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Integrated Nutrient Management in Groundnut at Coastal Zone of Karnataka, India

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A B S T R A C T

Pod and haulm yield was significantly superior in POP + 50 per cent RDN through poultry manure (2272 and 2900 kg ha^{-1}, respectively) followed by POP + 50 per cent RDN through vermicompost (2162 and 2771 kg ha^{-1}, respectively). Treatments receiving POP + 50 per cent RDN through poultry manure and POP + 50 per cent RDN through vermicompost resulted in significantly more nitrogen, P_2O_5 and K_2O uptake (99.05, 28.20, 32.93 and 94.15, 27.00, 29.28 kg ha^{-1}, respectively). Significant influence of treatments on nitrogen availability which was higher in POP + 50 per cent RDN through eupatorium (390.16 kg ha^{-1}), followed by POP + 50 per cent RDN through gliricidia (388.66) and POP + 50 per cent RDN through goat manure (384.97 kg ha^{-1}). Significantly higher availability of phosphorus was found in POP + 50 per cent RDN through poultry manure (85.26 kg ha^{-1}), followed by POP + 25 per cent RDN through goat manure (79.10 kg ha^{-1}). Application of recommended dose of nutrients + 50 per cent RDN through eupatorium resulted in higher available K_2O (152.93 kg ha^{-1}) as compared to other treatments.

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). 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). 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}). 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. 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) (Table 1). Higher economical and biological yields in poultry manure might be due to ammonium-N (NH4-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). The increase in pod yield in vermicompost treatment may be attributed to the reason that organic manure along with FYM and inorganic nutrients possibly increased the concentration of N, P and K ions of soil solution and ultimately affected the formation of more nodules, vigorous root development, better N fixation and better development of plant growth leading to higher photosynthetic activity and translocation of photosynthates to the sink which in turn resulted in better development of yield attributes and finally in higher pod yield. The findings closely followed the results of Badole *et al.,* (2001) and Thakare *et al.,* (2003).

Uptake of nutrients

Treatments receiving POP + 50 per cent RDN through poultry manure, POP + 50 per cent RDN through vermicompost and POP + 50 per cent RDN through goat manure resulted in significantly more nitrogen uptake (99.05, 94.15 and 88.47 kg ha^{-1}, respectively). The total uptake of phosphorus in POP + 50 per cent RDN through poultry manure recorded significantly higher value of 28.20 kg ha^{-1} followed by POP + 50 per cent RDN through vermicompost and POP + 50 per cent RDN through goat manure (27.00 and 25.15 kg ha^{-1}, respectively). The data showed that the former treatment (T_{10}) recorded significantly higher total uptake of potassium (32.93 kg ha^{-1}) which was on par with POP + 50 per cent RDN through vermicompost and POP + 50 per cent RDN through eupatorium treatments (29.28 and 29.20 kg ha^{-1}, respectively) (Table 2). The uptake of nutrients was increased with the application of graded combination of vermicompost and poultry manure. Such increases in nitrogen and phosphorus contents and uptake in kernel and haulm with the application vermicompost and poultry manure might be due to enhanced supply of plant nutrients by direct addition through nitrogen fixation and solubilisation of native phosphorus content of soil and also by increasing nutrient use efficiency and better absorption and utilization of nutrient in balanced form (Choudhary *et al.,* 2011). Another factor contributing to more nutrient uptake with poultry manure might be due to presence of high phosphorus content and increased availability of native soil phosphorus. The results corroborated the finding of Bulu *et al.,* (2016) in groundnut production in which they reported that organic manure, especially poultry manure and goat manure could increase yield of crops when compared with other sources of manure. Further, *Chromolaena odorata* contain N, P, and K which improve the soil cation exchange capability, due to increased soil organic colloids. Soil organic colloids can be either humic or other organic compounds. The increasing of organic colloids will extend the area of nutrients absorption in the soil. It can decrease the loss of nutrients due to leaching that takes place in the soil. It has been described that humic acid has a negative surface originating from the dissociation of carboxylate groups and its phenolate (Jamilah, 2006).

Availability of nutrients

The data revealed that significant influence of treatments on nitrogen availability which was higher in POP + 50 per cent RDN through eupatorium (390.16 kg ha^{-1}), followed by POP + 50 per cent RDN through gliricidia (388.66) and POP + 50 per cent RDN through goat manure (384.97 kg ha^{-1}). Significantly higher availability of phosphorus was found in POP + 50 per cent RDN through poultry manure (85.26 kg ha^{-1}), followed by POP + 25 per cent RDN through goat manure (79.10 kg ha^{-1}).

