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Research Paper

Effect of integrated organic sources of nutrients on quality and economics of groundnut (*Arachis hypogaea* L.)

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ABSTRACT

A field experiment was conducted during *Kharif* season 2008 at farmer's field, Chintamani Taulk, Karnataka, to evolve integrated organic nutrient management practices for quality and economics of groundnut under rainfed condition. Quality parameters like protein content (22.4%), oil and protein yield (648.6 kg $ha^{-1}$and 363.2kg ha^{-1}, respectively) were significantly higher with application of FYM (7.5 t/ha^{-1}) + *Rhizobium* + PSB + Panchagavya spray (3% at 30, 60 and 75 DAS) as compared with other treatments. However, oil content did not differ significantly. The highest net monetary returns (Rs. 45,201 ha^{-1}) and benefit: cost ratio (2.66) were recorded with application of FYM (7.5 t/ha^{-1}) + *Rhizobium*+ PSB (10 kg each ha^{-1}) + Panchagavya (3% @ 30, 60 and 75 DAS) followed by FYM + *Rhizobium* + PSB (10 kg each ha^{-1}) + bio-digester based on N equivalent (2.41).

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Key words : Organic manures, Panchagavya, Jeevamruta, Yield, Quality, Economics

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is the world's fourth important source of edible oil and third important source of vegetable protein. The low level of productivity of groundnut in India has been ascribed to several constraints. Soils low in organic matter content, poor in fertility status are considered to be the major problem. The ever- increasing cost of chemical fertilizer has made it to be realized once again that organic material will have to be utilized judiciously to maintain and improve the soil fertility and productivity. Hence, an attempt was made to investigate the effect of integrated organic sources of nutrients on production and quality of groundnut.

MATERIALS AND METHODS

Field experiment was conducted at farmer's field, Chintamani, Karnataka state during *Kharif* season 2008. The texture of soil was red sandy loam having neutral pH with organic carbon (0.66%), available nitrogen (256.14 kg ha^{-1}), phosphorus (37.45 kg ha^{-1}) and potassium (381.6 kg ha^{-1}). The variety used was CTMG 1. The experiment was laid out in a Randomized Complete Block Design with three replications involving 12 treatments. The biofertilizers are enriched with bulky organic manures and oil cakes. Liquid organic manures like 3% Panchagavya was sprayed @ 30, 60 and 75DAS and Jeevamruta and Bio-digester were analyzed for its nitrogen content (prior to application), on the basis of nitrogen content required quantity of Jeevamruta was applied in treatment T_6 and T_9 and bio-digester with 1:10 dilutions (Bio-digester**:** water) was applied in treatment T_8 and $T_{11.}$ Both Jeevamruta and Bio-digester were applied four times *i.e.* three hours before sowing, 30, 60 and 90 days after sowing (DAS).

Panchagavya stock solution was prepared by using following ingredients and method. 7 kg cow dung and 1 kg cow ghee were mixed well and kept for 2 days; 2 l cow urine and 10 l water were added to the mixture and left for 15 days; Then 3 l of sugarcane juice + 2 l of cow milk + 2 l of curd + 2 l tender coconut water + 250 g jaggary + 1kg ripened banana were added to accelerate the fermentation. All the materials were added to a wide

mouthed pot and kept under shade. The mixture was left for 14 days and stirred twice a day for about 20 minutes both in morning and evening and then filtered. Jeevamrutha: A plastic drum of 200 l capacity was filled with 90 L of water. Cattle dung (5 kg) was mixed with 10 l water in a bucket and this mixture was added to drum followed by stirring with long stick. Then 5 l cattle urine was poured slowly with continuous stirring. Jaggery (1 kg) was crushed to small pieces with pestle and mortar and added to drum with continuous stirring. Pulse flour (1kg) was added slowly to mixture with stirring to avoid formation of flour clods. One handful fertile soil was added to above mixture as source of beneficial micro-organisms. Jeevamruta was stirred well until mixture become homogenous. The drum was covered with plastic lid. Jeevamruta was incubated for 120-144 hours. Jevamruta was stirred twice in a day (morning- evening) during its incubation period. Bio-digester: It was prepared in a small compost pit wherein the cattle shed washings and other liquid organic wastes were spread on the manure collected in the pit. The manure was aerated frequently for faster decomposition at fortnight intervals. The liquid residue was collected in the bottom corner side of the compost pit. The collected liquid residue manure was used for application in the field. The crop was sown on August 4th and harvesting was done on 14th December, 2008.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Yield and quality:

