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Performance of Rainfed Moth bean and Sesame as Influenced by Intercropping Systems and Sulphur Fertilization

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Abstract: A field experiment, comprising twenty treatment combinations replicated three times, was conducted in Split Plot Design with five intercropping systems [sole moth bean, sole sesame, moth bean + sesame (2:1), moth bean + sesame (2:1) paired row (PR) and moth bean + sesame (3:1)] in main plot and four levels of sulphur (0, 20, 40 and 60 kg ha^{-1}) in sub plot during kharif, 2011 at Jobner (Rajasthan). Results indicated that sole moth bean recorded significantly higher yield attributes i.e., pods/plant and seeds/pod as compared to different row ratios. Significantly higher seed (905.8 kg ha^{-1}) and straw (1855.6 kg ha^{-1}) yields were observed in sole moth bean, which was 78.24 and 69.92% higher as compared to intercropping in 2:1 PR ratio. The planting of sesame in 2:1 PR ratio gave significantly more capsules/plant and seeds/capsule over sole sesame. The sole sesame recorded significantly highest seed (720.5 kg ha^{-1}) and stick yields (2598.2 kg ha^{-1}) as compared to different row ratios. The increase in seed yield of sole sesame was 187.28, 111.66 and 102.84% over 3:1, 2:1 and 2:1 PR ratios, respectively. Increasing levels of sulphur upto 40 kg ha^{-1} recorded significant improvement in yield attributes i.e., pods/plant, seeds/pod, seed and straw yields of moth bean and capsules/plant, seeds/capsule, seed and stick yields of sesame. Application of 40 kg S ha^{-1} increased seed yield of moth bean by 21.46 and 6.30% and sesame by 28.62 and 8.20% over control and 20 kg S ha^{-1} respectively. Intercropping in 2:1 row ratio recorded 12.18 and 9.68% higher moth bean equivalent yield (MEY) and 19.23 and 11.34% higher net returns compared to sole moth bean and sesame, respectively. MEY and net returns were also increased with sulphur upto 40 kg ha^{-1}.

Key words: Moth bean, sesame, intercropping, row ratio, sulphur.

Pulses are the main source of protein, particularly for vegetarians, and occupy a unique position in farming as main, cover, green manure, intercrop and their inclusion in crop rotation keep the soil alive, productive and improve physical properties of the soil by virtue of their biological nitrogen fixation, deep root system and leaf fall. Oilseeds also occupy important place in Indian economy. Moth bean (*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 aberrant weather conditions. The scope for increasing the area under irrigation in the Rajasthan state is limited and in dry farming regions, only rainfed crops can be taken in kharif season. In such areas, increasing the cropping intensity may contribute to production and productivity through efficient utilization of available resources. Intercropping is one of the most important technique which, involves growing of crops under different plant geometry. To avoid the risk of sole crop failure, 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 an opportunity to utilize diverse resources available at his farm (Ghosh, 2004). Legumes offer excellent compatible combination for mixing with oilseeds to minimize the competition and to confer a symbiotic association to achieve the prime aim of maximum use of available resources. The oilseed crops require higher amount of sulphur to augment the oil productivity and quality. Sulphur plays an important role in the formation of sulphur containing amino acids, vitamins and development of root nodules in pulses. Therefore, present study was undertaken to investigate effect of intercropping systems and application of sulphur on moth bean and sesame under rainfed conditions.

