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Research Article

Integrated Nutrient Management for Yield and Economics of Summer Gingelly (*Sesamum Indicum* L.) In-Rice-Gingelly-Maize Cropping System through Integrated Farming System

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Abstract

A field experiment was conducted during summer seasons of 2014-15 and 2015-16 at Tamil Nadu Agricultural University, coimbatore in a clay loam soil, wetland to study the response of gingelly to integrated nutrient management practices. Thirteen treatments were allotted to the randomized block design with three replications. Yield were higher for integrated nutrient management of resulting in higher seed yield in 100% RDF + vermicompost 5 t/ha (T_1) 910 kg/ha, Stalk yield 4040 kg/ha, Harvest Index 0.23, net returns Rs.27120/ha, benefit cost ratio 2.2 and this on par with 100% RDF + goat manure as pondsilt 5 t/ha(T_1) 885 kg/ha Stalk yield 3650 kg/ha, Harvest Index 0.22.The net returns Rs.25745/ha, benefit cost ratio 2.12 for 2014-15 duration. The similar results followed resulting in higher seed yield in100% RDF + vermicompost 5 t/ha (T_1) 922 kg/ha, Stalk yield 4190 kg/ha, Harvest Index 0.22, net returns Rs 27780 benefit cost ratio 2.21 and this onpar with 100% RDF + goat manure as pondsilt 5 t/ha (T_4) 878 kg/ha Stalk yield 4160 kg/ha, Harvest Index 0.21. The net returns Rs25360 benefit cost ratio (2.11) for the duration of 2015-16.Thisfollowed treatment comparable to the75% RDF+ vermicompost. It was expressed better yield and economics in integrated nutrient management for gingelly (*Sesamum indicum* L.) in-rice-gingelly-maize cropping system through integrated farming system.

Keywords: nutrient management, integrated farming, cropping system, gingelly

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Introduction

Gingelly (*Sesamum indicum* L.) is queen of oilseeds. The Technology Mission on Oilseeds, launched in 1986, envisaged a production boost largely contributed by oilseeds like rapeseed mustard, groundnut, soybean and sunflower. India became the self-sufficient in edible oils by early 1990's and thereafter, the gap between demand and production have widened radically. At present, India imports more than 40% of its annual edible oil need amounting to Rs.11,000 crores to the exchequer. Gingelly (*Sesamum indicum* L.), the ancient oilseed crop of India having 50% oil, 25% protein and vitamins, minerals and antioxidants is grown in 1.74m ha area with productivity of 421 kg/ha. In eastern India, the crop is successfully grown, in all the seasons and more so in the summer season. But, its productivity is low because it is grown in marginal lands with least external nutrient supply and limited water. However, [1] recorded positive response of gingelly to application of integrated nutrient management and water in croppping system. Similarly, [2] and [3] reported that increasing NPK level up to 150% resulted in better yield attributes and yield. Application of 75 + 25.8 + 49.8 kg N + P + K/ha increased biometric parameters, yield attributes and yields of gingelly in West Bengal [4]. [5] found that conjunctive use of inorganic fertilizers with organics influenced soil water content and increased seed yield of gingelly. However, studies on response of the crop to water regimes under different fertility levels in general and to Integrated nutrient management practices in particular are scanty. Hence, this study was made to find out the optimum integrated nutrient management to gingelly in rice-gingelly-maize cropping system through integrated farming system.

Materials and Methods

The experiment was conducted at the wetland farm, Tamil Nadu Agricultural university, Coimbatore, Tamil Nadu situated at 11' N latitude, 77' E longitude and 426.7 meters above mean sea level during the *summer* seasons of 2014-2015 and 2015-2016. The soil of the experimental site was clay loam in texture with pH 8.42 organic carbon 5.4 g/kg and available N, P and K, 310, 12.9 and 712 kg/ha. The total amounts of rainfall received during the cropping seasons were 198.4 and 163.7 mm, respectively. The mean maximum and minimum temperatures of both the seasons were within the optimal range of 27.6, 36.2 ^{0}C and 18.1, 25.5 ^{0}C, 27.3, 37.9 and 16.7, 26.0 ^{0}C in 2014-15 and 2015-16, respectively. The experiment was laid out in a randamized block design with three replications and thirteen treatments. The physic chemical characteristics according to the methods as described measurements are presented in **Table 1**. Vermicompost, FYM, Turkey manure as pond silt, Quail manure as pond silt and Goat manure as pond silt used as OM for field application and inorganic fertilizer.OM were applied before transplanting of rice only. Treatment details wise applied (**Table 2**). As regards to fertilizers, was applied basal. Gingelly (TMV 7) @ 5 kg seed/ha was sown at 30 x 30 cm spacing Observations on crop yield were recorded yield Parameters. The economics was calculated as per the official market price for different commodities.

