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Performance of Sesame (*Sesamum indicum* L.) based Intercropping System in *kharif* under Different Row Proportion on Yield and Economics

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An Agronomic investigation entitled "Performance of sesame (*Sesamum indicum* L.) Based intercropping system in *kharif* under different row proportion" was carried out at Agriculture College Farm, Nagpur during *kharif* 2017-18. The experiment was laid out in Randomized Block Design with nine treatments as T_1- Sole sesame, T_2 - Sole green gram, T_3 - Sole black gram, T_4 - Sesame : Green gram in 1:1 row ratio, T_5 - Sesame : Green gram in 2:1 row ratio, T_6 - Sesame : Green gram in 3:1 row ratio, T_7 - Sesame : Black gram in 1:1 row ratio, T_8 - Sesame : Black gram in 2:1 row ratio and T_9 - Sesame : Black gram in 3:1 row ratio and were replicated thrice. The results of the study indicated that, among all treatments, sole sesame (T_1) recorded highest seed yield, straw yield and biological yield. Among the intercropping treatments, sesame with black gram in 1:1 row

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ratio recorded higher seed yield, straw yield and biological yield. Intercropping of sesame: black gram in 1:1 row ratio (T_7) recorded the higher GMR (₹ 87563 ha^{-1}), NMR (₹ 62060 ha^{-1}), B:C ratio (3.43).

Keywords: Sesame; intercropping; yield; economics; black gram.

1. INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the oldest oilseed crop cultivated in India. It is called as "Queen of oil seed crop" by virtue of its excellent quality. It has been called a survivor crop, due to its ability to grow where most crops fails. Sesame produce unique antioxidants which contribute to its reputation for yielding high quality oil not found in other edible oils that allow its oil to resist oxidative rancidity. Sesame seed contains 40-60% oil, 19-26% protein and 3-6% fiber [1]. The demand supply gap between production of edible oilseed and domestics need for edible oil warrant increase in production of edible oilseed in India. Hence there is scope for adoption of appropriate cropping system with improve agronomic practices by Panda et al. [2].

"Short duration pulse crop such as blackgram/greengram/cowpea can be grown as an intercrop to increase the productivity and nutrients availability of the system" [3]. India is the largest producer of sesame in the world. It also ranks first in the world in terms of sesame growing area (26%) and is the world's largest producer of sesame with maximum production and highest export in world. The production of sesame during the year 2016-2017 was 8.11 lakh tones from 1778.00 thousand ha area with productivity of 456 kg ha^{-1}. In Maharashtra, it was 3.3 thousand tones from 28 thousand ha area with productivity of 60 thousand tones [4]. India is the fifth largest producer of oilseeds and second largest producer of pulses in the world and more than dozen oilseed and pulse crops are grown. We are lacking in oilseed and pulses production in our country. We are spending ₹.20,000 Crore for importing edible oil and ₹.25,600 Crore for importing pulses from other countries [5]. Therefore, there is an urgent need to increase the production of oilseeds and pulses in the country to meet their increasing demand by developing new and efficient production technologies. Oilseeds/ pulses are generally grown as intercrop or mixed crop in wide spaced crops. Though the concept of intercropping gained momentum in cropping systems research which has been in vogue from time immemorial in India. The concept of growing more than one crop in a year in the intercropping system for bountiful harvest per unit area per unit time through efficient resource utilization without affecting environmental conditions is of recent origin. "Greengram [*Vigna radiate* (L.) Wilczek], Mothbean (*Vigna aconitifolia* (Jacq.) Marechal) and sesame (*Sesamum indicum* L.) are the most important pulse and oilseed crops grown in rainfed areas of Rajasthan where the probability of crop failure is higher due to frequent occurrence of aberrant weather conditions. The scope for increasing the area under irrigation in the Rajasthan state is limited and in dry farming regions, only one season is available for taking crops. In such areas, increasing the cropping intensity is only the practice which may contribute to production and productivity by way of better and efficient utilization of available resources. Intercropping is one of the most important technique which embodies growing of crop under different plant geometry. To avoid the risk of sole crop, adoption of intercropping is more safe and profitable cropping system for increasing the total production and net profit per unit area. Intercropping offers to farmers the opportunity to engage nature's principles of diversity at his farm" [6].