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Materials and Methods

A field experiment, comprising twenty treatment combinations replicated three times, was conducted in Split Plot Design with five intercropping systems [sole moth bean, sole sesame, moth bean + sesame (2:1), moth bean + sesame (2:1) paired row (PR) and moth bean + sesame (3:1)] in main plot and four levels of sulphur (0, 20, 40 and 60 kg ha^{-1}) in sub plot during kharif, 2011 at S.K.N. College of Agriculture, Jobner (Rajasthan). The soil of experimental field was loamy sand in texture, alkaline in reaction (pH 8.2), low in organic carbon (0.16%), available nitrogen (132.5 kg ha^{-1}), available phosphorus (16.0 kg P_2O_5 ha^{-1}), available sulphur (8.16 mg kg^{-1}) and medium in available potassium (142.2 kg K_2O ha^{-1}). The crops were sown on 25th July 2011 in lines 30 cm apart for sole crops. In intercropping, third and fourth rows of moth bean were replaced by one row of sesame in 2:1 and 3:1 intercropping systems, respectively. Whereas, after pairing two rows of moth bean at 20 cm leaving a space of 40 cm in between pairs, one row of sesame was sown in 2:1 paired row intercropping system. The moth bean 'RMO-40' and sesame 'RT-127' were raised with recommended package of practices. Sulphur through gypsum was incorporated in the soil before sowing in plots as per treatments. Yield of moth bean and sesame were computed from the plants of net plot in each treatment. The economics and moth bean equivalent yields (MEY) were computed at prevailing market rates of different commodities during 2011.

Results and Discussion

Intercropping

Results indicated that sole planting of moth bean, being at par with 2:1 and 3:1 row ratios, gave significantly higher pods/plant as compared to 2:1 PR ratio, while sole moth bean gave significantly higher seeds/pod as compared to intercropping (Table 1). The sole moth bean produced 11.39 and 22.68% more pods/plant and seeds/pod compared to 2:1 PR ratio, respectively. Reduction in yield attributes under intercropping might be due to competition between the component crops for nutrients, light and water as compared to sole moth bean. Significantly 78.24 and 69.92% higher seed (905.8 kg ha^{-1}) and straw (1855.6 kg ha^{-1}) yields of moth bean were recorded under sole moth bean over the intercropping system of 2:1 PR ratio. Among intercropping systems, 3:1 row ratio also recorded significantly higher seed and straw yields over 2:1 PR and 2:1 row ratios. A significant reduction in seed and straw yields of moth bean were recorded due to intercropping with sesame over sole moth

Table 1. Performance of moth bean and sesame as influenced by intercropping and sulphur fertilization

Treatments	Moth bean				Sesame				MEY (kg ha^{-1})	Net returns (Rs ha^{-1})
	Pods/ plant	Seeds/ pod	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Capsules/ plant	Seeds/ capsules	Seed yield (kg ha^{-1})	Stick yield (kg ha^{-1})		
Cropping systems										
Moth bean sole	25.52	5.30	905.8	1855.6	-	-	-	-	905.8	20254
Sesame sole	-	-	-	-	27.62	42.18	720.5	2598.2	926.4	21690
Moth bean + sesame (2:1)	24.75	4.76	578.4	1211.2	30.71	46.06	340.4	1176.0	1016.1	24150
Moth bean + sesame (2:1) PR	22.91	4.32	508.2	1092.0	32.74	47.12	355.2	1207.6	964.9	22152
Moth bean + sesame (3:1)	25.08	4.98	685.2	1384.8	30.20	45.70	250.8	839.2	1007.7	23828
CD (P=0.05)	2.18	0.31	48.5	115.9	2.18	3.41	54.9	115.1	48.0	1493
Sulphur (kg ha^{-1})										
0	19.52	4.35	580.6	1238.3	27.25	41.06	346.6	1265.5	821.0	17266
20	23.90	4.78	663.4	1368.0	30.06	44.62	412.0	1443.7	954.5	22122
40	26.70	5.06	705.2	1447.7	31.52	47.05	445.8	1531.6	1022.7	24540
60	28.14	5.18	728.4	1489.6	32.44	48.33	462.5	1580.1	1058.4	25730
CD (P=0.05)	1.43	0.23	29.3	75.9	1.43	2.30	30.6	75.2	38.9	1232

bean primarily due to low plant population of moth bean in intercropping treatments as the replacement system of intercropping was followed. These results are in close conformity with those of Goud and Andhalkar (2012) who reported significant reduction in yield of pigeon pea when intercropped with soybean. Prajapat *et al.* (2011) also reported reduction in seed yield of mung bean when intercropped with sesame as compared to sole crop.

