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Effect of Organic Source of Nutrients on Groundnut (*Arachis Hypogaea* L.) Under Southern Transitional Zone of Karnataka

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Abstract: *A field experiment was conducted at Agricultural and Horticultural Research Station, University of Agricultural and Horticultural Sciences, Bhavikere, Karnataka to study the influence of organic source of nutrients on yield of groundnut (*Arachis hypogaea *L.) under rainfed condition. The soil was red clay loam with low in available nitrogen, medium in available phosphorus and potassium. The experiment was laid out in a Randomized Complete Block Design with involving twelve treatments which were replicated thrice.*

Pod and haulm yields of groundnut was significantly higher (2304 kg ha^{-1} *and 2695 kg ha*$^{-1}$*, respectively) with application of FYM (7.5 t ha*$^{-1}$*)* + Rhizobium + *PSB + Panchagavya spray (3% at 30, 60 and 75 DAS) as compared to pod and haulm yield obtained from rest of the treatments except application of FYM (7.5 t ha*$^{-1}$*)* + Rhizobium + *PSB + Jeevamruta (equivalent to 25 kg N ha*$^{-}$*) (2249 kg ha*$^{-1}$ *and 2620 kg ha*$^{-1}$*, respectively). Significantly lowest pod and haulm yield (1413 kg ha*$^{-1}$*and 2071 kg ha*$^{-1}$*, respectively) was obtained with the application of FYM (7.5 t ha*$^{-1}$*) alone. Combined application of FYM (7.5 t ha*$^{-1}$*)* + Rhizobium + *PSB + Panchagavya spray (3% at 30, 60 and 75 DAS) increased matured pods per plant, 100 kernel weight, shelling per cent and sound mature kernel per cent and quality parameters like oil and protein yield (kg ha*$^{-}$*), oil content (%) and protein content (%) when compared with other treatments.*

Keywords: *Organic manures, Panchagavya, Jeevamruta, PSB, yield and quality.*

INTRODUCTION

Groundnut (*Arachis hypogaea* L.), is the world's fourth important source of edible oil and third important source of vegetable protein. It is valuable cash crop planted by millions of small farmers because of its economic and nutritional value. About two thirds of world production is crushed for oil and remaining one third is consumed as food. The shelled nuts are consumed after roasting, frying, salting or boiling and in many culinary preparations and confectionery products. The high-energy value, protein content and minerals make groundnut a rich source of nutrition at a comparatively low price. Groundnut cakes obtained after oil extraction is a high protein animal feed. It contains about 50% oil, 25-30% protein, 20% carbohydrate and 5% fiber and ash which make a substantial contribution to human nutrition. Besides, it's a valuable source of vitamins E, K and B. It is the richest plant source of thiamine and is also rich in niacin, which is low in cereals.

Groundnut covers an area of 254.60 Lakh ha with a production of 453.08 Lakh tonnes and productivity of 1780 kg ha^{-1} in world during 2014-15. In India it covers an area of 52.50 Lakh hectare with production of 94.72 Lakh tones and productivity of 1804 kg ha^{-1} during 2014-15. India's average productivity is 938 kg ha^{-1} which is far behind the most of the groundnut growing countries with the highest productivity of 4496 kg ha^{-1} in USA. Globally, India is leading in acreage, but behind China in production (169.19 Lakh tonnes) due to low productivity. (Anon., 2016)

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Groundnut being an important oilseed crop of the karnataka, growing in an area of 7.25 lakhs hectare with a production of 6.58 lakhs tonnes with productivity of 908 kg ha^{-1} during 2013-14. The major groundnut growing districts in Karnataka are Chitradurga, Dharwad, Belgaum, Bijapur, Raichur, Bellary and Bidar. (Anon., 2015)

It is interesting to note that productivity of groundnut has decreased by 12% inspite of use of higher levels of input like fertilizers and pesticides. 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.