2. MATERIALS AND METHODS

A field was conducted at the Agronomy farm, College of Agriculture, Nagpur (Maharashtra). The experiment was laid out in Randomized Block Design with nine treatments as T_1- Sole sesame, T_2 - Sole green gram, T_3 - Sole black gram, T_4 - Sesame : Green gram in 1:1 row ratio, T_5 - Sesame : Green gram in 2:1 row ratio, T_6 - Sesame : Green gram in 3:1 row ratio, T_7 - Sesame : Black gram in 1:1 row ratio, T_8 - Sesame : Black gram in 2:1 row ratio and T_9 - Sesame : Black gram in 3:1 row ratio and were replicated thrice. soil of the experimental site was clayey in texture, slightly alkaline (7.98) in nature having moderate organic carbon content (0.60), low available nitrogen (256.52 kg ha^{-1}), medium in available phosphorus (19.78 kg ha^{-1}) and high in available potassium (406.06 kg ha^{-1}). The crops were sown on 5th July 2015 in lines 30 cm

apart for sole crops. In intercropping situation, after pairing two rows of blackgram at 20 cm leaving the space of 40 cm in between pairs, one row of sesame was sown in 2:1 paired row intercropping system. The mugbean 'Green gold' blackgram 'TAU-1' and sesame 'AKT-64' were raised with recommended package of practices. Nutrient management through fertilizer Urea, Single super phosphate and Murate of Potash was applied in the soil before sowing in plots as per treatments. Yield of *kharif* pulses and sesame were computed from the plants of net plot in each treatment.

3. RESULTS AND DISCUSSION

3.1 Mean Seed Yield, Straw Yield and Biological Yield of Sesame (q ha^{-1})

Data pertaining to mean seed yield and straw yield (q ha^{-1}) of sesame as influenced by various treatments are presented in Table 1.

Among all the treatments, sole sesame recorded higher seed yield (7.47 q ha^{-1}), straw yield (26.99 q ha^{-1}) and biological yield of (34.45 q ha^{-1}). Among the intercropping treatments, Sesame: Black gram in 3:1 row ratio (T_9) recorded higher seed yield of (6.77 q ha^{-1}), straw yield (25.16 q ha^{-1}) and biological yield (31.93 q ha^{-1}) than other intercropping treatments. Bindhu et al. [7] and Sarma et al. [8] also recorded more seed yield in sole crop of sesame and Sesame: Black gram in 3:1 row ratio. Cultivation of sesame + green gram (1:1) gave 36.80% higher net return as sole sesame cropping [9].

3.2 Mean Harvest Index of Sesame (%)

The mean harvest index was 21.67%. Among all the treatments, sole sesame recorded highest harvest index (21.67%). Among the intercropping treatments, Sesame: green gram in 1:1 row ratio (T_4) recorded highest harvest index of 21.63%.

The result revealed that Intercropping of sesame: green gram in 1:1 row ratio recorded maximum seed yield (6.57 q ha^{-1}), straw yield (14.19 q ha^{-1}) and biological yield (20.76 q ha^{-1}) followed by 2:1 and 3:1 row ratio similarly, in sesame: black gram, 1:1 row ratio (T_7) recorded maximum seed yield (8.03 q ha^{-1}), straw yield (17.36 q) and biological yield (31.03 q ha^{-1}) followed by 2:1 and 3:1 row ratio this might be due to higher plant population and higher number of pods plant^{-1} in this treatment. Similar results were also reported by Bindhu et al. [7] and Sarma et al. [8].

3.3 Economic Studies

3.3.1 Cost of cultivation (₹ ha^{-1})

Sole sesame required ₹ 23682 ha^{-1} while sole green gram / black gram required expenditure of ₹ 24622 ha^{-1} for cultivation. This difference was mainly due to the seed, input cost and fertilizer cost as the RDF for sesame was 40:25:00 while for green gram / black gram was 20:40:00. The difference in cost for various intercropping treatments is mainly due to variation in seed cost and input cost.

