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Yield And Economics of Sesame Based Cropping System In North Coastal Zone of Andhra Pradesh

B.RAJENDRA KUMAR[1], S.GOVINDA RAO[2*] and P.KONDABABU[3]

[1,2]Agricultural College, Naira-532185 Acharya N.G.Ranga Agricultural University, Andhra Pradesh, India.
[3]Department of Statistics, MR College (A) Vizianagaram, Andhra Pradesh, India.

Abstract

A field experiment was conducted during 2011 *rabi* and 2012 *kharif* at Agricultural Research Station, Yellamanchili. In the first year of experimentation *rabi* 2011-12, sole crop sesamum was sown in bulk as base crop or main crop to study sesame based cropping system with other sequential crops greengram, groundnut, cowpea, ragi, fodder cowpea and sunhemp, sunhemp fodder sown during *kharif* . Average yield of sesamum sown during *rabi* was 380 kg/ha. During *kharif* 2012 all the crops were sown on 12-06-2012, the yields realized by different crops were converted into sesamum equivalent yield. The prevailing sesame- horsegram sequence cropping system is not at all remunerative to the farmers and hence introduction of new crops in the cropping system with, Maize, Ragi, ID crops and with other cropping systems were tried when there is deficit in rain fall for maximum profitability. The initial soil sample analysis revealed a pH of 6.7, Electrical Conductivity dsm^{-1} of 0.17, Organic Carbon % of 0.51in the experimental site. Available N was 247 kg/ha, P_2O_5 29 and available K_2O was 262 kg/ha. The results revealed that the cost of cultivation, gross income, net income and the BC ratio was highest for T7 (Sesame-maize). The same is the case with *rabi* season also, where in the net income and the benefit cost ratio was Rs.50329 and 4.35, respectively. In the cropping sequence, highest BC ratio was recorded with T7- Sesame- maize - sunhemp (Green manure) 3.91 with sesamum and maize crop only, Green manure crop (Sunhemp) is an added advantage crop to improve soil fertility. The other highest recorded B C ratio was with Sesamum-ragi and Sesamum- cowpea based cropping system with 2.92 and 2.83.

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CONTACT S.Govinda Rao govinda.seepana@gmail.com Agricultural College, Naira-532185 Acharya N.G.Ranga Agricultural University, Andhra Pradesh, India.

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Introduction

Sesame (*Sesamum indicum* L.) is one of the most versatile and survivor crops that can be grown in semi-arid and arid regions. It has unique attributes that can fit almost any cropping system being a short duration crop with a potential to sustainable intensify crop production through crop diversification (Weiss, 2000). This evidently indicates the potentiality for improvement in yield. Worldwide sesame seed consumption was USD 6559.0 million in 2018, and it will reach USD 7244.9 million by 2024, with a CAGR (compound annual growth rate) of 1.7% Global sesame consumption is steadily increasing mainly due to changing consumer's consumption patterns and increasing health awareness. According to Directorate of Economics and Statistics (2019), India ranks first in world with 19.47 lakhs ha area and 8.66 lakhs tones production. The average yield of sesame (413 kg/ha) in India is low as compared with other countries in the world (535 kg / ha). The main reasons for low productivity of sesame are its rainfed cultivation in marginal and sub marginal lands under poor management and input starved conditions. However, improved varieties and agro production technologies capable of increasing the productivity levels of sesame are now developed for different agro ecological situations in the country. A well managed crop of sesame can yield 1200 - 1500 kg/ha under irrigated and 800 - 1000 kg/ ha under rainfed conditions (FAOSTAT, 2017). The crop is grown in almost all parts of the country. More than 85% production of sesame comes from West Bengal, Madhya Pradesh, Rajasthan, Uttar Pradesh, Gujarat, Andhra Pradesh (A.P) and Telangana. Identification of a remunerative and stable cropping system for the rainfed areas of north-coastal zone (NCZ) will stabilize the farm income of the small and marginal farmers. Hence a experimental study was undertaken at Agricultural Research Station, Yelamanchili of Visakhapatnam district in Andhra Pradesh.

Materials and Methods

The experiment was laid out in a randomized complete block design with 7 different sesame-based cropping systems treatments replicated three times. Sequential cropping systems were followed; comprising sesame was sown as *rabi* crop and followed by greengram, groundnut, cowpea, ragi, fodder cowpea and sunhemp, Sun hemp fodder as sequence crops during *kharif*. Green gram and cowpea crops of short duration also grown after *rabi* crops. A total of seven crops were grown in 21 experimental plots with gross plot area of 60/m^2.

T1 - Sesame- Cowpea- Sesamum
T2 - Ragi- Green gram- Sesamum
T3 - Ragi- Cowpea (Fodder)- Sesamum
T4 - Green gram - cowpea - Sesamum
T5 - Ground nut - Green gram - Sesamum
T6 - Ground nut- Sunhemp (Green manure) - Sesamum
T7 - Maize - Sunhemp (Green manure) – Sesamum

In the first year of experimentation *rabi* 2011-12. Sole crop sesamum was sown in bulk as base crop or main crop to study sesame based cropping system with other crops which is prevalent in this area. Average yield of sesamum sown during *rabi* was 380 kg/ha. During *kharif* 2012 all the crops were sown on 12-06-2012, the yields realized by different crops were converted into sesamum equivalent yield.

