Research Article

Effect of Intercropping Systems and Integrated Nutrient Management on Growth, Yield and Nutrient Uptake by Sesame under Semi-Arid Region

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Abstract

To find out the most compatible intercropping system and effect of integrated nutrient management, field experiment was conducted during *kharif*, 2015 with 5 intercropping systems *viz.* sole mungbean sole mothbean, sole sesame, mungbean + sesame (2:1)PR, mothbean + sesame (2:1) PR and and 4 treatment of integrated nutrient management (100 % RDF through fertilizer, 75% RDF through fertilizer + 25% RDF through vermicompost, 50% RDF through fertilizer + 50% RDF through vermicompost and 100% RDF through vermicompost. Seed and stick yields of sesame in sole crop was significantly more than intercropping in different row ratios with mungbean and mothbean, while dry matter production and yield attributes in 2:1 PR ratio. Mungbean + sesame (2:1) PR system, being at par with Mothbean + sesame (2:1) PR system, mungbean + sesame (2:1) PR systemrecorded significantly higher LER and net returns (`78656/ha). Application of 50% RDF through fertilizer + 50% RDF through vermicompost recorded significantly highest plant height, dry matter accumulation, yield attributes and yields, total uptake of N, P and K and oil content in seed of sesame.

Keywords: growth, Intercropping, paired row, sesame, yield, nutrient uptake

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Introduction

Sesame is an important edible oilseed crop grown in semi-arid and arid regions. In this area, rainfall is generally erratic and insufficient in nature. Moreover, irrigation facilities are also limited. Therefore, to avoid the risk of sole crop, adopting 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 [1]. The system of intercropping not only improves the yield and returns but also reduces the risk of complete crop failure as compare to the sole cropping system [2]. The yield advantage obtained through intercropping is due to efficient utilization of available growth resources like water [3], nutrients [4], and sun light. Intercropping, besides utilizing growth resources efficiently, suppressed weeds, disease and pest incidences [5].

In *kharif* pulses + sesame intercropping system, all crop have different peak demand for light, nutrients and water, therefore it facilitates optimum utilization of resources. Plant population and spatial arrangement in intercropping have important bearing on productivity of component crops. The reason for better growth and development under these treatments might be the increased availability of nutrients to plant initially through inorganic fertilizers and then by organic manures like vermicompost and FYM matching to the need of crop throughout the growing season.

Materials and Methods

A field experiment was conducted during *kharif,* 2015 at Jobner (Jaipur). The soil was loamy sand in texture, alkaline in reaction (pH 8.2), low in organic carbon (0.14%), available nitrogen (130 kg/ha), available phosphorus (16.52 kg P_2O_5/ha) and medium in potassium (151.8 kg K_2O/ha) content. The experiment consisted of 5 intercropping systems *viz.* sole mungbean sole mothbean, sole sesame, mungbean + sesame (2:1) PR, mothbean + sesame (2:1) PR and and 4 treatment of integrated nutrient management (100 % RDF through fertilizer, 75% RDF through fertilizer + 25% RDF through vermicompost, 50% RDF through fertilizer + 50% RDF through vermicompost and 100% RDF through vermicompost) was laid out in randomized block design with three replications. The experimental crops were sown in lines 30 cm apart for sole as well as intercropping systems. Under intercropping third and fourth row of mungbean and mothbean were replaced by one row of sesame. Whereas, after pairing two rows of mungbean and mothbean 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 intra row spacing of 10 cm for both crops was maintained after the thinning. The mungbean and

mothbean varieties RMG-492 'RMO-257' and sesame 'RT-46' were used. Cost of cultivation was calculated by taking current market prices of inputs, while gross returns were obtained by multiplying seed and stick yields with market prices. Net returns were calculated by deducting cost of cultivation from gross returns. The N, P and K uptake and their available status in soil were estimated using standard procedures. The yields further used for computation of LER as suggested by [6]. Data was statistically analysed by the procedure described by [7].

Results and Discussion

Growth parameters

There was no significant variation in plant stand and height of sesame at different growth stages and this indicates that there was no interference of mungbean and mothbean on establishment of sesame crop **(Table-1).** While, dry matter accumulation per meter row length found significantly higher in mothbean + sesame (2:1) PR ratio, which remained at par with mothbean + sesame (2:1) PR ratio. Different treatment of integrated nutrient management could not influence the plant stand and plant height at early stages. Plant height at 60 DAS and dry matter accumulation at 30 DAS, 60 DAS and at harvest significantly increased 50% RDF through fertilizer + 50% RDF through vermicompost and remained at par with 75% RDF through fertilizer + 25% RDF through vermicompost at all the growth stages.

Yield

Among different intercropping systems mothbean + sesame 2:1 PR ratio recorded higher yield attributes of sesame (Number of capsules/plant and number of seeds/capsule) which remained at par with mungbean + sesame 2:1 PR ratio while test weight found non-significant. Sole planting of sesame recorded significantly higher seed and stick yields as compared to other intercropping systems (**Table 1**). Among the intercropping systems, mothbean + sesame (2:1) PR ratio, remained at par with mungbean + sesame 2:1 PR ratio, recorded significantly higher seed and stick yields. The reduction in seed and stick yield in all row ratios over sole crop was due to low plant population. While, yield of sesame on unit area basis was higher due to better yield attributes over sole crop. These results are in close conformity with those of [8] and [9]. Higher LER found in mungbean and mothbean 2:1 paired row ratio. The higher LER under intercropping might be due to biological efficiency of system in terms of yields per unit area.

