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Effect of Intercropping on Productivity and Profitability of Sesame under Dryland Arid Conditions

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Abstract

An experiment on sesame intercropping system was conducted during *kharif* (rainy) season of 2017 on sandy loam soil (8.72 pH, 0.88 EC dS m^{-1}), with low nitrogen (137 kg N ha^{-1}), medium phosphorus (14.4 kg ha^{-1}) and high potassium content (357 kg ha^{-1}) at Agricultural Research Station, Mandor, Jodhpur in randomized block design with 3 replications. Among 7 treatments (T1 – Sole Sesame, T2 – Sesame + Urdbean in 3:1, T3 – Sesame + Urdbean in 4:2, T4 – Sesame + Mungbean in 3:1, T5 – Sesame + Mungbean in 4:2, T6 – Sesame + Mothbean in 3:1, T7 – Sesame + Mothbean in 4:2 row ratio), it was found that intercropping of sesame with mungbean in ratio 3:1 resulted significantly higher total productivity and net returns (541 kg ha^{-1} & Rs. 18270 ha^{-1}) over sole sesame crop (344 kg ha^{-1} & Rs. 6156 ha^{-1}) followed by mungbean in 4:2 (490 kg ha^{-1} with net return of Rs. 15164 ha^{-1}) being at par with urdbean in 3:1 (473 kg ha^{-1} with net return of Rs. 14078 ha^{-1}). It was concluded that mungbean can be grown as a beneficial intercrop in sesame under dryland conditions of Rajasthan.

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Sesame (*Sesamum indicum* L.) is one of oldest oilseed crop[1] with excellent nutritional, medicinal, cosmetic and cooking qualities of the oil. The oil has wide applications in culinary, industry, engineering, and pharmaceuticals.[2] India leads in area, production and export of sesame seed in the world. However, productivity of sesame in India (291 kg ha^{-1}) is quite low[3] in comparison to the average yield of the world and major sesame producing countries mainly because of its cultivation under rainfed/dryland conditions on marginal, poor fertility soils. Sesame is arid climate resilient crop and is, therefore, grown on considerable area (1.59 lac ha) in western Rajasthan which comprises about 61% area of Rajasthan and receives very low rainfall. Millets, mothbean, mungbean and clusterbean are other low water requiring crops adapted to the area.[10] Under such conditions, cultivation of sole crop is a risky proposition, whereas different legumes prove more remunerative in the

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region due to their short duration and good market price. Intercropping is one of the strategies practiced under rainfed and dryland conditions to minimize risk of yield reduction or total crop failure due to inadequate or uncertain moisture availability during crop growth.[4, 5, 6, 7] Intercropping of sesame with legumes may prove more remunerative under such conditions. Therefore, present attempt was made to find out profitable sesame based intercropping system under western Rajasthan conditions.

Materials and Methods

The experiment was conducted at research farm of Agricultural Research Station, Mandor, Jodhpur during *kharif* (rainy) 2017. The soil of experimental field was sandy loam in texture, slightly alkaline (pH 8.72, EC 0.88 dS m^{-1}) in reaction, low in nitrogen (137 kg N ha^{-1}), medium in phosphorus (14.4 kg ha^{-1}) and rich in potassium content (357 kg ha^{-1}) in the 15 cm soil layer. Experiment was conducted in 7 treatments viz. (T1 – Sole Sesame, T2 – Sesame + Urdbean in 3:1, T3 – Sesame + Urdbean in 4:2, T4 – Sesame + Mungbean in 3:1, T5 – Sesame + Mungbean in 4:2, T6 – Sesame + Mothbean in 3:1, T7 – Sesame + Mothbean in 4:2 row ratio), replicated thrice under randomized block design. The component crops were sown as per treatments on 8th July, using variety RT 351 of sesame, GM 4 of mungbean, RMO 435 of mothbean and Local of urdbean. Application of 20 kg nitrogen and 25 kg phosphorus per ha was made through urea and DAP at the time of sowing.