General view of field experiment

Table 1 Physico chemical characteristics of the experimental field

Physical properties	Units	Quantity
a. Mechanical analysis		
1. Sand	(%)	36.40
2. Silt	(%)	19.20
3. Clay	(%)	44.10
2. Chemical properties		
a. pH (1:2.5 soil/water)	-	8.42
b. Electric conductivity	(ds/m)	0.39
c. Organic carbon	(Kg/ha)	0.54
d. Available Nitrogen	(Kg/ha)	30
e. Bray-P(Kg ha^{-1})	(Kg/ha)	12.90
f. NH_4OAC-K	(Kg/ha)	712

Table 2 Treatments Details

T_1	100% RDF +vermicompost 5 t/ha
T_2	100% RDF + turkey manure as pondsilt 5 t/ha
T_3	100% RDF + quail manure as pondsilt 5 t/ha
T_4	100% RDF + goat manure as pondsilt 5 t/ha
T_5	75% RDF + vermicompost 5 t/ha
T_6	75% RDF + turkey manure as pondsilt 5 t/ha
T_7	75% RDF + quail manure as pondsilt 5 t/ha
T_8	75% RDF + goat manure as pondsilt 5 t/ha
T_9	50 % RDF + vermicompost 5 t/ha
T_{10}	50 % RDF + turkey manure as pondsilt 5 t/ha
T_{11}	50 % RDF + quail manure as pondsilt 5 t/ha
T_{12}	50 % RDF + goat manure as pondsilt 5 t/ha
T_{13}	RDF+ FYM 12.5 t/ha
	RDF: As per the recommendation to individual crop
	OM : First crop in the system

Results and Discussion

Seedyield, stalk yield, harvest index and economics

Data on seed yield, stalk yield, harvest index and economics of plants due integrated nutrient management (**Tables 3** and **4**) revealed that nutrient the gingelly crop. Yield were higher for integrated nutrient management of resulting higher in 100% RDF + vermicmpost 5 t/ha (T_1) 910 kg/ha, Stalk yield 4040 kg/ha, Harvest Index 0.23 and this on par with 100% RDF + goat manure as pondsilt 5 t/ha 885 kg/ha Stalk yield 3650 kg/ha, Harvest Index 0.22.The net returns Rs.27120/ha, benefit cost ratio 2.2 for 2014-15 duration. The similar results followed resulting in higher seed yield in100% RDF + vermicmpost 5 t/ha (T_1) 922 kg/ha, Stalk yield 4190 kg/ha, Harvest Index 0.22 and this onpar with 100% RDF + goat manure as pondsilt 5 t/ha 878 kg/ha Stalk yield 4160 kg/ha, Harvest Index 0.21. The net returns Rs 25745 benefit cost ratio 2.11 for the duration of 2015-16.

Table 3 Effect of Integrated nutrient management on seed yield (kg/ha), stalk yield (kg/ha) and harvest index of gingelly in rice-gingelly-maize cropping system

Treatment	2014-2015			2015-2016		
	Seed yield (kg/ha)	Stalk yield (kg/ha)	Harvest Index	Seed yield (kg/ha)	Stalk yield (kg/ha)	Harvest Index
T_1 - 100% RDF + vermicompost	910	4040	0.23	922	4190	0.22
T_2 - 100% RDF + turkey manure as pondsilt	812	3650	0.22	838	4085	0.21
T_3 - 100% RDF + quail manure as pondsilt	790	3708	0.21	802	3858	0.21
T_4 - 100% RDF + goat manure as pondsilt	885	3880	0.23	878	4160	0.21
T_5 - 75% RDF + vermicompost	705	3640	0.19	822	3790	0.22
T_6 - 75% RDF + turkey manure as pondsilt	635	3398	0.19	715	3548	0.20
T_7 - 75% RDF + quail manure as pondsilt	608	3170	0.19	698	3520	0.20
T_8 - 75% RDF + goat manure as pondsilt	680	3595	0.19	776	3745	0.21
T_9 - 50% RDF + vermicompost	650	3418	0.19	684	3568	0.19
T_{10} - 50% RDF + turkey manure as pondsilt	580	3183	0.18	630	3333	0.19
T_{11} - 50% RDF + quail manure as pondsilt	548	2950	0.19	598	3100	0.19
T_{12} - 50% RDF + goat manure as pondsilt	612	3210	0.19	654	3420	0.19
T_{13} - 100% RDF + FYM at 12. 5 t/ha	810	3920	0.21	816	4050	0.20
SEd	27	141	0.005	29	129	0.006
CD (P = 0.05)	58	286	NS	62	260	NS
T_1 to T_{12}- Organic manure at 5t/ha						

