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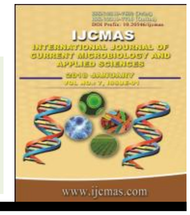

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# Response of Integrated Nutrient Management on Nutrient Uptake, Economics and Nutrient Status of Soil in Bold Seeded Summer Groundnut

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## A B S T R A C T

An experiment was conducted during *summer* season of 2016 on clayey soil at College of Agriculture, Junagadh Agricultural University, Junagadh to study the "Integrated nutrient management in bold seeded summer groundnut (*Arachis hypogaea* L.)". The study comprised of ten treatments consisting of three different organic sources of nutrients and these organic sources were combined with 50 and75 per cent recommended dose of fertilizer. The results revealed that combined application of 75% RDF(18.75-37.50-37.50-15 kg N-$P_2O_5$-$K_2O$-S ha$^{-1}$) + 25% N through FYM (1.25 t/ha) + Biofertilizer (*Rhizobium* and PSM @ 10 ml kg$^{-1}$ seed) recorded significantly higher pod and haulm yield with gross (Rs. 102200 ha$^{-1}$), net realizations (Rs. 56582 ha$^{-1}$), benefit: cost ratio (2.24) N, P, K and S content (4.56, 0.51, 0.60, 0.32% and 1.90, 0.31, 0.72, 0.26 %) and uptake (105.92, 11.80, 13.93, 7.36 kg ha$^{-1}$ and 58.64, 9.44, 36.12, 8.09 kg ha$^{-1}$) in pod and haulm, respectively and post-harvest N, $P_2O_5$ and S available status (255.00, 40.30 kg ha$^{-1}$ and 30.63 mg kg$^{-1}$, respectively) of soil which was closely followed by application of 75% RDF + 25% N through Vermicompost + Biofertilizer.

## Introduction

Groundnut is an important oilseed crop of India, cultivated in various parts of the country. Among the various agronomic practices, nutrient management has an important role in maximizing the pod yield. Judicial use of fertilizers is necessary for increasing agricultural production and reduced environmental pollution because continuous use of chemical fertilizers has deleterious effects on soil which in turn cause decline in productivity. Groundnut is an exhaustive crop and removes large amount of macro and micronutrient. No single source of nutrient is capable at supplying plant nutrients in adequate amount and balanced proportion. Therefore, to maintain soil fertility and to supply plant nutrients in balanced proportion for optimum growth, yield and quality of crop in an integrated manner in a specific agro ecological situation is to practice integrated nutrient supply through the combined use of biological and organic sources of plant nutrients (Kachot *et al.,* 2001).Groundnut farmers use very less organic fertilizer resulting in severe mineral nutrient deficiencies due to inadequate and imbalance use of nutrients is one of the major factors responsible for low yield in groundnut (Veermani and Subrahmaniyan, 2011). Confectionary groundnut is gaining more important in recent years in view of its export potential to earn the foreign exchange and also to pattern at groundnut utilization for oil purpose is gradually changed during the past decades. The food and confectionary use is on the rise. The present experiment was therefore undertaken in order to increase the productivity of bold seeded groundnut, quality, nutrient uptake and post-harvest nutrient status of soil through efficient use of resources like organic manure, inorganic fertilizer and biofertilizer.

## Materials and Methods

A field experiment was conducted with groundnut variety GJG 31 at College of Agriculture, Junagadh Agricultural University, Junagadh during the summer season of 2016. The experiment was laid out in Randomized Blocks Design with three replications and ten treatments. The following treatments were imposed *viz.*, $T_1$ (control),$T_2$ [Biofertilizer (*Rhizobium* and PSM)],$T_3$ (FYM 5 t $ha^{-1}$), $T_4$ [100% RDF (25-50-50-20 kg N-$P_2$O5-$K_2$O-S $ha^{-1}$)], $T_5$ (50% RDF + 50% N through FYM), $T_6$(50% RDF + 50% N through FYM +Biofertilizer),$T_7$(75% RDF + Biofertilizer), $T_8$ (75% RDF + 25% N through FYM), $T_9$ (75% RDF + 25% N through FYM + Biofertilizer) and $T_{10}$ (75% RDF + 25% N through Vermicompost + Biofertilizer).The soil of the experimental plot was clayey in texture and slightly alkaline in reaction with pH 7.9, EC 0.38 ds $m^{-1}$and organic carbon 0.62%. The soil was low in available nitrogen (241.00 kg $ha^{-1}$), medium in available phosphorus (31.60 kg $ha^{-1}$), potash (215.36 kg $ha^{-1}$) and sulphur (17.5 mg $kg^{-1}$). Groundnut was sown @ 125 kg seed/ha in rows 30 cm apart and 10 cm plant to plant spacing. The recommended dose of fertilizers @ 25:50:50:20 kg NPKS $ha^{-1}$ was considered as 100% RDF. The crop was fertilized as per treatments at the time of sowing, while well decomposed FYM containing 0.5% N, 0.2% $P_2O_5$, and 0.5% $K_2O$ and vermicompost containing 1.5% N, 1.0% $P_2O_5$ and 1.5% $K_2O$ were applied based on the nutrient equivalent basis of groundnut nitrogen requirement at preparation of soil. Seed was inoculated with a culture of *Rhizobium* plus PSM as per treatment before sowing. Other cultural operations were done as per recommendation and crop requirements. Regularly biometric observations were recorded at specific time intervals by selecting randomly five plants in each treatment. The initial and at harvest soil samples at 0-15 cm depth and organic manures were analyzed for different parameters by following standard methods (Jackson, 1974). Pod and haulm plant samples after harvest were analyzed for total N, P, K and S. Finally the crop was harvested and produce were dried, threshed, cleaned and weighed.