Sesame as an intercrop gave significantly higher capsules/plant and seeds/capsule as compared to sole sesame (Table 1). The planting of sesame in 2:1 PR ratio was at par with 2:1 row ratio, produced significantly higher capsules/plant (18.54%) and seeds/capsule (11.71%), as compared to sole sesame. It might be due to conducive environment created by main crop (moth bean) as it fixed atmospheric nitrogen and increased its availability in soil, which might have also been utilized partly by sesame plants for better growth and development and ultimately increased the growth and yield attributes. Prajapat *et al.* (2012) also reported increase in yield attributes of sesame when intercropped with mung bean as compared to sole cropping. However, planting of sole sesame gave significantly highest seed yield (720.5 kg ha^{-1}) and stick yield (2598.2 kg ha^{-1}) as compared to different row ratios. The increase in seed yield of sole sesame was 187.28, 111.66 and 102.84% over 3:1, 2:1 and 2:1 PR ratios, respectively.

Sulphur

Increasing levels of sulphur upto 40 kg ha^{-1} recorded significant improvement in seeds/pod, seed and straw yields of moth bean (Table 1). However, pods/plant increased significantly upto 60 kg S ha^{-1}. Application of 40 kg S ha^{-1} increased seed yield of moth bean by 21.46 and 6.30% and straw yield by 16.91 and 5.82%, respectively, over control and 20 kg sulphur. Increasing levels of sulphur upto 40 kg ha^{-1} recorded significant improvement in capsules/plant, seeds/capsule, seed and stick yields of sesame. Application of 40 kg S ha^{-1} increased seed yield of sesame by 28.62 and 8.20% and stick yield by 21.03 and 6.09%, respectively, over control and 20 kg sulphur. At optimum, S level greater photosynthates are translocated from leaves towards sink i.e., yield attributes. Hence, it is obvious that sulphur improved nutritional environment of rhizosphere as well as in the plant system, which in turn enhanced plant metabolism and photosynthetic activity resulting in better growth and development of plants and ultimately the yield. Similar results were also observed by Kumar *et al*. (2011) and Sepat and Yadav (2008) who reported increased yield contributing characters and yield of crops with sulphur fertilization.

Moth bean equivalent yield and economic returns

The productivity of intercropping system, measured as moth bean equivalent yield (MEY), was significantly higher in 2:1 row ratio (1016.1 kg ha^{-1}), which was 12.18 and 9.68% compared to sole moth bean and sesame, whereas it was at par to planting in 3:1 row ratio (Table 1). Similarly, intercropping in 2:1 row ratio also recorded 19.23 and 11.34% higher net returns (Rs. 24150 ha^{-1}) compared to sole moth bean and sesame. This was due to higher production per unit area in intercropping and higher price of produce compared to sole cropping (Prajapat *et al.,* 2012). Increasing levels of sulphur upto 40 kg ha^{-1} recorded significantly higher MEY (1022.7 kg ha^{-1}) and net returns (Rs. 24540 ha^{-1}). This increase with sulphur supply could be explained on the basis of beneficial effects of sulphur application on the yield contributing characters as well as yields of both the component crops. Similar results were also reported by Prajapat *et al.* (2011).

Conclusion

It was concluded that intercropping of moth bean+sesame in 2:1 row ratio gave significantly higher moth bean equivalent yield (1016.1 kg ha^{-1}) and net returns (Rs. 24150 ha^{-1}) closely followed by 3:1 row ratio. Application of 40 kg sulphur ha^{-1} also fetched significantly higher moth bean equivalent yield (1022.7 kg ha^{-1}) and net returns (Rs. 24540 ha^{-1}).

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