The prevailing sesame- horsegram sequence cropping system is not at all remunerative to the farmers and hence introduction of new crops in the cropping system with, maize, ragi, ground nut, green gram and sesamum crops were tried when there is deficit in rain fall for maximum profitability. Data on Soil available N, P, K, economic yield/plot and Economics were collected to identify the superior sesame based cropping systems. Net returns was calculated and included in pooled data. Sesame equivalent yield was obtained by adding the yield of sesame and that of the different intercrops and their by-products multiplied by their current respective prices in the local market over the price of sesame. Only the operating costs were taken into consideration while calculating the cost of cultivation of sesame based cropping systems tested in the experiment. The economic impact of the cropping systems was observed through Gross income, Net Income, Cost of cultivation and the B: C ratio.

Gross Returns

Refers to returns calculated in Rupees after selling the produce and without deducting the input cost.

Net Returns
Refers to returns calculated in Rupees after selling the produce and after deducting the input and labour cost.

Cost of Cultivation
Refers to cost of all inputs and labour cost.

Benefit Cost Ratio
It is the ratio of rupee gained for rupee invested.

Sesamum equivalent yield = Yield of *rabi* crops (kg) × Price of *rabi* crops/kg / Price of sesamum/kg

Results and Discussion
The results of the initial soil sample analysis revealed a pH of 6.7, EC ds/m of 0.17, OC% of 0.51in the experimental site. Available N was 247 kg/ha, P_2O_5 29 kg/ha and available K_20 was 262 kg/ha. The yield data pertaining to different crops that are grown after sesamum and during *kharif* 2012 were presented in table -1. Superior yield was recorded in maize, ragi and groundnut respectively than green gram and sesamum.

The yields of the respective crops were converted into their equivalent yields in order to compare the performance of the different sesame based cropping systems. The results presented in the table-2 revealed that sesame –maize (T7) recorded highest yield with an equivalent yield of 1089 kg followed by sesame- ragi (T2) which yielded 399 kg.

Table 1: Crops sown during Kharif, 2012

Treatments	Variety	Yield (kg/ha)	Date of sowing	Date of harvest
T1- Sesamum 10.9.2012	YLM -17	261		
T2- Ragi	VR-847	1596		17.10.2012
T3- Ragi	VR-847	1525		17.10.2012
T4- Green gram	TM96-2	257	12-06-2012	20.8.2012
T5- Groundnut	Vemana	875		8.10.2012
T6- Groundnut	Vemana	840		8.10.2012
T7- Maize	SIRI 4455 (Hybrid maize)	43553 (Green cobs)		30.8.2012

Table 2: Sesamum equivalent yield and gross income of the crops grown during Kharif, 2012

Treatments	Yield (kg/ha)	Gross income (Rs)	Sesamum equivalent yield (kg)
T1- Sesamum	261	@60 =15660	261
T2- Ragi	1596	@15 =23940	399
T3- Ragi fodder	1525	@15 =22875	381
T4- Green gram	257	@55 =14135	235
T5- Groundnut	875	@20 =17500	292
T6- Groundnut	840	@20 =16800	280
T7- Maize	43553 (Green cobs)	@1.50=65329	1089

During *rabi* 2012 crops sown were cowpea for fodder and grain purpose, green gram and sunhemp for green manure were sown and the yields were presented in table 3. sesamum equivalent yield of cowpea for grain purpose 381 kg performed better than sesamum (Check) and other crops, sesamum equivalent yield of all the other crops were recorded inferior than the check presented in table 4. The highest net profit in the systems having cowpea was due to the increased net primary productivity. These results are in conformity with Brij (Nandan *et al.,* 2013). The equivalent yields calculated in order to compare the performance of the different sesame based cropping systems during *rabi*, 2012 revealed that sesame – cowpea (T4) yielded highest with an equivalent yield of 381 kg.

Table 3: Crops grown during Rabi, 2012

Treatments	Variety	Yield (kg/ha)	Date of sowing	Date of harvest
T1- Cowpea	Local	438	17.9.2012	3.1.2013
T2- Green gram	TM96-2	308	20.10.2012	23.12.12
T3- Cowpea fodder	Local	24433	20.10.2012	5.1.2013
T4- Cowpea	Local	457	17.9.2012	3.1.2013
T5- Green gram	TM96-2	279	17.9.2012	20.11.12
T6- Sunhemp (GM)	Local	11116	20.10.2012	8.12.12
T7- Sunhemp (GM)	Local	10783	20.10.2012	8.12.12