Table 4 Integrated nutrient management on economics of gingelly in rice-gingelly-maize cropping system

Treatment	2014-2015				2015-2016			
	Cost of cultivation	Gross return (Rs./ha)	Net return (Rs./ha)	BC ratio	Cost of cultivation	Gross return (Rs./ha)	Net return (Rs./ha)	BC ratio
T_1 - 100% RDF + vermicompost	22930	50050	27120	2.18	22930	50710	27780	2.21
T_2 - 100% RDF + turkey manure as pondsilt	22930	44660	21730	1.95	22930	46090	23160	2.01
T_3 - 100% RDF + quail manure as pondsilt	22930	43450	20520	1.89	22930	44110	21180	1.92
T_4 - 100% RDF + goat manure as pondsilt	22930	48675	25745	2.12	22930	48290	25360	2.11
T_5 - 75% RDF + vermicompost	21880	38775	16895	1.77	21880	45210	23330	2.07
T_6 - 75% RDF + turkey manure as pondsilt	21880	34925	13045	1.60	21880	39325	17445	1.80
T_7 - 75% RDF + quail manure as pondsilt	21880	33440	11560	1.53	21880	38390	16510	1.75
T_8 - 75% RDF + goat manure as pondsilt	21880	37400	15520	1.71	21880	42680	20800	1.95
T_9 - 50% RDF + vermicompost	21440	35750	14310	1.67	21440	37620	16180	1.75
T_{10} - 50% RDF + turkey manure as pondsilt	21440	31900	10460	1.49	21440	34650	13210	1.62
T_{11} - 50% RDF + quail manure as pondsilt	21440	30140	8700	1.41	21440	32890	11450	1.53
T_{12} - 50% RDF + goat manure as pondsilt	21440	33660	12220	1.57	21440	35970	14530	1.68
T_{13} - 100% RDF + FYM at 12. 5 t/ha	21440	44550	23110	2.08	21440	44880	23440	2.09
T_1 to T_{12}: Organic manure at 5t/ha; DAS: Days after sowing; Data not statistically analysed								

This followed treatment comparable to the 75% RDF+ vermicompost (**Figures 1** and **2**). This might be due to the beneficial effect of combined use of fertilizers and organic manure during cropping system where, vermicompost improved the physico-chemical and biological properties of soil such as water holding capacity, availability of macro and micronutrients and better microbial nutrient activity in the root zone of plant to support vegetative growth to yield [6]. While, [5] reported positive response of sesame to NPK application and higher solar radiation absorbtion, [7] reported improved vegetative growth to yield due to application of organic manure with fertilizers. The interaction effect of organic manure and fertilizer and higher photosynthesis by solar radiation was significant for all growth to yield then provide better return. Gingelly crop grown in clay loam soil during summer season can be recommended for higher productivity and profitability by higher water holding capacity and nutrient dynamics and soil extraction pattern in the effective root zone depth to be under different integrated nutrient management practices was to provide better economics. The similar findings were reported by [8], [9] and [10].