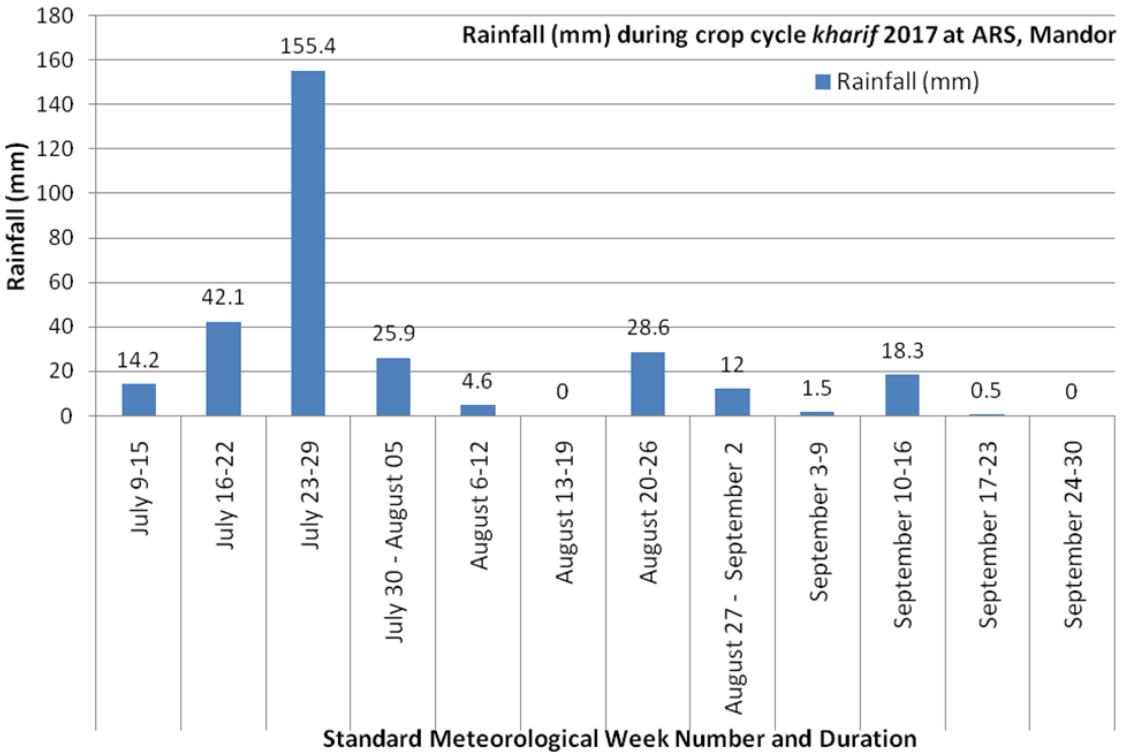

Fig. 1: Rainfall distribution pattern during the crop season

The crops were sown at row spacing of 30 cm. Seed rate of sole sesame was 3.0 kg ha^{-1} whereas it was 2.25 kg ha^{-1} in case of 3:1 row ratio and 2.0 kg ha^{-1} in 4:2 row ratio with intercrops. The seed rate of mothbean was 2.5 and 3.3 kg ha^{-1} in 3:1 and 4:2 row ratio, respectively. Seed rate of urdbean and mungbean was 3.0 and 4.0 kg ha^{-1} in 3:1 and 4:2 row ratio, respectively. Mothbean was earliest to mature in 68 days, urdbean and mugbean in 73 days and sesame was last to harvest at 82 days which were harvested on 14th September, 19th September and 28th September, 2017, respectively. Nutrients were

applied as per recommended dose of fertilizers in the package of practices for the region i.e. 20 nitrogen and 25 kg phosphorus per ha for rainfed condition. Rainfall of 303.1 mm was received in 24 rainy days during crop period between 28th to 38th meteorological week (MW) but bulk of total rainfall (155.4 mm) was received in a single week of 23-29 July (30th MW) just after two weeks of sowing (Fig. 1). The crop observations were recorded at harvest stage. Yields of component crops were converted into sesame seed equivalent yield using following formula:

Sesame Seed Equivalent Yield = [(Intercrop Seed Yield x Intercrop Seed Price) / Sesame Seed Price] + Sesame Seed Yield

The cost of cultivation of main crop was taken into account for calculating economics of treatments as yield was converted into equivalent yield and expressed as gross return, net return (Rs. ha^{-1}) and benefit cost ratio (B:C). Investments on inputs and labour for different field operations etc., were worked out on market prices prevailing at Jodhpur. The gross return was computed by multiplying current price of sesame with sesame equivalent yield. The net return was estimated by deducting cost of cultivation from gross return. The benefit-cost ratio was worked out by dividing gross return by cost of cultivation.

