Original Research Article

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, P₂O₅ and K₂O 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 K₂O (152.93 kg ha⁻¹) as compared to other treatments.

Keywords
Yield, Groundnut, Vermicompost, Poultry manure, Eupatorium, POP

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° 45’ to 74° 46’ East longitude and 13° 24’ 45” to 13° 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 T₁ – Package of practice (POP- FYM 10 t + 25:50:25 kg N:P₂O₅:K₂O ha⁻¹), T₂- POP + 25 per cent RDN through eupatorium, T₃- POP + 25 per cent RDN through gliricidia, T₄- POP + 25 per cent RDN through vermicompost, T₅- POP + 25 per cent RDN through poultry manure, T₆- POP + 25 per cent RDN through goat manure, T₇- POP + 50 per cent RDN through eupatorium, T₈ - POP + 50 per cent RDN through gliricidia, T₉- POP + 50 per cent RDN through vermicompost, T₁₀- POP + 50 per cent RDN through poultry manure, T₁₁- POP + 50 per cent RDN through goat manure and T₁₂- 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 (T₁₀), followed by POP + 50 per cent RDN through vermicompost POP + 50 per cent RDN through poultry manure and control 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 NH₄-N in most soils, and the net result of the high NH₄-N and uric acid contents in poultry waste is that a large percentage of N can be
converted to nitrate-N (NO₃-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 (T₁₀) 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\(_2\)O\(_5\):K\(_2\)O 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$_2$O$_5$) and Potassium (K$_2$O) uptake (kg ha$^{-1}$) of groundnut as influenced by integrated nutrient management

| Treatments                                                                 | Nitrogen | P$_2$O$_5$ | K$_2$O  |
|----------------------------------------------------------------------------|----------|------------|---------|
| T$_1$ – POP (FYM 10 t + 25:50:25 kg N:P$_2$O$_5$:K$_2$O 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\(_2\)O\(_5\) (kg ha\(^{-1}\)) | Available K\(_2\)O (kg ha\(^{-1}\)) |
|----------------------------------------------------|-------------------------------------|---------------------------------------------|-------------------------------------|
| T\(_1\) – POP (FYM 10 t + 25:50:25 kg N:P\(_2\)O\(_5\):K\(_2\)O 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 K₂O (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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How to cite this article:

Nagaraj R., M. Hanumanthappa and Sudhir Kamath K. V. 2018. Integrated Nutrient Management in Groundnut at Coastal Zone of Karnataka. *Int.J.Curr.Microbiol.App.Sci.* 7(06): 1737-1744. doi: [https://doi.org/10.20546/ijemas.2018.706.206](https://doi.org/10.20546/ijemas.2018.706.206)