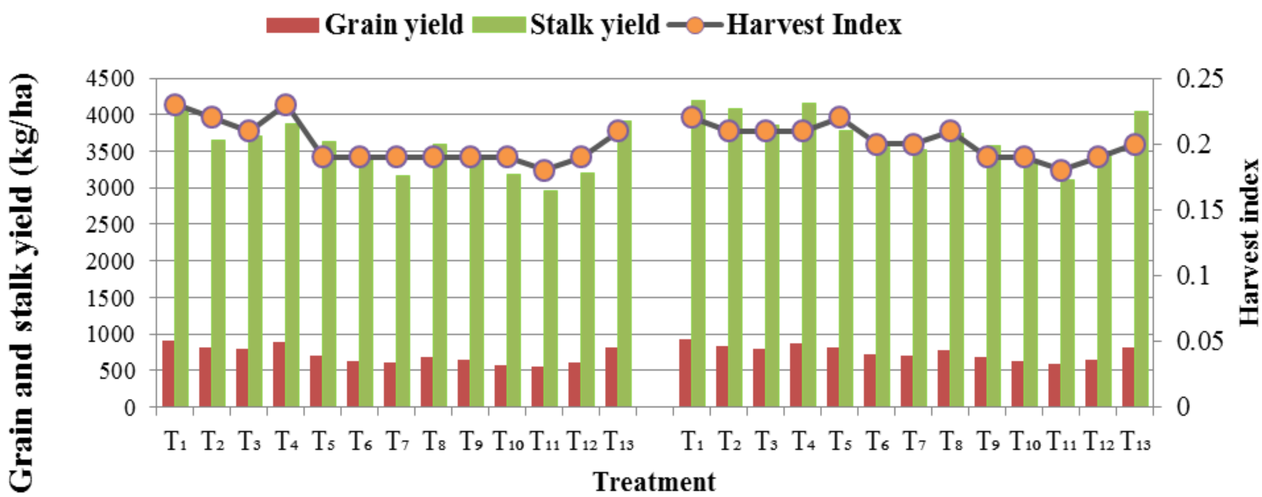

Figure 1 Influence of integrated nutrient management on yield and harvest index of gingelly in rice-gingelly-maize cropping system

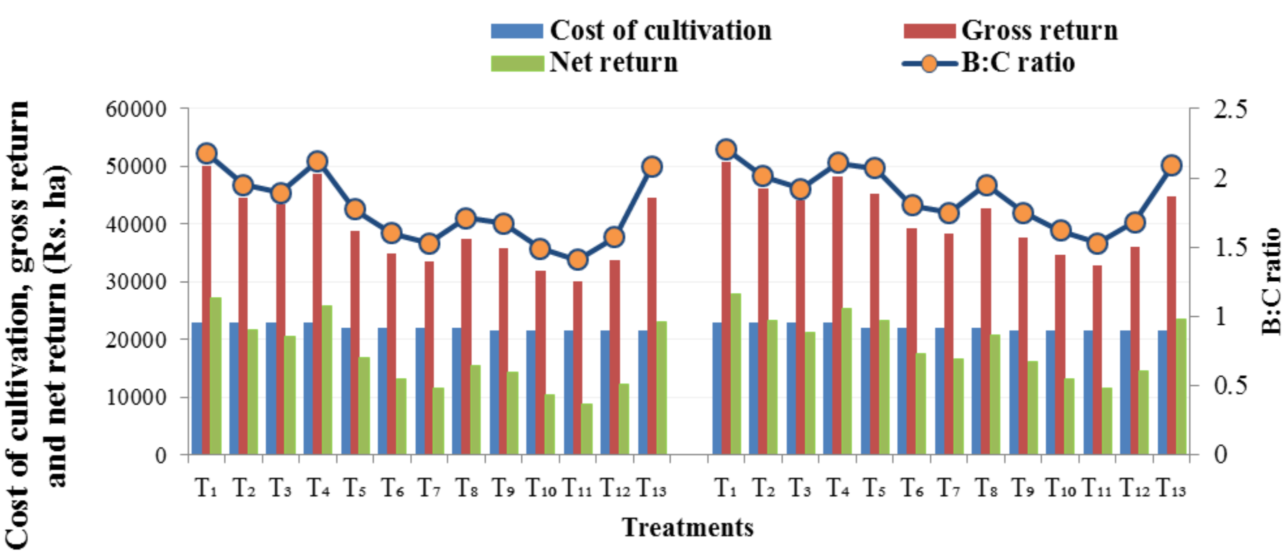

Figure 2 Influence of integrated nutrient management on economics of gingelly in rice-gingelly-maize cropping system

Conclusion

The established beneficial effect of integrated nutrient management was improving the physico-chemical properties of soil and enhancing availability of nutrients. This due to integrated use of nutrients was gave better yield100% RDF + vermicmpost 5 t/ha on a par followed by the 100% RDF + turkey manure as pond silt and FYM first sequence followed the second sequence arrived on a par followed by 75% RDF + vermicompost. So the cropping system to minimized the fertilizer usage and finally optimization of fertilizer and sustainability followed.

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