Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(5): 3028-3031
Received: 13-07-2018
Accepted: 15-08-2018

R Nagaraj
Ph.D. Student (Agronomy), College of Agriculture, UAHS, Shivamogga, Karnataka, India

M Hanumanthappa
Dean (Hort.), College of Horticulture, Mudigere, Chickamagluru, Karnataka, India

Sudhir Kamath
Associate Professor (Agronomy), ZAHRS, Brahmavar, Udupi, Karnataka, India

Correspondence
R Nagaraj
Ph.D. Student (Agronomy), College of Agriculture, UAHS, Shivamogga, Karnataka, India

Effect of integrated nutrient management in groundnut on yield, nutrient uptake, availability of secondary nutrients and microbial activity in soil at coastal zone of Karnataka

R Nagaraj, M Hanumanthappa and Sudhir Kamath

Abstract
Pod yield was significantly superior in POP + 50 per cent RDN through poultry manure (2272 kg ha^{-1}) followed by POP + 50 per cent RDN through vermicompost (2162 kg ha^{-1}) and POP + 50 per cent RDN through goat manure (2018 kg ha^{-1}). Higher uptake of calcium resulted in POP + 50 per cent RDN through poultry manure followed by POP + 50 per cent RDN through vermicompost (32.50 and 30.95 kg ha^{-1}, respectively). The highest total uptake of magnesium (14.92 kg ha^{-1}) was recorded in POP +50 per cent RDN through goat manure, followed by POP + 50 per cent RDN through vermicompost (12.98 kg ha^{-1}). Significantly higher sulphur uptake (15.17 kg ha^{-1}) resulted in POP + 50 per cent RDN through poultry manure, followed by POP + 50 per cent RDN through vermicompost (13.60 kg ha^{-1}). Higher bacteria, fungi and actinomycetes population (37.27 cfu x 10^5, 41.92 cfu x 10^3 and 13.73 cfu x 10^4 g^{-1} of soil, respectively) were found by the application of recommended dose of nutrients (POP) + 50 per cent RDN through vermicompost

Keywords: Yield, vermicompost, poultry manure, goat manure

Introduction
India requires around 20.3 million tonnes of edible oil. It is essential to enhance the productivity of prominent crops of the country like paddy, wheat, pulses and groundnut through location- specific nutrient management practices. To augment major food crops production, Food and Agriculture Organization (FAO) conceptualized the idea of plant nutrients in a crop and cropping system for better resource use. It is not only a reliable way of obtaining fairly higher yields with substantial fertilizer economy, but also a concept that is ecologically sound leading to sustainable agriculture. None of the sources of nutrient alone can meet the total plant nutrients. Integration of from chemical, organic and biological sources of nutrients is the most efficient way to supply plant nutrients for sustained crop productivity and improved of soil fertility (Singh and Singh, 2002) [1]. Among problematic soils, acid soils less availability of nutrients (N, P, Ca, S, and B) besides inadequate organic matter. Paddy and groundnut being, exhaustive crops, removes large amount of macro and micro nutrients from soil. None of the sources of nutrient alone can meet the total plant nutrients. Integration of from chemical, organic and biological sources of nutrients is the most efficient way to supply plant nutrients for sustained crop productivity and improved of soil fertility

It is therefore necessary to judiciously manage the inflow of organic sources of nutrients, and their integration with fertilizers, biofertilizers and organic manure. Application of organic materials along with inorganic fertilizers leads to increased productivity of the system and sustained soil health for a longer period (Gawai and Pawar, 2006) [2]. Due to escalation of fertilizer prices and associated environment problem the crisis has necessitated in search for alternative sources of manures for integrated nutrient management, which includes organic manures, biofertilizers and inclusion of legume (groundnut) to sustain the cereal based cropping system.

