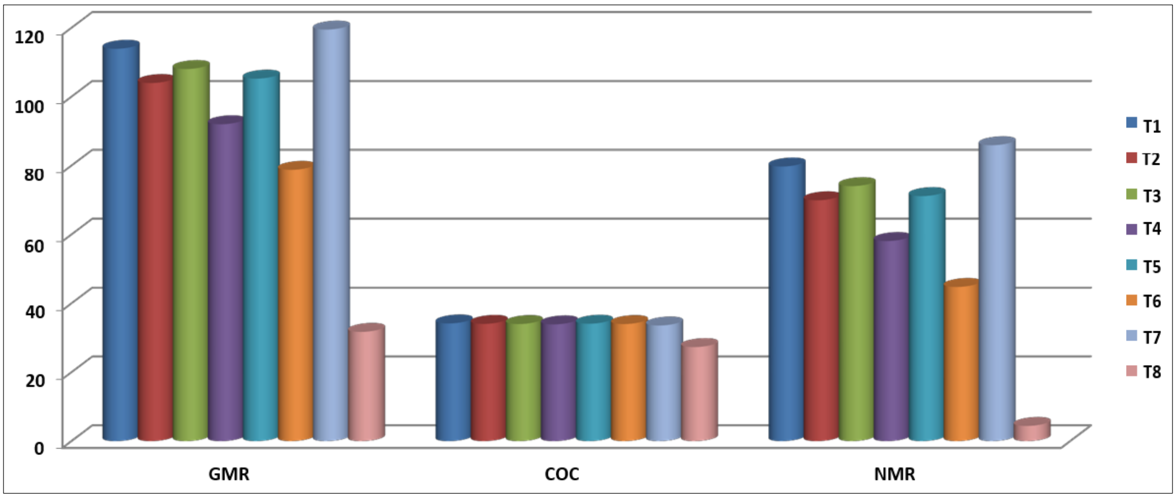

Fig 1: Cost of cultivation (× 10^{3}` $ha^{-1}$), gross monetary returns (GMR) (× $10^{3}$` ha^{-1}), net monetary returns (NMR) (×10^{3}` ha^{-1}), and benefit: cost ratio (B:C ratio) of pigeonpea + pearl millet intercropping production system as influenced by different treatments

Conclusion

Conclusions may be made in light of the research investigation's results. Therefore, it can be said that pigeonpea and Bajra are intercropped. The economics of the system revealed that sole pigeonpea recorded significantly higher gross monetary return (119.492 × 10^{3}` $ha^{-1}$) and net monetory return (85.916 × $10^{3}$` ha^{-1}) and lowest gross and net monitory return were recorded in sole pearl millet treatment (31.722 × 10^{3}` $ha^{-1}$) and (4.416 × $10^{3}$` ha^{-1}) respectively.

Higher B:C ratio was realized with sole pigeonpea i.e. T_7 (90 cm x 20 cm) (3.55) with narrow planting geometry followed by planting geometry of T_1 (90 cm x 30 cm) with row proportion 1:1 (3.33) and T_3 (120 cm x 30 cm) i.e. row proportion 1:1. Low B: C ratio (1.16) was recorded with sole pearl millet treatment (45 cm x 15 cm).

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