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# Effect of phosphorus levels through integrated nutrient management (INM) packages on nutrient uptake by groundnut (*Arachis hypogaea* L.)

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**Abstract**
A field experiment was conducted to study the Effect of phosphorus levels through INM packages on nutrient uptake by groundnut at College of Agriculture, UAHS, Shivamogga during 2015-2016. Results revealed that the higher uptake of major nutrients N, P, K Ca, Mg and S were noticed by haulm, shell and kernel of groundnut due to application of 75 % of 30 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM + PSB ($T_6$) compared to rest of the treatments. However, uptake by haulm with highest N uptake followed by Ca, K, Mg and S uptake, uptake by shell found to be higher uptake of Ca followed by N, Mg, K, P and S and kernel found to be higher uptake of Ca followed by N, K, Mg, P and S was noticed.

**Keywords:** FYM, INM, CF, chemical fertilizers, PSB: phosphorus solubilising bacteria and nutrient uptake

## Introduction
Groundnut is also known as peanut (*Arachis hypogaea* L.) belongs to family of Fabaceae, it is considered as one of the most important oil seed crop and dominant annual crop widely cultivated in India (Rathore and Kamble, 2008) [14]. Phosphorus play a major role in plant as constituent of nucleoproteins, phytins and phospholipids, essential constituent of number of enzymes, important in energy transfer, essential for cell division and development, mainly it aids in root and nodule formation. In soils, applied phosphate fertilizer enter into complex reactions with the various constituents of soils such as Fe, Al, Ca, Mg and get quickly converted to less soluble or insoluble forms as a result 20-25 per cent of applied phosphatic fertilizer is utilized by the crop in a season indicating low phosphorus use efficiency and build-up of P in soil is very common in the soils.

Incorporation of organic residues into soil influences the reactions of phosphates and its availability to plants, there by increases the P concentration in soil solution through mineralization of organic P and solubilisation of native soil P compounds. During decomposition of organic matter various organic acids are produced which solubilise the phosphates and other P bearing minerals and thereby lower the P-fixation. Combined use of organic and chemical and bio fertilizers enhances crop production and sustains soil fertility (Gupta *et al.,* 2003) [5]. Integrated use of phosphorus fertilizers with FYM and bio-fertilizers like P solubilising bacteria for instance *Pseudomonas striatus*, enhancing the more P solubility and availability in soils. Keeping these views and facts in mind, a field experiment was conducted at College of Agriculture, UAHS, Shivamogga during 2015-2016 on sandy loam soil to study the Effect of phosphorus levels through integrated nutrient management (INM) packages on nutrient uptake by groundnut.

## Materials and methods
A field experiment was conducted to investigate the effect of phosphorus levels through integrated nutrient management (INM) packages on status of phosphorus in soil under groundnut crop during the *kharif* 2015-16 under rainfed condition at College of Agriculture, comes under University of Agricultural and Horticultural Sciences, Shivamogga and belongs to Southern Transition Agro-climatic Zone of Karnataka (Zone No. 7). The experimental site is situated at 14º0' to 14º1' North latitude and 75º 40' to 75º 42' East longitude with an altitude of 650 meters above the mean sea level. Groundnut crop variety (G2-52) was selected as a test crop. The experiment comprised nine treatment combinations with three phosphorus

levels *viz.,* 20, 30 and 50 kg $P_2O_5$ $ha^{-1}$ applied through inorganic P fertilizer (75 %) and FYM (25 %) along with PSB bio fertilizer which are laid out in Randomized Completely Block Design (RCBD) with three replications. The treatment details are $T_1$: RDNK + 20 kg $P_2O_5$ $ha^{-1}$, $T_2$: RDNK + 75 % of 20 kg $P_2O_5$ $ha^{-1}$ through chemical fertilizers (CF) + 25 % through FYM, $T_3$: $T_2$ + PSB, $T_4$: RDNK + 30 kg $P_2O_5$ $ha^{-1}$, $T_5$: RDNK + 75 % of 30 kg $P_2O_5$ $ha^{-1}$ through chemical fertilizers (CF) + 25 % through FYM $T_6$: $T_5$ + PSB,$T_7$: RDNK + 50 kg $P_2O_5$ $ha^{-1}$,$T_8$: RDNK + 75 % of 50 kg $P_2O_5$ $ha^{-1}$ through chemical fertilizers (CF) + 25 % through FYM and $T_9$: $T_8$ + PSB. Soil texture (Piper, 1966), soil pH and EC determined by standard procedures laid out by Jackson (1973) [7]. Total nitrogen phosphorus, potassium, calcium and magnesium Jackson (1973) [7] while, total sulphur laid out by (Black, 1965). Fisher's method of analysis of variance was used for analysis and interpretation of the data as outlined by Panse and Sukhatme (1985) [10]. Nutrient uptake was calculated by following formula.