3.3.2 (GMR) Gross monetary returns (₹ ha^{-1})

Intercropping of sesame : black gram in 1:1 row ratio (T_7) recorded the higher gross monetary return of ₹ 87563 ha^{-1} which was significantly superior over all other cropping patterns, except Sesame : Black gram in 2:1 row ratio (T_8) and Sesame : Green gram in 1:1 row ratio (T_4).

3.3.3 (NMR) Net Monetary Returns (₹ ha^{-1})

Among all treatments, intercropping of sesame: black gram in 1:1 row ratio gave significantly highest NMR of ` 62060 ha^{-1}. The higher NMR was due to more combine yield of both crops, sesame and black gram, which in turn gave highest net monetary returns in sesame : black gram (1:1) row ratio.

3.3.4 Benefit: cost ratio

Among all the intercropping tested, sesame : black gram in 1:1 row ratio gave maximum B:C ratio followed by sesame : black gram in 2:1 row ratio which might be attributed to higher gross monetary return compared to the cost involve in production. Similar result is also reported by Sarma et al. [8].

Table 1. Mean seed yield, straw yield, biological yield (q ha^{-1}), harvest index (%) of base crop and intercrop as influenced by various treatments

Treatment	Sesame (Base crop)				Green gram (intercrop)			Black gram (intercrop)		
	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})
T_1 - Sole sesame	7.47	26.99	34.45	21.67	-	-	-	-	-	-
T_2 - Sole green gram	-	-	-	-	8.46	17.49	25.95	-	-	-
T_3 - Sole black gram	-	-	-	-	-	-	-	8.82	19.07	27.89
T_4 - Sesame : Green gram (1:1) row ratio	5.41	19.59	25.00	21.63	6.57	14.19	20.76	-	-	-
T_5 - Sesame : Green gram (2:1) row ratio	6.13	22.53	28.67	21.39	5.49	11.65	17.14	-	-	-
T_6 - Sesame : Green gram (3:1) row ratio	6.53	23.88	30.41	21.32	4.87	10.28	15.16	-	-	-
T_7 - Sesame : Black gram (1:1) row ratio	5.62	20.62	26.24	21.42	-	-	-	8.03	17.36	25.39
T_8 - Sesame : Black gram (2:1) row ratio	6.36	23.50	29.86	21.30	-	-	-	5.75	12.84	18.60
T_9 - Sesame : Black gram (3:1) row ratio	6.77	25.16	31.93	21.19	-	-	-	4.28	09.55	13.83
GM	6.33	23.18	29.50	21.41	6.34	13.40	19.75	6.72	14.70	21.42

Table 2. Mean cost of cultivation, gross monetary returns, net monetary returns (₹ ha^{-1}) and benefit cost ratio of influenced by various treatments

Treatments	Cost of cultivation ` ha^{-1}	GMR ₹ ha^{-1}	NMR ₹ ha^{-1}	B:C Ratio
T_1 - Sole sesame	23682	49982	26300	2.11
T_2 - Sole green gram	24622	52468	27846	2.13
T_3 - Sole black gram	24622	54837	30215	2.22
T_4 - Sesame : Green gram (1:1 row ratio)	25503	77062	51559	3.02
T_5 - Sesame : Green gram (2:1 row ratio)	25346	74128	48782	2.92
T_6 - Sesame : Green gram (3:1 row ratio)	25268	70574	45306	2.79
T_7 - Sesame : Black gram (1:1 row ratio)	25503	87563	62060	3.43
T_8 - Sesame : Black gram (2:1 row ratio)	25346	78334	52988	3.09
T_9 - Sesame : Black gram (3:1 row ratio)	25268	71913	46645	2.84
SE (m)	-	4213	2665	-
CD at 5%	-	12629	7990	-
GM	25018	68540	43522	2.72

4. CONCLUSION

It was concluded that intercropping system of sesame with green gram or black gram in row ratio (1:1) produced significantly higher sesame equivalent yield than sole cropping of sesame, GMR (₹ 87563 ha^{-1}), NMR (₹ 62060 ha^{-1}) and B:C ratio (3.43). Such intercropping system provide higher production and utilization of land.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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