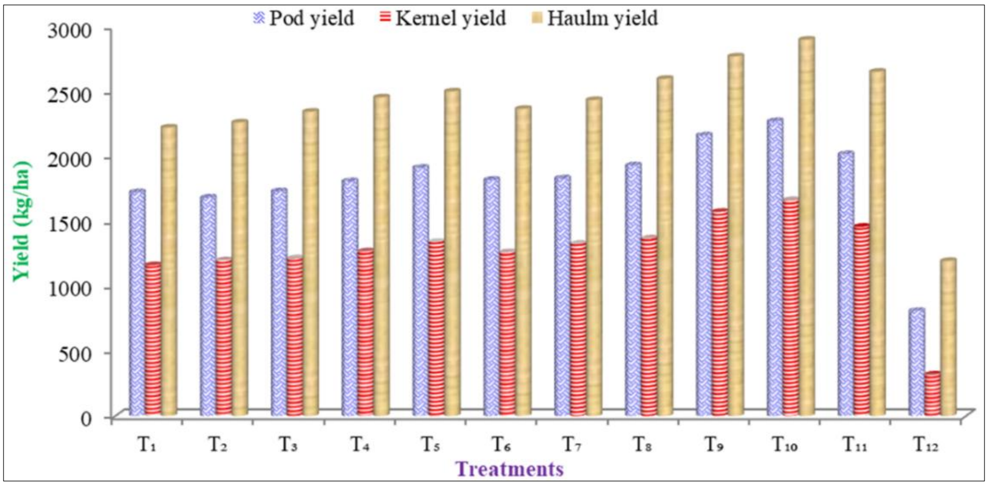
Materials and Methods
A field experiment was conducted during *rabi* season of 2015 at Zonal Agricultural and Horticultural Research Station, Brahmavar, Udupi district, Karnataka, to study the of integrated nutrient management in groundnut. The experimental site is situated between 74^0 45’ to 74^0 46' East longitude and 13^0 24' 45’’ to 13^0 25’ 30’’ North latitude and an altitude of 10 meters above mean sea level. Soil type is sandy loam in texture and pH was acidic (4.78).

The soil was medium in available nitrogen (362.84 kg ha^{-1}), high in available phosphorus (56.28 kg ha^{-1}) and medium in available potassium (113.61 kg ha^{-1}), low in exchangeable calcium and magnesium [1.13 and 0.35 C. mol (p^+) kg^{-1}, respectively] and medium in available sulphur (13.16). The organic carbon content was high (1.32 %) in range. TMV-2 a popular variety was sown in January with a spacing of 30 cm X 10 cm in paddy fallow. Experiment included twelve treatments consisted of T_1 – Package of practice (POP- FYM 10 t + 25:50:25 kg N:P_2O_5:K_2O ha^{-1}), T_2- POP + 25 per cent RDN through eupatorium, T_3- POP + 25 per cent RDN through gliricidia, T_4- POP + 25 per cent RDN through vermicompost, T_5- POP + 25 per cent RDN through poultry manure, T_6- POP + 25 per cent RDN through goat manure, T_7- POP + 50 per cent RDN through eupatorium, T_8 - POP + 50 per cent RDN through gliricidia, T_9- POP + 50 per cent RDN through vermicompost, T_{10}- POP + 50 per cent RDN through poultry manure, T_{11}- POP + 50 per cent RDN through goat manure and T_{12}- Control were laid out in Randomized Complete Block Design (RCBD) with three replications. All organics were applied 25 days before transplanting of paddy. Yield (biological and economical) was recorded from individual plots at harvest and converted to kg/ha. Composite soil sample were used to assess soil nutrient status by using standard procedures. Enumeration of fungi, bacteria and actinomycetes was found by using suitable media viz., Soil Extract Agar, Martin's Rose Bengal Agar and (MRBA) Kuster's Agar (KA), respectively. Standard statistical methods were used for comparing the treatment means.

Results and Discussion

Yield of groundnut

Pod yield was significantly superior in POP + 50 per cent RDN through poultry manure (2272 kg ha^{-1}) followed by POP + 50 per cent RDN through vermicompost (2162 kg ha^{-1}) and POP + 50 per cent RDN through goat manure (2018 kg ha^{-1}). The former treatment (T_{10}), followed by POP + 50 per cent RDN through vermicompost POP + 50 per cent RDN through goat manure and POP + 50 per cent RDN through gliricidia resulted in significantly higher haulm yield (2900, 2771, 2653 and 2598 kg ha^{-1}, respectively) (Fig. 1). Higher economical and biological yields in poultry manure might be due to ammonium-N (NH_4-N) is a significant part of total N in poultry manure, which additionally contains uric acid. Uric acid metabolizes rapidly to NH_4-N in most soils, and the net result of the high NH_4-N and uric acid contents in poultry waste is that a large percentage of N can be converted to nitrate-N (NO_3-N) within a few weeks. Poultry manure improves the number of pods per plant, pod yield and haulm yield in groundnut (Veeramani *et al.*, 2012) [3]. Application of vermicompost and FYM might have provided sufficient and balanced nutrients in readily available form throughout the growth period of the crop and the increased availability of plant nutrients, their uptake leading to the greater photosynthesis production of metabolites and enzymatic activities which might have influenced into increased nodulation and extensive root system and the greater production of metabolites and their translocation to various sinks especially the productive strictures (pods and seeds) could have helped to increase into the number of pods per plant besides increasing the overall growth. Results of the present investigation were in similar line with those of Sharma *et al.* (2005) [4]. Further, application of goat manure increased concentrations of labile inorganic P fractions (resin P and $NaHCO_3$ P) following the application of goat manure indicated that net mineralization of P occurred, possibly because the goat manure contained 2.4 g P kg^{-1}, which was greater than the critical P content of 2 g kg^{-1} reported by Floate, (1970) [5] as necessary for plant material to mineralize P.