Table.1 Pod yield, kernel yield, haulm yield and harvest index of groundnut as influenced by integrated nutrient management

Treatments	Pod yield (kg ha^{-1})	Kernel yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest index
T_1 – POP (FYM 10 t + 25:50:25 kg $N:P_2O_5:K_2O$ ha^{-1})	1725	1163	2223	0.439
T_2 - POP + 25 % RDN through eupatorium	1683	1199	2262	0.426
T_3 - POP + 25 % RDN through gliricidia	1732	1214	2345	0.424
T_4 - POP + 25 % RDN through vermicompost	1809	1269	2456	0.424
T_5 - POP + 25 % RDN through poultry manure	1913	1341	2501	0.434
T_6 - POP + 25 % RDN through goat manure	1821	1262	2367	0.436
T_7 - POP + 50 % RDN through eupatorium	1832	1325	2435	0.428
T_8 - POP + 50 % RDN through gliricidia	1932	1366	2598	0.427
T_9 - POP + 50 % RDN through vermicompost	2162	1574	2771	0.438
T_{10} -POP + 50 % RDN through poultry manure	2272	1665	2900	0.439
T_{11} -POP + 50 % RDN through goat manure	2018	1458	2653	0.432
T_{12} - Control	810	319	1195	0.405
S. Em±	105.12	90.89	123.34	0.019
CD (P=0.05)	308	267	362	NS

POP- Package of practice; RDN- Recommended dose of nitrogen

Table.2 Nitrogen, Phosphorus (P_2O_5) and Potassium (K_2O) uptake (kg ha^{-1}) of groundnut as influenced by integrated nutrient management

Treatments	Nitrogen	P_2O_5	K_2O
T_1 – POP (FYM 10 t + 25:50:25 kg N:P_2O_5:K_2O ha^{-1})	72.08	18.50	26.97
T_2 - POP + 25 % RDN through eupatorium	73.91	20.88	26.48
T_3 - POP + 25 % RDN through gliricidia	75.27	21.27	25.25
T_4 - POP + 25 % RDN through vermicompost	78.81	22.35	26.13
T_5 - POP + 25 % RDN through poultry manure	82.04	23.29	28.89
T_6 - POP + 25 % RDN through goat manure	77.38	22.05	26.24
T_7 - POP + 50 % RDN through eupatorium	80.62	22.74	29.20
T_8 - POP + 50 % RDN through gliricidia	83.99	23.81	25.56
T_9 - POP + 50 % RDN through vermicompost	94.15	27.00	29.28
T_{10} -POP + 50 % RDN through poultry manure	99.05	28.20	32.93
T_{11} -POP + 50 % RDN through goat manure	88.47	25.15	28.58
T_{12} - Control	31.78	6.72	6.97
S. Em±	4.72	1.91	1.95
CD (P=0.05)	13.87	5.61	5.73

POP- Package of practice; RDN- Recommended dose of nitrogen

Table.3 Nutrient status of soil after harvest of groundnut as influenced by integrated nutrient management

Treatments	Available nitrogen (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})
T_1 – POP (FYM 10 t + 25:50:25 kg N:P_2O_5:K_2O ha^{-1})	376.20	65.00	134.16
T_2 - POP + 25 % RDN through eupatorium	384.17	67.10	136.10
T_3 - POP + 25 % RDN through gliricidia	383.01	62.00	138.17
T_4 - POP + 25 % RDN through vermicompost	381.54	64.90	129.53
T_5 - POP + 25 % RDN through poultry manure	379.90	68.43	132.42
T_6 - POP + 25 % RDN through goat manure	381.91	79.10	135.67
T_7 - POP + 50 % RDN through eupatorium	390.16	70.16	152.93
T_8 - POP + 50 % RDN through gliricidia	388.66	61.80	142.80
T_9 - POP + 50 % RDN through vermicompost	381.01	64.44	143.16
T_{10} -POP + 50 % RDN through poultry manure	378.21	69.15	145.95
T_{11} -POP + 50 % RDN through goat manure	384.97	85.26	147.81
T_{12} – Control	318.10	39.14	95.67
S. Em±	18.95	12.52	15.04
CD (P=0.05)	55.65	36.79	44.49

POP- Package of practice; RDN- Recommended dose of nitrogen

Application of recommended dose of nutrients + 50 per cent RDN through eupatorium resulted in higher available K_2O (152.93 kg ha^{-1}) as compared to other treatments (Table 3). The increase in soil available N, P and K could be attributed to greater biological nitrogen fixation with adequate P supply. The nodulation of legume crop fixes atmospheric N and N content in soil increases. The status of soil P improved firstly due to direct application of P to soil, and secondly through organic acids released by legume roots capable of solubilizing soil P. The results are in close conformity with Dadhich *et al.,* (2011). The increased N was due to the high N content in goat manure (Pannerselvam *et al.,* 1999), slow release of nitrogen and improved nitrogen fixation by soil microbes (Goyal *et al.,* 1992). Application of goat manure increased K availability as a consequence of releases of potassium from the added goat manure and solubilization of potassium from minerals (Jagannathan *et al.,* 1990).

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