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%) x Dry matter (kg ha}^{-1})}{100}$$

## Results and discussion

### NPK uptake by groundnut plant parts

The data pertaining to the uptake of NPK by groundnut haulm, shell and kernel as influenced by various treatments effects are presented in Table 1.

At harvest, application of 75 % of 30 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM + PSB, showed significantly higher nitrogen uptake by different ground plant parts (67.30, 6.16 and 48.56 kg $ha^{-1}$, respectively), 6.58, 0.86 and 6.74 kg $ha^{-1}$, respectively, followed by application of 75 % $P_2O_5$ of 50 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM + PSB ($T_9$), over the rest of the treatments. Significantly lower nitrogen uptake by groundnut haulm, shell and kernel (18.71, 0.73 and 26.34 kg $ha^{-1}$, respectively), (2.19, 0.14 and 1.87 kg $ha^{-1}$, respectively) was recorded in $T_1$ (20 kg $P_2O_5$ $ha^{-1}$).

This might be due to increased photosynthetic products and their subsequent translocation to storage organ resulted in better fill up of production it leads to increases the uptake of nutrients N, P, K and S by kernel, shell and haulm of groundnut. These results are in accordance with the findings of Bagayoko *et al.* (2000) [1].

Rhizobium inoculants increased the infection of root with rhizobia and there by increased the nodules formation resulting in greater nitrogen fixation. Higher fixation led to greater nitrogen uptake Manisha and Bhadoria (2008) [9]. Similar results were also noted by Bajarag *et al.*, (2013) and Salve and Gunjal (2011) [15]. Phosphobacterium inoculants solubilised the unavailable phosphorus to plant available form and thereby increases P uptake. These results are corroborated with findings of Ramesh and Sabale (2001) [12], Hossn *et al.* (2007) [6].

Application of 75 % of 30 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM + PSB ($T_6$) was recorded statistically significant with higher potassium uptake to extent of 38.13, 4.78 and 19.29 kg $ha^{-1}$ (56.35, 8.74 and 52.78 kg $ha^{-1}$, respectively), followed by treatment $T_9$. Significantly lower potassium uptake by groundnut haulm, shell and kernel (16.60, 0.92 and 6.05 kg $ha^{-1}$, respectively), (17.60, 1.61 and 19.26 kg $ha^{-1}$, respectively).was recorded in treatment $T_1$ (20 kg $P_2O_5$ $ha^{-1}$ only).

The uptake of K by groundnut showed similar trend of N and P uptake. This might be due to application of N and P which increased the K content in plant significantly. Phosphorus fertilization helps in promoting root growth and lead to increase the uptake of K by the crop. Dutta and Mondal (2006), Hossn *et al.* (2007) [6], and Salve and Gunjal (2011) [15] also similar results were reported in groundnut.

### Ca, Mg and S uptake by groundnut plant parts

Data pertaining to the effect of phosphorus levels through INM packages on Ca, Mg and S uptake by groundnut haulm, shell and kernel presented in Table 2.

Significant increase in magnesium uptake by groundnut haulm, shell and kernel was recorded due to supplying of 75 % of 30 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM + PSB in treatment $T_6$ (24.82, 5.33 and 29.42 kg $ha^{-1}$, respectively), (6.87, 0.36 and 3.39 kg $ha^{-1}$, respectively) followed by treatment $T_9$. Significantly lower magnesium uptake by groundnut haulm, shell and kernel was noticed due to treatment supplied with 20 kg $P_2O_5$ $ha^{-1}$ alone (7.95, 0.84 and 9.32 kg $ha^{-1}$, respectively) (1.95, 0.06 and 1.36 kg $ha^{-1}$, respectively).