T_1 – POP (FYM 10 t + 25:50:25 kg N: P2O5: K2O ha-1)	T_7 - POP + 50 % RDN through eupatorium
T_2 - POP + 25 % RDN through eupatorium	T_8 - POP + 50 % RDN through gliricidia
T_3 - POP + 25 % RDN through gliricidia	T_9 - POP + 50 % RDN through vermicompost
T_4 - POP + 25 % RDN through vermicompost	T_{10} -POP + 50 % RDN through poultry manure
T_5 - POP + 25 % RDN through poultry manure	T_{11} -POP + 50 % RDN through goat manure
T_6 - POP + 25 % RDN through goat manure	T_{12} – Control

Fig 1: Pod yield, kernel yield and haulm yield of groundnut as influenced by integrated nutrient management

Uptake of calcium, magnesium and sulphur

Higher uptake of calcium resulted in POP + 50 per cent RDN through poultry manure followed by POP + 50 per cent RDN through vermicompost (32.50 and 30.95 kg ha^{-1}, respectively). The highest total uptake of magnesium (14.92 kg ha^{-1}) was recorded in POP +50 per cent RDN through goat manure, followed by POP + 50 per cent RDN through vermicompost (12.98 kg ha^{-1}), POP + 50 per cent RDN through poultry manure (12.90 kg ha^{-1}) and POP + 25 per cent RDN through poultry manure (10.42 kg ha^{-1}). Significantly higher sulphur uptake (15.17 kg ha^{-1}) resulted in POP + 50 per cent RDN through poultry manure, followed by POP + 50 per cent RDN through vermicompost (13.60 kg ha^{-1}), POP + 50 per cent RDN through goat manure (13.27 kg ha^{-1}) and POP + 50 per cent RDN through gliricidia treatments (11.99 kg ha^{-1}) (Table 1).

Increase in the uptake of sulphur, calcium and magnesium is attributed to the fact that organics are excellent sources of these nutrients (Tandon, 1993) [6] and due to decomposition, mineralization and solubulization might have accelerated their availability and uptake by okra plants. Increased uptake of N and P from poultry manure might have increased the uptake of K, Ca and Mg. Increase in seed nutritional composition in plants treated with animal manures is in line with the report that significant differences were observed in okra Na, K, Ca, Mg, P, N and Zn. Increase in the moisture content of the seed in soil treated with different animal manure may also be due to their conditioning effect and increases it ability to take up water which after transpiration, some portion are retained in the seeds (Awodun and Alafusi, 2007) [7]. Eghball *et al.* (2002)[8] who had reported that the integrated role of applied organic manure is more pronounced for availability of sulphur in the soil, may be the released active organic acids during microbial activity that enhanced the oxidation of sulphur from the native and added sources to sulphate form (SO_4^{2-}).

Table 1: Calcium, magnesium and sulphur uptake (kg ha^{-1}) of groundnut as influenced by integrated nutrient management.

Treatments	Calcium	Magnesium	Sulphur
T_1 – POP (FYM 10 t + 25:50:25 kg N:P_2O_5:K_2O ha^{-1})	31.05	7.31	7.92
T_2 - POP + 25 % RDN through eupatorium	23.96	7.84	9.53
T_3 - POP + 25 % RDN through gliricidia	24.49	8.49	8.82
T_4 - POP + 25 % RDN through vermicompost	25.63	8.94	10.01
T_5 - POP + 25 % RDN through poultry manure	26.64	10.42	10.89
T_6 - POP + 25 % RDN through goat manure	25.00	9.42	11.66
T_7 - POP + 50 % RDN through eupatorium	26.49	9.56	11.19
T_8 - POP + 50 % RDN through gliricidia	27.33	9.63	11.99
T_9 - POP + 50 % RDN through vermicompost	30.95	12.98	13.60
T_{10} -POP + 50 % RDN through poultry manure	32.50	12.90	15.17
T_{11} -POP + 50 % RDN through goat manure	28.68	14.92	13.27
T_{12} – Control	8.95	1.61	1.16
S. Em±	1.86	0.92	1.30
CD (P=0.05)	5.46	2.71	3.76

Exchangeable calcium and magnesium [C.mol (p$^+$) kg^{-1}] and available sulphur (mg kg^{-1}).