## Results and Discussion

### Effect on content and uptake of nutrients

The present study revealed that nitrogen, phosphorous, potassium and sulphur content (Table 1) and uptake by the crop (Table 2) was significantly influenced by integrated nutrient management treatments. Significantly higher N, P, K and S content in pod (4.56,0.51, 0.60 and 0.32%, respectively) and haulm(1.90%, 0.31%, 0.72% and 0.26%, respectively) were noticed under the treatment $T_9$ which constitutes 75% RDF + 25% N through FYM + Biofertilizer. However, it was found statistically at par with treatments$T_6$, $T_{10}$ and $T_2$ in respect of N content, $T_6$, $T_{10}$ and $T_7$ in respect of P and S content and $T_8$, $T_{10}$ and $T_7$ in respect of K content in pod, while in haulm, it was found statistically comparable with treatments $T_{10}$, $T_6$ and $T_3$ in N content, $T_8$,

$T_7$, $T_6$ and $T_{10}$ in P content, $T_8$ and $T_{10}$ in K content and $T_8$ in S content. An examination of data (Table 2) showed that different treatments exerted their signifiant influence on nutriments uptake by pod and haulm. Application of 75% RDF + 25% N through FYM + Biofertilizer ($T_9$) reported significantly the highest nitrogen uptake (105.92 and 58.64 kg $ha^{-1}$), phosphorus uptake (11.80 and 9.44 kg $ha^{-1}$), potash uptake (13.93 and 22.19 kg $ha^{-1}$) and sulphur uptake (7.36 and 8.09 kg $ha^{-1}$) by pod and haulm, respectively which was remained at par with treatments $T_6$ and $T_{10}$ in respect of N and P, $T_8$, $T_{10}$, $T_6$, $T_5$, $T_4$ and $T_7$ in respect of K and $T_6$, $T_{10}$ and $T_7$ in respect of S. Treatment $T_1$ (control) recorded the lowest N. P, K and S uptake by pod and haulm.

A glimpse of data (Table 2) indicated that significantly the highest total N, P, K and S uptake (164.56, 21.25, 36.12 and 15.45kg $ha^{-1}$, respectively) by crop were recorded in treatment $T_9$ (75% RDF + 25% N through FYM + Biofertilizer) which was remained statistically at par with $T_{10}$ and $T_6$in N uptake, $T_{10}$ in K uptake and $T_6$ in S uptake by crop. The combined application of chemical fertilizers along with enough bulk of FYM has always stimulated the uptake of nutrients and partly might by because of stimulated microbes flush and improved root growth due to congenial soil physical condition. Application of N fixing biofertilizers enhances the soil N and PSM produces the organic acids which may partly by responsible for quick release of nutrients which resulted into more content of nutrients. Thus, improvement in uptake of N, P, K and S might be attributed to their respective higher concentration in pod and haulm and associated with higher pod and haulm yields. The results of present investigation are in close agreements with the findings of Zalate and Padmani (2010), Tatpurkar *et al.*, (2014) and Vallabh *et al.*, (2015).