MATERIAL AND METHODS

Field experiment was conducted at Agricultural and Horticultural Research Station, University of Agricultural and Horticultural Sciences, Bhavikere, Karnataka. The texture of soil was red sandy loam having neutral pH with organic carbon (0.66%), available nitrogen (256.14 kg ha^{-1}), phosphorous (37.45 kg ha^{-1}) and potassium (381.6 kg ha^{-1}). The variety used was GPBD-2. The experiment was laid out in a Randomized Complete Block Design with three replications involving twelve treatments *viz.*, T_1= FYM (7.5 t ha^{-1}); T_2= T_1 + *Rhizobium* + phosphorous solubilizing microorganisms (PSB) (10kg each ha^{-1}); T_3= T_2 + *Trichoderma* (5kg ha^{-1}); T_4 = T_2 + *Pseudomonas* (10kg ha^{-1}); T_5= T_2 + Vesicular arbuscular mycorrhiza (VAM) (10kg ha^{-1}); T_6 = T_2 + Jeevamruta (equivalent to 25 kg N ha^{-1}); T_7 = T_2 + Panchagavya spray (3% @ 30, 60 and 75DAS); T_8 = T_2 + Bio-digester (equivalent to 25 kg N ha^{-1}); T_9= Vermicompost (3 t ha^{-1}) + *Rhizobium* + PSB (10kg each ha^{-1}) + Jeevamruta (equivalent to 25 kg N ha^{-1}); T_{10} = Vermicompost (3 t ha^{-1}) + *Rhizobium* + PSB (10kg each ha^{-1}) + Panchagavya spray (3% @ 30, 60 and 75DAS); T_{11} = Vermicompost (3 t ha^{-1} + *Rhizobium* + PSB (10kg each ha^{-1}) + Bio-digester (equivalent to 25 kg N ha^{-1}); T_{12} = Neem cake (500 kg ha^{-1}) + Pongamia cake (500 kg ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}). The biofertilizers are enriched with bulky organic manures and oil cakes. Liquid organic manures like 3% Panchagavya was sprayed @ 30, 60 and 75 DAS 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 10L water were added to the mixture and left for 15 days; Then 3 L of sugarcane juice + 2L of cow milk + 2 L of curd + 2 L tender coconut water + 250 g jaggary + 1 kg 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. The crop was sown on august 4th and harvesting was done on 14th Dec, 2014.

Pod and haulm yields and yield attributes *viz.*, matured pods per plant, 100 kernel weight, shelling per cent and sound mature kernel per cent were recorded in the study. Quality parameters like oil content (%), protein content (%), oil and protein yield (kg ha^{-1}) were also estimated as per the procedures. The data obtained during the investigation was statistically analyzed by adopting Fisher's method of analysis of variance as outlined by Gomez And Gomez (1984).

RESULTS AND DISCUSSION

Yield and Yield Attributes

Application of FYM (7.5 ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Panchagavya spray (3 % at 30, 60 and 70 DAS) recorded significantly higher pod and haulm yields 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 (equivalent to 25 kg N ha^{-1}) which has recorded on 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

Table 1
Pod yield, haulm yield and harvest index of groundnut as influenced by organic sources of nutrients

	Yield (kg ha^{-1})		
Treatments	*Pod*	*Haulm*	*HI*
T_1 : FYM (7.5 t ha^{-1})	1413	2071	0.40
T_2 : T_1+ *Rhizobium* + PSB (10 kg each ha^{-1})	1632	2208	0.42
T_3 : T_2 + *Trichoderma* (5 kg ha^{-1})	1838	2359	0.44
T_4 : T_2 + *Pseudomonas* (10 kg ha^{-1})	1852	2373	0.44
T_5 : T_2 + VAM (10 kg ha^{-1})	1687	2263	0.43
T_6 : T_2 + Jeevamruta (N equivalent)	2249	2620	0.46
T_7 : T_2 + Panchagavya spray (3% @ 30,60 and 75DAS)	2304	2695	0.46
T_8 : T_2 + Bio-digester (N equivalent)	2030	2535	0.44
T_9 : Vermicompost (3 t ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Jeevamruta (N equivalent)	1948	2469	0.44
T_{10} : Vermicompost (3 t ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Panchagavya spray (3% @ 30,60 and 75DAS)	1975	2506	0.44
T_{11} : Vermicompost (3 t ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Bio-digester (N equivalent)	1934	2433	0.44
T_{12} : Neem cake (500 kg ha^{-1}) + Pongamia cake (500 kg ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1})	1701	2291	0.43
S. Em+	62.36	52.57	0.027
C. D. at 5%	182.91	154.21	NS

NS: Non significant.