Significantly higher exchangeable calcium was observed in POP + 50 per cent RDN through poultry manure, POP + 50 per cent RDN through goat manure, POP + 25 per cent RDN through goat manure, POP + 25 per cent RDN through poultry manure and POP + 50 per cent RDN through vermicompost applied treatments [0.75, 0.73, 0.71, 0.71 and 0.70 C. mol (p$^+$) kg^{-1}]. The highest exchangeable Mg [0.43 C. mol (p$^+$) kg^{-1}] was recorded in the treatment which received POP + 50 per cent RDN through goat manure, followed by POP + 50 per cent RDN through poultry manure [0.39 C. mol (p$^+$) kg^{-1}]. Significantly higher sulphur content (10.25 mg kg^{-1}) of soil was recorded in POP + 50 per cent RDN through poultry manure which was highest among all the treatments and it was followed by POP + 50 per cent RDN through vermicompost and POP + 50 per cent RDN through goat manure (10.13 and 10.06 mg kg^{-1}, respectively) (Table 2).

The higher Ca status of poultry manure and goat manure applied treatments might partially be due to the Ca supplied to the soil from the decomposition of these organic amendments. Application of organic manures increase the pH of the acidic soil, equally higher pH might be a consequence of the Ca supplied to the soil by these organic manures (Adenawoola and Adejoro, 2005) [9]. Changes in soil contents of K, Ca and Mg upon application of animal manures have been documented by several workers (Ano and Ubochi, 2006[10] and Uwah *et al.,* 2011) [11]. Eghball *et al.,* (2002) [8] who had reported that the combined application of sulphur along with poultry manure, the available content of sulphur in soil role of applied organic manure is more pronounced for availability of sulphur in the soil, may be the released active organic acids during microbial activity that enhanced the oxidation of sulphur (S^0) from the native and added sources to sulphate form ($SO^{2-}{}_4$).

Table 2: Exchangeable calcium, magnesium and available sulphur content of soil after harvest of groundnut as influenced by integrated nutrient management.

Treatments	Calcium [C. mol (P$^+$) kg^{-1}]	Magnesium [C. mol (P$^+$) kg^{-1}]	Sulphur (mg kg^{-1})
T_1 – POP (FYM 10 t + 25:50:25 kg N:P_2O_5:K_2O ha^{-1})	0.51	0.24	7.62
T_2 - POP + 25 % RDN through eupatorium	0.56	0.27	8.28
T_3 - POP + 25 % RDN through gliricidia	0.54	0.26	8.53
T_4 - POP + 25 % RDN through vermicompost	0.66	0.32	9.81
T_5 - POP + 25 % RDN through poultry manure	0.71	0.36	9.87
T_6 - POP + 25 % RDN through goat manure	0.71	0.38	9.72
T_7 - POP + 50 % RDN through eupatorium	0.62	0.31	9.60
T_8 - POP + 50 % RDN through gliricidia	0.62	0.28	9.34
T_9 - POP + 50 % RDN through vermicompost	0.70	0.34	10.13
T_{10} -POP + 50 % RDN through poultry manure	0.75	0.39	10.25
T_{11} -POP + 50 % RDN through goat manure	0.73	0.43	10.06
T_{12} – Control	0.38	0.15	6.15
S. Em±	0.06	0.044	0.82
CD (P=0.05)	0.18	0.13	2.42

Microbial population

Among various INM treatments, higher bacterial population (37.27 cfu x 10^5 g^{-1} of soil) were found by the application of recommended dose of nutrients (POP) + 50 per cent RDN through vermicompost followed by POP + 50 per cent RDN through goat manure (34.47 cfu x 10^5 g^{-1} of soil). Higher population of fungi (43.53 cfu x 10^3 g^{-1} of soil) were found with recommended practice (POP) + 50 per cent RDN through vermicompost followed by POP + 50 per cent RDN through goat and poultry manure treatments *i.e.* T_{11}, and T_{10} (41.92 and 37.45 cfu x 10^3 g^{-1} of soil, respectively). Recommended practice (FYM 10 t + 25:50:25 $N:P_2O_5:K_2O$ kg ha^{-1}) + 50 per cent RDN through vermicompost resulted in higher population of actinomycetes (13.73 cfu x 10^4 g^{-1} of soil), followed by POP + 50 per cent RDN through goat manure, POP + 50 per cent RDN through poultry manure, POP + 50 per cent RDN through eupatorium and POP + 50 per cent RDN through gliricidia applied treatments (13.22, 12.85, 12.26 and 11.59 cfu x 10^4 g^{-1} of soil, respectively) (Table 3). This might be due to the fact that as groundnut is a legume component which is known to release a part of unused NO_3 fixed through symbiotic nitrogen fixation into the soil and also a lot of low molecular weight organic compounds are released to the soil as exudates. These serve as a substrate to soil microbes and their population builds-up in the soil (Masood Ali *et al*., 2002) [12].