Application of FYM (7.5 t ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Panchagavya spray (3% at 30, 60 and 70 DAS) recorded significantly higher pod and haulm

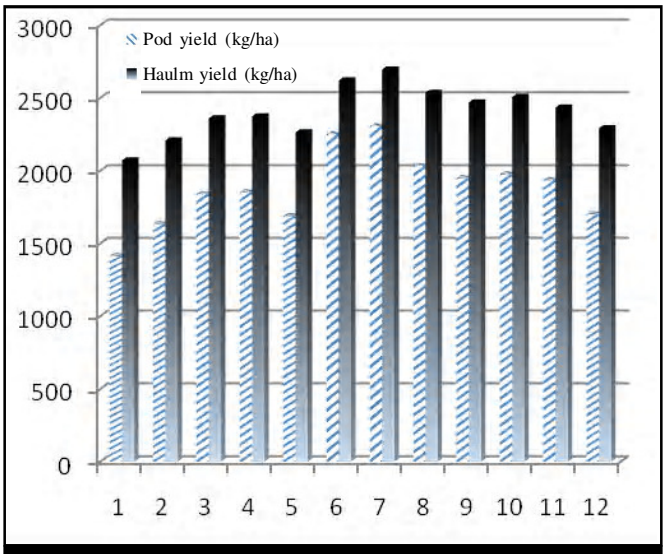


Fig.1: Pod and haulm yields of groundnut as influenced by integrated organic sources of nutrient

Table 1: Oil content, oil yield, protein content and protein yield of kernels as influenced by integrated organic sources of nutrients