**Table.1** Effect of different treatments on N, P, K and S content in pod and haulm of groundnut

| Treatments | | Nutrient content (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | N | | P | | K | | S | |
| | | Pod | Haulm | Pod | Haulm | Pod | Haulm | Pod | Haulm |
| $T_1$ | Control | 3.41 | 1.63 | 0.38 | 0.18 | 0.51 | 0.61 | 0.20 | 0.15 |
| $T_2$ | Biofertilizer (*Rhizobium* and PSM) | 3.99 | 1.65 | 0.43 | 0.21 | 0.53 | 0.65 | 0.23 | 0.16 |
| $T_3$ | FYM (5 t $ha^{-1}$) | 3.86 | 1.73 | 0.42 | 0.25 | 0.54 | 0.64 | 0.26 | 0.21 |
| $T_4$ | 100% RDF (25-50-50-20 kg N-$P_2O_5$-$K_2O$-S $ha^{-1}$) | 3.59 | 1.67 | 0.41 | 0.24 | 0.52 | 0.62 | 0.24 | 0.19 |
| $T_5$ | 50% RDF + 50% N through FYM | 3.80 | 1.71 | 0.43 | 0.23 | 0.55 | 0.63 | 0.25 | 0.21 |
| $T_6$ | 50% RDF + 50% N through FYM + Biofertilizer | 4.23 | 1.85 | 0.49 | 0.20 | 0.58 | 0.66 | 0.30 | 0.24 |
| $T_7$ | 75% RDF + Biofertilizer | 3.56 | 1.70 | 0.44 | 0.28 | 0.56 | 0.67 | 0.28 | 0.20 |
| $T_8$ | 75% RDF + 25% N through FYM | 3.64 | 1.65 | 0.39 | 0.29 | 0.59 | 0.71 | 0.22 | 0.23 |
| $T_9$ | 75% RDF + 25% N through FYM + Biofertilizer | 4.56 | 1.90 | 0.51 | 0.31 | 0.60 | 0.72 | 0.32 | 0.26 |
| $T_{10}$ | 75% RDF + 25% N through vermicompost + Biofertilizer | 4.04 | 1.87 | 0.45 | 0.26 | 0.57 | 0.69 | 0.29 | 0.18 |
| | S.Em. ± | 0.21 | 0.06 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | C.D. (P = 0.05) | 0.64 | 0.18 | 0.07 | 0.05 | 0.04 | 0.04 | 0.05 | 0.04 |
| | C. V. % | 9.76 | 6.08 | 9.66 | 12.21 | 4.90 | 4.05 | 11.84 | 13.79 |

**Table.2** Effect of different treatments on uptake of N, P, K and S by groundnut

| Treatments | | Nutrient uptake(kg ha$^{-1}$) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | | | P | | | K | | | S | | |
| | | Pod | Haulm | Total | Pod | Haulm | Total | Pod | Haulm | Total | Pod | Haulm | Total |
| $T_1$ | Control | 59.00 | 38.36 | 97.36 | 6.48 | 4.33 | 10.81 | 8.82 | 14.53 | 23.36 | 3.48 | 3.46 | 6.94 |
| $T_2$ | Biofertilizer (*Rhizobium* and PSM) | 72.25 | 41.94 | 114.19 | 7.75 | 5.48 | 13.23 | 9.66 | 16.38 | 26.04 | 4.20 | 4.17 | 8.36 |
| $T_3$ | FYM (5 t ha$^{-1}$) | 76.79 | 43.08 | 119.87 | 8.45 | 6.22 | 14.67 | 10.81 | 15.92 | 26.73 | 5.20 | 5.30 | 10.50 |
| $T_4$ | 100% RDF (25-50-50-20 kg N-$P_2O_5$-$K_2O$-S ha$^{-1}$) | 80.16 | 41.40 | 121.56 | 9.18 | 5.84 | 15.02 | 11.75 | 15.47 | 27.22 | 5.56 | 4.66 | 10.22 |
| $T_5$ | 50% RDF + 50% N through FYM | 83.97 | 44.46 | 128.43 | 9.40 | 5.99 | 15.39 | 12.15 | 16.49 | 28.64 | 5.42 | 5.46 | 10.88 |
| $T_6$ | 50% RDF + 50% N through FYM + Biofertilizer | 93.09 | 53.39 | 146.46 | 10.71 | 5.77 | 16.47 | 12.80 | 19.03 | 31.82 | 6.60 | 6.82 | 13.44 |
| $T_7$ | 75% RDF + Biofertilizer | 75.02 | 42.44 | 117.46 | 9.36 | 7.09 | 16.45 | 11.74 | 16.82 | 28.56 | 5.82 | 5.00 | 10.83 |
| $T_8$ | 75% RDF + 25% N through FYM | 82.64 | 37.62 | 120.26 | 9.03 | 6.58 | 15.60 | 13.39 | 16.19 | 29.58 | 5.08 | 5.27 | 10.36 |
| $T_9$ | 75% RDF + 25% N through FYM + Biofertilizer | 105.92 | 58.64 | 164.56 | 11.80 | 9.44 | 21.25 | 13.93 | 22.19 | 36.12 | 7.36 | 8.09 | 15.45 |
| $T_{10}$ | 75% RDF + 25% N through vermicompost + Biofertilizer | 91.99 | 54.23 | 146.22 | 10.17 | 7.59 | 17.76 | 13.17 | 19.95 | 33.13 | 6.46 | 5.12 | 11.58 |
| | S.Em. ± | 5.75 | 5.56 | 6.40 | 0.68 | 0.64 | 1.06 | 0.84 | 1.13 | 1.26 | 0.58 | 0.45 | 0.74 |
| | C.D. (P = 0.05) | 17.08 | 7.62 | 19.02 | 2.02 | 1.92 | 3.16 | 2.51 | 3.36 | 3.76 | 1.73 | 1.36 | 2.20 |
| | C. V. % | 12.14 | 9.76 | 8.69 | 12.76 | 17.44 | 11.77 | 12.41 | 11.35 | 7.54 | 18.29 | 14.90 | 11.82 |