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 and thus, helped in the necessary growth and development in plants leading to better yield. These results are in agreement with the Mamarali and Lopez (1997) in sweet pepper, Somasundaram (2003) in green gram, Selvaraj (2003) in french bean and Yadav and Chistopher Lourduraj (2006) in rice (Table 1).

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 fruiting 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 (Mukund Joshi, 2009)

The yielding ability of a crop is the reflection of yield attributing characters like total number of mature pods, 100 kernel weight and shelling percentage and sound mature kernel per cent. Application of FYM (7.5 ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Panchagavya spray (3% at 30, 60 and 70 DAS) may be attributed to significantly

Table 2
100-kernel weight, shelling per cent, kernel yield and sound mature kernels per cent of groundnut as influenced by organic sources of nutrients

Treatments	*100-kernel weight (g)*	*Shelling (%)*	*Kernel Yield (kg ha^{-1})*	*Sound mature kernels (%)*
T_1 : FYM (7.5 t ha^{-1})	34.5	67.0	946	85.33
T_2 : T_1 + *Rhizobium* + PSB (10 kg each ha^{-1})	36.7	67.8	1107	87.23
T_3 : T_2 + *Trichoderma* (5 kg ha^{-1})	38.8	68.5	1259	88.13
T_4 : T_2 + *Pseudomonas* (10 kg ha^{-1})	38.9	68.4	1268	88.50
T_5 : T_2 + VAM (10 kg ha^{-1})	37.3	68.3	1150	87.68
T_6 : T_2 + Jeevamruta (N equivalent)	41.7	72.1	1621	91.34
T_7 : T_2 + Panchagavya spray (3% @ 30, 60 and 75 DAS)	42.1	73.1	1684	92.07
T_8 : T_2 + Bio-digester (N equivalent)	39.3	70.6	1432	89.94
T_9 : Vermicompost (3 t ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Jeevamruta (N equivalent)	38.8	70.0	1364	89.34
T_{10} : Vermicompost (3 t ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Panchagavya spray (3% @ 30,60 and 75DAS)	39.1	70.4	1389	90.04
T_{11} : Vermicompost (3 t ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Bio-digester (N equivalent)	38.5	69.9	1352	88.26
T_{12} : Neem cake (500 kg ha^{-1}) + Pongamia cake (500 kg ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1})	38.1	69.7	1185	88.01
S. Em+	0.47	0.62	38.32	0.37
C. D. at 5%	1.39	1.83	112.39	1.11

higher number of matured pods per plant (32.60), Higher 100 kernel weight (42 g) and shelling percentage (73.1%). Growth promoters and micro nutrients content of Panchagavya might be the reason to record higher test weight and shelling per cent (Table 2). These results are in line with Somasundaram (2003) in green gram, maize and sunflower, Boomiraj (2003) in bhendi and Yadav and Chistopher Lourduraj (2006) in rice.

Quality of Oil

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, equivalent to 25 kg N ha^{-1} (648.5 kg ha^{-1}) over the rest of treatments. 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 (equivalent to 25 kg N ha^{-1}), respectively (Table 3).

Higher protein percentage and protein yield were recorded (22.4% and 377.7 kg ha^{-1}, respectively) with (T_7) The 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) application of FYM (7.5 t ha^{-1}) + *Rhizobium* + PSB (10 kg each ha^{-1}) + Jeevamruta, equivalent 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 3). This is in conformity with the findings of Beaulah *et al*. (2002) in Moringa.

Table 3
Oil content, oil yield, protein content and protein yield of kernels as influenced by organic sources of nutrients

	Content (%)		*yield (kg ha^{-1})*	
Treatments	*Oil*	*Protien*	*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. Em+	1.18	0.30	20.29	8.74
C. D. at 5%	NS	0.88	59.53	25.63

NS: Non significant

CONCLUSION

Thus, it can be concluded that application FYM (7.5 t ha^{-1}) + *Rhizobium* + PSB + Panchagavya spray (3% at 30, 60 and 75 DAS) not only increase the pod yield but also improve quality of oil and protein.

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