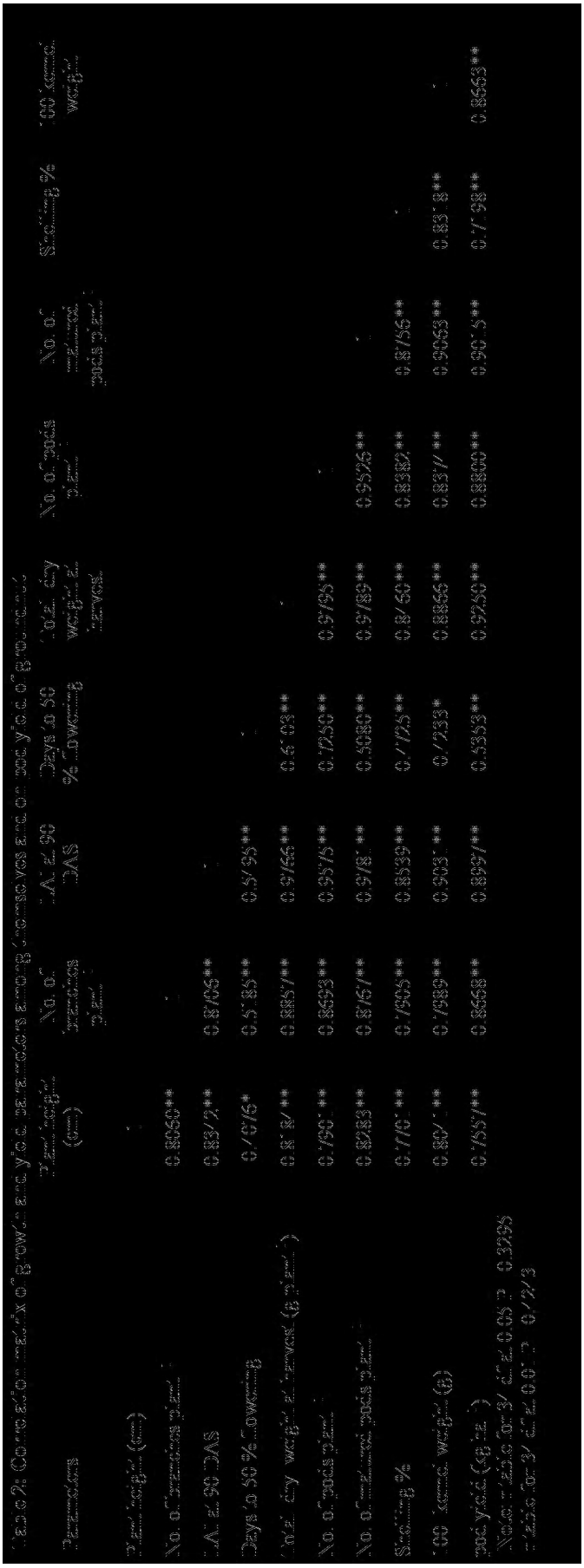
Treatments	Per cent (%)		yield ($kgha^{-1}$)	
	Oil	Protein	Oil	Protein
T_1: FYM (7.5 t ha^{-1})	38.4	20.6	362.2	195.1
T_2: T_1 + *Rhizobium* + PSB (10 kg each ha^{-1})	39.0	20.9	431.4	231.2
T_3:T_2 + *Trichoderma* (5 kg ha^{-1})	39.7	21.4	499.4	269.9
T_4:T_2+ *Pseudomonas* (10 kg ha^{-1})	39.4	21.4	499.6	271.5
T_5: T_2 + VAM (10 kg ha^{-1})	39.0	20.9	448.1	240.6
T_6:T_2 + Jeevamruta (N equivalent)	40.0	22.4	648.6	363.2
T_7:T_2 + Panchagavya spray (3% @ 30,60 and 75 DAS)	40.7	22.4	685.1	377.7
T_8:T_2+ Bio-digester(N equivalent)	40.5	22.3	579.8	319.1
T_9:Vermicompost (3 t/ha) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Jeevamruta (N equivalent)	39.9	21.9	544.2	298.1
T_{10}:Vermicompost (3 t/ha) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Panchagavya spray (3% @ 30,60 and 75 DAS)	40.3	21.9	560.0	303.8
T_{11}: Vermicompost (3 t/ha) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Bio-digester(N equivalent)	40.1	21.8	542.3	295.0
T_{12}:Neem cake (500 kg/ha) + Pongamia cake (500 kg/ha) + *Rhizobium* + PSB (10 kg each ha^{-1})	40.1	21.7	474.7	257.2
S.E. ±	1.18	0.30	20.29	8.74
C. D. (P=0.05)	NS	0.88	59.53	25.63

NS: Non significant

yields (Fig.1) of groundnut (2304 kg ha^{-1} and 2695 kg ha^{-1}, respectively) than all other treatments except the treatment application of FYM (7.5 t ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Jeevamruta (equvivalent to 25 kg N ha^{-1}) which has recorded at par pod yield (2249 kg ha^{-1}) and haulm yield (2620 kg ha^{-1}). The increase in pod yield of these treatments may be due to the fact that nitrogen and phosphorus play an important role in the synthesis of chlorophyll and amino acids, *Rhizobium* and PSB ensured the continuous supply of these nutrients, while FYM beside supplying N, P, K, secondary and micro nutrients also improved the soil condition, which enhanced the root proliferation and source to sink relationship. Increase in yield in these treatments may also be attributed to synergistic effect of combined use of *Rhizobium* + PSB (Panwar and Singh, 2003). In case of Panchagavya spray, the easy transfer of nutrients to plant through foliar spray and the quantities of IAA and GA present in Panchagavya (Somasundaram, 2003), could have created the stimuli in the plant system and which in turn increased the production of growth regulators in cell system. Hence, stimulated the necessary growth and development in plants, leading to better yield.These results are in agreement with the Selvaraj (2003) in french bean and Yadav and Lourduraj (2006) in rice.