**Table.3** Effect of different treatments on yield and economics

| Treatments | | Pod yield (kg $ha^{-1}$) | Haulm yield (kg $ha^{-1}$) | Gross return (Rs. $ha^{-1}$) | Cost of cultivation (Rs. $ha^{-1}$) | Net returns (Rs. $ha^{-1}$) | Benefit cost ratio |
|---|---|---|---|---|---|---|---|
| $T_1$ | Control | 1714 | 2368 | 75664 | 38208 | 37456 | 1.98 |
| $T_2$ | Biofertilizer (*Rhizobium* and PSM) | 1811 | 2536 | 80048 | 38796 | 41252 | 2.06 |
| $T_3$ | FYM (5 t $ha^{-1}$) | 1991 | 2496 | 87128 | 43358 | 43770 | 2.01 |
| $T_4$ | 100% RDF (25-50-50-20 kg N- $P_2O_5$-$K_2O$-S $ha^{-1}$) | 2256 | 2481 | 97683 | 45587 | 52096 | 2.14 |
| $T_5$ | 50% RDF + 50% N through FYM | 2201 | 2617 | 95891 | 44473 | 51419 | 2.16 |
| $T_6$ | 50% RDF + 50% N through FYM + Biofertilizer | 2200 | 2882 | 96646 | 45061 | 51586 | 2.14 |
| $T_7$ | 75% RDF + Biofertilizer | 2114 | 2506 | 92078 | 44330 | 47748 | 2.08 |
| $T_8$ | 75% RDF + 25% N through FYM | 2278 | 2276 | 97948 | 45030 | 52918 | 2.18 |
| $T_9$ | 75% RDF + 25% N through FYM + Biofertilizer | 2324 | 3080 | 102200 | 45618 | 56582 | 2.24 |
| $T_{10}$ | 75% RDF + 25% N through vermicompost + Biofertilizer | 2274 | 2908 | 99684 | 46098 | 53586 | 2.16 |
| | S.Em. ± | 116 | 157 | - | - | - | - |
| | C.D. (P = 0.05) | 344 | 469 | - | - | - | - |
| | C. V. % | 9.50 | 10.46 | - | - | - | - |

**Market price**

| Commodity | Rs. $kg^{-1}$ | Herbicide | Rs. $L^{-1}$ |
|---|---|---|---|
| **Urea** | 06.28 | Pendimethalin | 350.00 |
| **DAP** | 25.00 | | |
| **MOP** | 17.64 | **Insecticide** | Rs. $L^{-1}$ |
| **Cosavate** | 132.00 | Imidacloprid | 560.00 |
| **FYM** | 01.00 | Chloropyriphos | 270.00 |
| **Vermicompost** | 04.00 | | |
| **Pod** | 40.00 | | |
| **Haulm** | 03.00 | | |