Result and Discussion

Growth and yield

Plant height, number of branches per plant and capsules per plant of sesame were not influenced significantly by different inter crops *viz.,* urdbean, mungbean and mothbean in 3:1 and 4:2 ratios (Table 1). However marginally higher plant height, number of branches per plant and capsules per plant of sesame were recorded in intercropping with mungbean in 3:1 ratio than other component crops. Grain yield was significantly influenced by different row ratios of intercrops. Though yield of sole sesame was significantly higher than its yield under intercropping with different component crops, sesame seed equivalent yield was significantly higher in intercropping of sesame with mungbean in 3:1 followed by the same intercrop in 4:2 (Table 2). Sesame seed equivalent yield with urdbean was also significantly higher than sole sesame. Similar findings of more productivity due to intercrops were also reported in soybean[8] and sesame.[9]

Table 1: Plant height, number of branches, capsules per plant and seed yield of component crops

Treatments	Plant height (cm)		Number of branches ($plant^{-1}$)		Capsules/pods ($plant^{-1}$)		Seed yield (kg ha^{-1})	
	Sesame	Intercrop	Sesame	Intercrop	Sesame	Intercrop	Sesame	Intercrop
T1	135.5	-	1.97	-	61.6	-	344	-
T2	129.3	70.3	2.09	7.04	59.0	26.6	285	231
T3	128.5	67.5	2.07	6.35	56.1	24.1	265	223
T4	136.9	74.0	2.17	8.76	61.5	29.8	321	311
T5	131.2	73.7	2.11	7.70	60.1	27.3	291	282
T6	132.7	36.7	2.00	7.33	53.6	98.1	221	236
T7	130.3	36.1	1.93	6.58	51.5	97.4	221	235
SEm ±	8.03	4.53	0.13	0.54	4.18	2.64	27.2	29.5
CD at 5%	NS	13.95	NS	1.68	NS	8.13	83.8	90.9
CV (%)	10.5	11.1	10.6	14.4	12.6	8.8	11.3	12.8

Economics of Sesame Intercropping

The maximum returns with B:C ratio of 2.2 was recorded due to intercropping of sesame with mungbean in row ratio of 3:1 followed by same intercrop in 4:2 row ratio (Table 2). The higher price of produce of mungbean as well seed yield of mungbean was responsible factor for higher return as sesame seed equivalent yield is the function of

yield and price. The intercropping of sesame with urdbean was next profitable system due to higher price of urdbean. Higher benefit cost ratio (2.15) was also achieved in three rows of groundnut within paired rows of sesame compared to other intercropping and sole cropping systems.[9]

Table 2: Sesame seed equivalent yield, gross returns, net returns and benefit : cost ratio of sesame intercropping treatments

Treatments	Sesame seed equivalent yield (kg ha^{-1})	Gross income (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
T1	344	21156	6156	1.41
T2	473	29078	14078	1.94
T3	446	27448	12448	1.83
T4	541	33270	18270	2.22
T5	490	30164	15164	2.01
T6	346	21262	6262	1.42
T7	345	21229	6229	1.42
SEm ±	32.1			
CD at 5%	98.8			
CV (%)	8.7			

(Seed price: sesame Rs. 61.5 kg^{-1}, mungbean Rs. 43.5 kg^{-1}, mothbean Rs. 32.5 kg^{-1}, urdbean Rs. 50 kg^{-1})

Conclusion

The variable rainfall condition is quite common in arid and semi arid regions; the sesame productivity under sole crop cannot be assured. In such condition, mungbean can be grown and recommended as intercrop with sesame in row ratio of 3:1 and 4:2 for higher productivity and profitability in western Rajasthan.

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Conflict of Interest

Author has no conflict of interest of any type.

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