The increase in pod yield due to the application of Jeevamruta as compared to application of bio-digester (both added on N equivalent basis and simultaneously, it supplied 23.6 and 13.88 kg calcium ha^{-1}, respectively) might be due to the addition of 12.5 kg ha^{-1} extra calcium by Jeevamruta application. Calcium plays an important role in the reproductive development of groundnut. This is probably because in the absence of both xylem and phloem supply of Ca, the penetrating gynophores have modified themselves into absorbing organs of Ca from the immediate fruting zone (Rao and Shaktwat, 2002). The improvement in yield may be due to addition of high N fixing bacteria along with Jeevamruta as compared to bio-digester. This contention holds credence because addition of jaggery, pulse flour coupled with continuous stirring while preparing Jeevamruta may help in proliferation of N fixing bacteria at a faster rate (Joshi, 2009)

Oil percentage was not significantly influenced by application of various organic nutrients. But application of FYM (7.5 t/ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Panchagavya (3% @ 30, 60 and 75 DAS) recorded higher oil yield (685.1 kg ha^{-1}) followed by application of FYM (7.5 t/ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Jeevamruta, equvivalent to 25 kg N ha^{-1} (648.5 kg ha^{-1}) over the rest of treatments (Table 1). These treatments recorded higher oil yield (47.1 and 44.1 per cent) than



application of FYM 7.5 tonnes per hectare alone (T_1). This was attributed to higher kernel yield with application of FYM (7.5 t/ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Panchagavya (3% @ 30, 60 and 75 DAS) and FYM (7.5 t/ha^{-1}) + *Rhizobium*+ PSB (10 kg each ha^{-1}) + Jeevamruta (equvivalent to 25 kg N ha^{-1}), respectively (Table 1). Higher protein percentage and protein yield were recorded (22.4 % and 377.7 kg ha^{-1}, respectively) with T_7 *i.e.* application of FYM (7.5 t/ha^{-1}) + *Rhizobium* + PSB (10 kg each/ha^{-1}) + Panchagavya (3% @ 30, 60 and 75 DAS) followed by T_6 *i.e.* application of FYM (7.5 t/ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Jeevamruta, equvivalent to 25 kg N ha^{-1} (22.4% and 363.2 kg ha^{-1}, respectively). The reason for higher protein may be due to more availability of nutrients particularly nitrogen which is an integral part of protein. Higher protein yield may be attributed to higher kernel yield with higher protein in the seed (Table 1). This is in conformity with the findings of Beaulah *et al*. (2002) in Moringa.

Correlation and regression study:

The correlation matrix of growth and yield parameters among themselves and on pod yield of groundnut (Table 2) indicated that the pod yield of groundnut was significantly and positively correlated with plant height (r = 0.76), number of branches per plant (r = 0.87), LAI at 90 DAS (r = 0.90), total dry weight per plant (r = 0.93), number of pods per plant (r =0.88), number of matured pods per plant (r =0.90) shelling percentage (r = 0.72), 100 kernel weight (r =0.87) and days to 50 % flowering (r = 0.54).

The relationship between growth and yield parameters was quantified through establishing regression equation. Among the significant parameters, all the parameters had significant linear relationship with pod yield of groundnut.Total dry weight per plant alone could be able to influence the pod yield of groundnut to the extent of 86 per cent followed by LAI at 90 DAS (81%) and No. of matured pods per plant (81%) as reflected from their respective R^2 values (Table 3).

Economics:

Economic analysis is one of the major criteria for evaluating efficient and economically viable nutrient management practices. In the present study comparative economics of production of organic groundnut indicated that gross return per hectare could be improved to a significant extent. Highest gross return (Rs. 62,189 ha^{-1}) were obtained with application of FYM (7.5 t/ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Panchagavya (3% @ 30, 60 and 75 DAS) which was followed by application of FYM (7.5 t/ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Jeevamruta based on N equivalent (Rs. 60,701 ha^{-1}).