**Table.4** Effect of different treatments on post-harvest nutrient status in soil

| Treatments | | Post-harvest available nutrients in soil | | | | |
|---|---|---|---|---|---|---|
| | | kg ha$^{-1}$ | | | mg kg$^{-1}$ | % |
| | | N | $P_2O_5$ | $K_2O$ | S | O.C. |
| $T_1$ | Control | 199.67 | 26.70 | 213.47 | 17.03 | 0.62 |
| $T_2$ | Biofertilizer (*Rhizobium* and PSM) | 234.33 | 29.13 | 220.00 | 24.43 | 0.64 |
| $T_3$ | FYM (5 t ha$^{-1}$) | 240.67 | 30.87 | 223.33 | 22.20 | 0.66 |
| $T_4$ | 100% RDF (25-50-50-20 kg N- $P_2O_5$-$K_2O$-S ha$^{-1}$) | 205.00 | 30.00 | 226.83 | 19.60 | 0.63 |
| $T_5$ | 50% RDF + 50% N through FYM | 217.00 | 31.83 | 223.70 | 26.30 | 0.68 |
| $T_6$ | 50% RDF + 50% N through FYM + Biofertilizer | 225.00 | 34.57 | 229.00 | 27.13 | 0.69 |
| $T_7$ | 75% RDF + Biofertilizer | 235.67 | 34.03 | 225.00 | 23.90 | 0.65 |
| $T_8$ | 75% RDF + 25% N through FYM | 246.67 | 35.37 | 228.00 | 28.67 | 0.67 |
| $T_9$ | 75% RDF + 25% N through FYM + Biofertilizer | 255.00 | 40.30 | 232.00 | 30.63 | 0.72 |
| $T_{10}$ | 75% RDF + 25% N through vermicompost + Biofertilizer | 253.33 | 37.50 | 226.67 | 27.20 | 0.70 |
| | S.Em. ± | 9.68 | 1.56 | 6.51 | 1.62 | 0.03 |
| | C.D. (P = 0.05) | 28.77 | 4.65 | NS | 4.82 | NS |
| | C. V. % | 7.25 | 8.20 | 5.04 | 11.33 | 8.04 |

## Effect on economics

Economics of the treatments revealed (Table 3) that the gross (Rs.102200 ha$^{-1}$), net realizations (Rs. 56582 ha$^{-1}$) and benefit: cost ratio (2.24) were higher with combined application of 75% RDF + 25% N through FYM + Biofertilizer ($T_9$) followed by $T_{10}$ (75% RDF + 25% N through vermicompost + Biofertilizer) and $T_8$ (75% RDF + 25% N through FYM). The lower gross returns (Rs. 175664 ha$^{-1}$), net returns (Rs. 37456 ha$^{-1}$) and B: C ratio (1.98) were noticed with the treatment $T_1$ (control).

The higher gross realization, net realization and B: C ratio in $T_9$, $T_{10}$ and $T_8$ treatments might be due to the higher pod and haulm yields in these treatments. These findings are in vicinity with those reported by Gunri and Nath (2012) and Kumar *et al.,* (2013).

## Effect on post-harvest nutrient status in soil

The post-harvest status of available N, $P_2O_5$ and S (255.00, 40.30, 30.63 kg ha$^{-1}$, respectively) in the soil (Table 4) was significantly improved by application of 75% RDF + 25 % N through FYM + Biofertilizer ($T_9$) over ($T_1$) control, but it was remained at par with $T_{10}$, $T_8$, $T_3$, $T_7$ and $T_2$ in available N status of soil, $T_{10}$ in available $P_2O_5$ of soil and $T_8$, $T_{10}$, $T_6$ and $T_5$ in available S status of soil.

However, available $K_2O$ status of soil and organic carbon remained unaffected due to various treatments. The lower values of these parameters were observed under control ($T_1$). Available potassium status of soil remained unaffected might be due to medium level of potassium available in soil, however slight increased $K_2O$ level was observed under integrated approach. Available nitrogen, phosphorus and sulphur status in soil after harvest of groundnut crop were significantly increased due to addition of these nutrients through the application of FYM, chemical fertilizers and biofertilizers.

Addition to this carbon dioxide and organic acids released during the process of decomposition FYM which increase the availability of nutrients from native as well as applied fertilizers. *Rhizobium* fixed the atmospheric nitrogen and *phosphobacteria solubilized* the fixed phosphate by secretion of organic acids and phosphate enzymes. These all might have contributed towards increased available status of soil with respect to these nutrients.

The results of present investigation strongly support the findings of Choudhary *et al.,* (2011) and Vallabh *et al.,* (2015).

Based on field experimentation, it can be concluded that an integrated supply of farm yard manure, biofertilizers or vermicompost with chemical fertilizers in bold seeded summer groundnut favored for better nutrient uptake resulting in higher yield which has caused for higher net returns and B: C ratio and improved post-harvest nutrients soil status of crop.

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