Economics of the sesame- based cropping system was presented in table 5. The cost of cultivation, Gross income, net income and B:C ratio were worked out for the sesame based cropping systems that were tested during the conduct of the experiment. he results revealed that the cost of cultivation, Gross income, net income and the BC ratio was highest for T7 (Sesame-maize). The same is the case with *rabi* season also, where in the net income and the benefit cost ratio was Rs.50329 and 4.35, respectively. Such yield advantage might be due to combined yield of both the crops. The results are in agreement with the finding of Islam *et al.,* (2016). To study the consistent performance of various sequences with sesame the pooled data of three seasons were analyzed and the economic impact of the cropping systems was observed through Gross income, Net income, cost of cultivation and the B:C ratio. Highest BC ratio was recorded with T7- Sesame- maize - sunhemp (Green manure) 3.91 with sesamum and maize crop only, Green manure crop (Sunhemp) is an added advantage crop to improve soil fertility. These findings are in conformity with Islam *et al.,* (2016). The other highest recorded B C ratio was with T3 Sesame-ragi- cowpea based cropping system with 2.92 and 2.83.

Table 4: Sesamum equivalent yield and gross income of the crops grown during Rabi, 2012

Treatments	Variety	Yield (kg/ha)	Gross income	Sesamum equivalent (Rs) yield (kg)
T1- Sesame	Local	438	@50 =21900	365
T2- Green gram	TM96-2	308	@55 =16940	282
T3- Cowpea fodder	Local	24433	@0.5 =12216	204
T4- Cowpea	Local	457	@50 =22850	381
T5- Green gram	TM96-2	279	@55 =15345	256
T6- Sunhemp (GM)	Local	11116	-----	--
T7- Sunhemp (GM)	Local)	10783	------	--

Table 5: Economics of the sesame based cropping systems during Kharif, 2012

Treatments For Kharif	Gross income (Rs)	Cost of cultivation (Rs)	Net income (Rs)	BC ratio
T1-Sesamum	15660	7000	8660	2.23
T2- Ragi	23940	8000	15940	2.99
T3-Ragi	22884	8000	14884	2.86
T4-Green gram	14135	6000	8135	2.35
T5-Ground nut	17500	10000	7500	1.75
T6- Ground nut	16800	10000	6800	1.65
T7- Maize	65329	15000	50329	4.35

Table 6: Economic Impact of the sesame based cropping system (Pooled data of three seasons)

Treatments	Total Gross income (Rs)	Cost of cultivation (Rs)	Net returns (Rs)	BC ratio
T1 - Sesame- Sesame- Cowpea	60360	22000	38360	2.74
T2 - Sesame -Ragi- Green gram	63680	22500	41180	2.83
T3 - Sesame - Ragi- Cowpea (Fodder)	61400	21000	40400	2.92
T4 - Sesame- Green gram – cowpea	59815	23500	36315	2.54
T5 - Seasme- Ground nut - Green gram.	55663	23500	32163	2.36
T6- Sesame- Ground nut- Sun hemp (Green manure)	39600	17500	22100	2.26
T7 - Sesame- Maize - Sun hemp (Green manure)	88129	22500	65629	3.91

Summary and Conclusions

In the first year of experimentation *rabi* 2011-12. Sole crop sesamum was sown in bulk as base crop or main crop to study sesame based cropping system with other crops. Average yield of sesamum sown during *rabi* was 380 kg/ha. This result corroborates with the findings of Uddin *et al.,* (2003). During *kharif*, 2012 all the crops were sown on 12-06-2012, the yields realized by different crops were converted into sesamum equivalent yield. Highest sesamum equivalent yield was realized by Maize -SIRI 4455 (Hybrid maize) 1089 kg/ha and Ragi 399 kg/ha when compared with sesamum 261 kg/ha (check). Green gram recorded lowest with 235 kg/ha. Net income and BC ratio was also high in maize 50,329 and 4.35 followed by ragi 15,940 and 2.99.lowest BC ratio was recorded with Ground nut crop with 1.75. The results are in conformity with the results obtained by Oyeogbe *et al.,* (2015).

Crops sown after *kharif* need to be given with two-three life saving irrigations to realize good harvest. As the crops sown during *kharif* was harvested during September, October there was a gap for three months during this period short duration crops and soil enriching crops like fodder crops and Green manure crops can be taken up with the little available moisture as the *rabi* sesamum will be sown during 2nd fortnight of December to 1st fortnight of January. The crops sown after *kharif* were between 17-9-2012 to 20-102012. Out of the crops sown after *kharif* cowpea recorded highest sesamum equivalent yield with 365 and 381 kg/ha, followed by Green gram 282and 256 kg/ha. B C ratio of 2.92

and 3.05 with cowpea crop and 2.82 and 2.56 with green gram crop.

Pooled results with the three seasons data was calculated in terms of total gross income, cost of cultivation and BC ratio. Highest BC ratio was recorded with T7- Sesame- maize - sun hemp (Green manure) 3.91 with sesamum and maize crop only, Green manure crop (Sunhemp) is an added advantage crop to improve soil fertility. The other highest recorded B C ratio was with ragi and cowpea based cropping system with 2.92 and 2.83.

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Conflict of Interest

The authors do not have any conflict of interest.

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