Table 3: Population of soil microorganisms after harvest of groundnut as influenced by integrated nutrient management.

Treatments	Bacteria (cfu x 10^5 g^{-1} of soil)	Fungi (cfu x 10^3 g^{-1} of soil)	Actinomycetes (cfu x 10^4 g^{-1} of soil)
T_1 – POP (FYM 10 t + 25:50:25 kg $N:P_2O_5:K_2O$ ha^{-1})	18.22	26.86	9.10
T_2 - POP + 25 % RDN through eupatorium	23.84	31.27	9.51
T_3 - POP + 25 % RDN through gliricidia	23.10	30.14	9.24
T_4 - POP + 25 % RDN through vermicompost	24.99	36.39	10.80
T_5 - POP + 25 % RDN through poultry manure	23.70	33.57	9.29
T_6 - POP + 25 % RDN through goat manure	26.42	35.56	9.83
T_7 - POP + 50 % RDN through eupatorium	31.54	35.78	12.26
T_8 - POP + 50 % RDN through gliricidia	29.78	33.94	11.59
T_9 - POP + 50 % RDN through vermicompost	37.27	43.53	13.73
T_{10} -POP + 50 % RDN through poultry manure	28.60	37.45	12.85
T_{11} -POP + 50 % RDN through goat manure	34.47	41.92	13.22
T_{12} - Control	11.04	13.29	7.43
S. Em±	2.78	3.30	0.82
CD (P=0.05)	8.16	9.68	2.41

References

1. Singh B, Singh Y. Concepts in nutrient management. *In:* Recent Advances in Agronomy. Indian Soc. Agron., New Delhi, 2002, 92-109.
2. Gawai PP, Pawar VP. Integrated nutrient management in sorghum (*Sorghum bicolor*)-chickpea (*Cicer arietinum*) cropping sequence under irrigated conditions. Indian J Agron. 2006; 51:17-20.
3. Veeramani P, Subrahmaniyan K, Ganesaraja V. Organic manure management on groundnut; A review. Wudpecker J Agric. Res. 2012; 1(7):238-243.
4. Sharma S, Dubey, Kaisthy BP, Verma TS. Effect or rhizobia inoculation and phosphorus levels on symbiotic parameters, growth and yield of French bean in North-West Himalayan acid Alfisol. Legumes Res. 2005; 28:103-106.
5. Floate MJS. Decomposition of organic materials from hill soils and pastures. II. Comparative studies on the mineralization of carbon, nitrogen, and phosphorus from soil. Soil Biol. Biochem. 1970; 2:173-194.
6. Tandon HLS. Fertilizer recommendations for oilseed crops. A guide book, FDCO, New Delhi, 1993.
7. Awodun MA, Alafusi RA. Effect of integrated application of goat manure and urea on soil nutrient content and yield of Okra. Nigerian Journal of Soil Science. 2007; 17:126-129.
8. Eghball BJ, Wienhold JE, Gilley Eigenberg RA. Mineralization of manure nutrients. Journal of Soil and Water Conservation. 2002; 57:470-473.
9. Adenawoola AR, Adejoro SA. Residual effects of poultry manure and NPK fertilizer residues on soil nutrients and performance of Jute (*Corchorus olitorius* L.). Nigerian Journal of Soil Science. 2005; 15:133-135.
10. Ano AO, Ubochi CI. Neutralization of soil acidity by animal manures: mechanism of reaction. African Journal of Biotechnology. 2007; 6(4):364-368.
11. Uwah DF, Eneji AE, Eshiet UJ. Organic and mineral fertilizers effects on the performance of sweet maize (*Zea mays* (L.) *saccharata* Strut) in South Eastern Rainforest Zone of Nigeria. Int. J Agric. Sci. 2011; 3(1):54-61.
12. Masood Ali, Ganeshmurhy AN, Srinivasara O. Role of pulses in soil health and sustainable crop production. Indian J Pulse Res. 2002; 15(2):107-117.