The cost of culativation was marginally higher with the application of vermicompost + *Rhizobium* + PSB + Jeevamruta compared with application of FYM alone. The highest net monetary returns (Rs. 45,201 ha^{-1}) were recorded with application of FYM (7.5 t/ha^{-1}) + *Rhizobium*+ PSB (10 kg each ha^{-1}) + Panchagavya (3% @ 30, 60 and 75 DAS). Whereas, maximum benefit: cost ratio (2.66) was observed with application of FYM (7.5 t ha^{-1}) + *Rhizobium*+ PSB (10 kg each ha^{-1}) + Panchagavya (3% @ 30, 60 and 75 DAS) followed by FYM + *Rhizobium* + PSB (10 kg each ha^{-1}) + bio-digester based on N equivalent (2.41). This was attributed to higher pod and haulm yield of groundnut with these treatments (Table 4). Similar results of higher gross return and net return were obtained with application of Panchagavya by Yadav and Lourduraj (2006) in rice and Somasundaram (2003) in green gram.

Table 3: Relationship of significant growth and yield parameters and regression equations established with the pod yield of groundnut

Parameters	Correlation co efficient with pod yield (r)	Regression equation with pod yield	R^2 value
1. Plant height (cm)	Linear = 0.76**	Y= - 109.13 + 83.22 X	0.57
2. No. of branches plant $^{-1}$	Linear = -0.87**	Y= -397.41 + 199.48 X	0.75
3. LAI at 90 DAS	Linear = 0.90**	Y= - 683.79 + 578.01X	0.81
4. Days to 50% flowering	Linear = 0.54**	Y= 1469.22+47.67 X	0.29
5. Total dry weight at harvest (g plant^{-1})	Linear = 0.93**	Y= 927.32 + 28.44 X	0.86
6. No. of pods plant $^{-1}$	Linear = - 0.88**	Y= 968.43 + 28.05 X	0.77
7. No. of matured pods plant $^{-1}$	Linear = 0.90**	Y= 947.91 + 39.67 X	0.81
8. Shelling %	Linear = 0.72**	Y= - 4851.36 + 96.66 X	0.52
9. 100-kernel weight	Linear = 0.87**	Y= - 2350.67+ 109.43 X	0.75

** (P= 0.01) = 0.4243

Table 4: Economics of groundnut as influenced by integrated organic sources of nutrients

Treatments	Cost of cultivation	Gross returns (Rs.ha^{-1})	Net returns (Rs. ha^{-1})	B:C Ratio
T_1: FYM (7.5 t/ha^{-1})	13695	38498	24803	1.81
T_2: T_1+ *Rhizobium* + PSB (10kg each ha^{-1})	15095	44298	29203	1.93
T_3:T_2 + *Trichoderma* (5kg ha^{-1})	15445	49793	34348	2.22
T_4:T_2+ *Pseudomonas* (10kg ha^{-1})	15795	50169	34374	2.17
T_5: T_2 + VAM (10kg ha^{-1})	15795	45785	29990	1.89
T_6:T_2 + Jeevamruta (N equivalent)	18005	60701	42696	2.37
T_7:T_2 + Panchagavya spray (3% @ 30,60 and 75DAS)	16988	62189	45201	2.66
T_8:T_2 + Bio-digester (N equivalent)	16075	54948	38873	2.41
T_9:Vermicompost (3 t ha^{-1}) + *Rhizobium* + PSB (10kg each ha^{-1}) + Jeevamruta (N equivalent)	22055	52747	30692	1.39
T_{10} :Vermicompost (3 t ha^{-1}) + *Rhizobium* + PSB (10kg each ha^{-1}) + Panchagavya spray (3% @ 30,60 and 75DAS)	21038	53472	32434	1.54
T_{11} :Vermicompost (3 t ha^{-1}) + *Rhizobium* + PSB (10kg each ha^{-1}) + Bio-digester (N equvivalent)	20125	52394	32269	1.60
T_{12}:Neem cake (500kg ha^{-1}) + Pongamia cake (500kg ha^{-1}) + *Rhizobium* + PSB (10kg each ha^{-1})	17895	46173	28278	1.58

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