Significant increase in yield attributes and yields observed with application of 50% RDF through fertilizer + 50% RDF through vermicompost over rest of the treatments. The increase in yield attributes and yields (seed and stick) under combination of organic and inorganic fertilizer is obvious from the fact that application of improved overall nutritional environment of the rhizosphere as well as in the plant system, which in turn enhanced the plant metabolism and photosynthesis activity resulting into better growth and development of plants and ultimately the yields. [10] also observed similar results.

Nutrient uptake and quality parameters

Intercropping system, mothbean + sesame (2:1) PR ratio recorded significantly higher N, P and K concentration in seed and stick, which remained at par with mungbean + sesame 2:1 PR ratio, over rest of systems (**Table 2**). While uptake of N, P and K by seed and stick observed significantly highest in sole crop. Among different row ratios 2:1 PR recorded significantly higher uptake of N, P and K by seed and stick which remained at par with mungbean + sesame 2:1 PR ratio. [48] also reported significantly higher uptake of nitrogen by sole clusterbean and sesame.

Application of 50% RDF through fertilizer + 50% RDF through vermicompost significantly influenced the N, P and K concentration and total uptake and oil content in seed of sesame. The significantly higher N, P and K content in seed and stick and oil content in seed and Total uptake of N, P and K increased with application of 50% RDF through fertilizer + 50% RDF through vermicompost, Similar results were also observed by [11] and [10].

Economics

Cost of cultivation varied according to different intercropping systems and application of integrated nutrient management. The significantly higher net returns were recorded under mungbean + sesame 2:1PR ratio (78656/ha). Application of 50% RDF through fertilizer + 50% RDF through vermicompost also gave the maximum net returns (55803/ha) and it remained at par with application of 75% RDF through fertilizer + 25% RDF through vermicompost.

Table 1 Effect of planting pattern and integrated nutrient management on growth and yield of sesame

Treatment	Plant height (cm)			Dry matter accumulation (g/meter row)			Seed yield (kg/ha)	Stick yield (kg/ha)	LER	Net returns (Rs/ha)
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest				
Intercropping										
S sole	21.12	104.12	107.02	12.23	100.00	115.37	720	2450	1.00	31066
M + S (2:1) PR	22.28	107.14	111.20	12.84	106.24	122.43	361	1274	1.34	78656
M + S (2:1) PR	21.85	105.24	109.51	13.45	108.04	126.55	380	1343	1.33	47829
SEm±	0.39	2.08	2.17	0.40	1.84	2.10	13	35	0.02	
CD (P=0.05)	NS	NS	NS	NS	5.32	6.06	36	101	.06	
Integrated nutrient management										
100 % RDF through fertilizer	21.77	103.41	106.12	12.19	102.82	117.01	475	1650	1.13	51692
75% RDF through fertilizer + 25% RDF through vermicompost	21.92	109.52	110.92	13.61	106.81	124.91	502	1737	1.13	54938
50% RDF through fertilizer + 50% RDF through vermicompost	22.12	111.13	114.72	13.84	109.29	129.01	523	1783	1.13	55803
100% RDF through vermicompost	21.19	97.94	105.22	11.72	100.12	114.89	448	1586	1.13	42492
SEm±	0.45	2.40	2.51	0.46	2.13	2.42	15	40	0.02	
CD (P=0.05)	NS	6.93	7.24	1.33	6.14	7.00	42	117	NS	

NS= Non significant

Table 2 Effect of planting pattern and integrated nutrient management on nutrient concentration and uptake of sesame

Treatment	N concentration (%)		Total N uptake (kg/ha)	P concentration (%)		Total P uptake (kg/ha)	K concentration (%)		Total K uptake (kg/ha)	Oil content (%)
	Seed	Stick		Seed	Stick		Seed	Stick		
Intercropping										
S sole	2.321	0.938	39.88	0.319	0.141	5.77	1.248	2.360	66.95	44.55
M + S (2:1) PR	2.753	1.036	23.24	0.348	0.157	3.28	1.464	2.485	37.03	46.16
M + S (2:1) PR	2.774	1.043	24.64	0.359	0.167	3.63	1.486	2.389	37.80	47.35
SEm±	0.073	0.016	1.11	0.007	0.005	0.16	0.023	0.037	1.43	0.88
CD (P=0.05)	0.211	0.045	3.20	0.021	0.014	0.45	0.065	0.106	4.14	NS
Integrated nutrient management										
100 % RDF through fertilizer	2.542	0.992	27.91	0.331	0.150	3.99	1.374	2.359	45.18	45.59
75% RDF through fertilizer + 25% RDF through vermicompost	2.752	1.036	31.21	0.348	0.162	4.48	1.388	2.406	48.39	47.29
50% RDF through fertilizer + 50% RDF through vermicompost	2.860	1.046	33.00	0.364	0.170	4.84	1.478	2.490	51.76	48.39
100% RDF through vermicompost	2.310	0.948	24.91	0.325	0.139	3.59	1.358	2.391	43.70	42.81
SEm±	0.084	0.018	1.28	0.008	0.006	0.18	0.026	0.042	1.65	1.01
CD (P=0.05)	0.244	0.052	3.69	0.024	0.016	0.52	0.076	NS	4.78	2.92

NS= Non significant

Conclusion

It was concluded that mungbean + sesame (2:1) PR ratio with 50% RDF through fertilizer + 50% RDF through vermicompost increase the productivity under rainfed condition with equivalent yield (1316 kg/ha) and net returns (`78656/h). Application of 50% RDF through fertilizer + 50% RDF through vermicompost fetched significantly maximum mungbean equivalent yield (1018 kg/ha) and net returns (55803/ha). However, these results are only indicative and require further experimentation to arrive at some more consistent and final conclusion for making recommendations to the farmers.

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