Addition of gypsum increased soil pH and might have accelerated the movement of phosphorus in soil solution, thereby increases the calcium uptake. Similarly results were stated by Ranjit *et al.* (2007) the solubility of Ca and Mg phosphates may be increased due to production of carbonic acid released by decay of organic matter. The increases in availability of availability of Ca and Mg in various plant parts of groundnut and their uptake due to application of phosphorus along with FYM. Similarly results also reported by Rao and Shaktawat (2005) [13]. Several studies had indicated that the solubilization effect was due to chelation of Ca ions by organic acids, most notably lactic, glyconic, citric, succinic and 2- keto gluconic acids. The increases the sulphur concentration and uptake by crop due to application of the NPK fertilizer. Similar results were observed by Kishore Babu *et al.* (2007) [8].

### Total uptake of nutrients by groundnut plant parts

The results of total uptake of primary and secondary nutrients by different plant parts are presented in Table 2 and 3. Significantly higher uptake of N, P, K, Ca, Mg and S by various plant parts due to influence of graded phosphorus levels through integrated nutrient management (INM) packages. The total uptake of N, P, K, Ca, Mg and S significantly shown higher value of uptake due to application of 75 % of 30 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM + PSB which recorded to extent of 122.02, 14.18, 62.20, 117.87, 59.57 and 10.62 kg $ha^{-1}$, respectively, compared to other treatments. Significantly lower uptake was recorded (45.78, 4.21, 23.57, 38.47, 80.11 and 3.36 kg $ha^{-1}$, respectively) in $T_1$ (20 kg $P_2O_5$ $ha^{-1}$.

**Table 1:** Effect of phosphorus levels through integrated nutrient management (INM) packages on NPK uptake by groundnut plant parts at harvest of groundnut

| Treatments | kg ha -1 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | | | | P | | | | K | | | |
| | Haulm | Shell | Kernel | Total | Haulm | Shell | Kernel | Total | Haulm | Shell | Kernel | Total |
| $T_1$: 20 kg $P_2O_5$ $ha^{-1}$ | 18.71 | 0.73 | 26.34 | 45.78 | 2.19 | 0.14 | 1.87 | 4.21 | 16.60 | 0.92 | 6.05 | 23.57 |
| $T_2$: 75 % of 20 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM | 27.20 | 1.28 | 29.77 | 58.25 | 2.83 | 0.23 | 2.26 | 5.33 | 21.47 | 1.47 | 7.58 | 30.52 |
| $T_3$: $T_2$ + PSB | 35.39 | 1.88 | 33.60 | 70.86 | 3.57 | 0.35 | 3.02 | 6.94 | 25.56 | 2.06 | 10.30 | 37.92 |
| $T_4$: 30 kg $P_2O_5$ $ha^{-1}$ | 43.62 | 2.43 | 40.56 | 86.61 | 4.23 | 0.46 | 4.35 | 9.03 | 29.13 | 2.75 | 13.24 | 45.12 |
| $T_5$: 75 % of 30 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM | 50.26 | 3.97 | 43.32 | 97.55 | 4.85 | 0.61 | 5.37 | 10.83 | 32.11 | 3.56 | 15.79 | 51.59 |
| $T_6$: $T_5$ + PSB | 67.30 | 6.16 | 48.56 | 122.02 | 6.58 | 0.86 | 6.74 | 14.18 | 38.13 | 4.78 | 19.29 | 62.20 |
| $T_7$: 50 kg $P_2O_5$ $ha^{-1}$ | 55.60 | 4.32 | 47.33 | 107.25 | 5.21 | 0.69 | 5.83 | 11.73 | 34.15 | 3.95 | 16.12 | 53.43 |
| $T_8$: 75 % of 50 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM | 57.31 | 4.24 | 47.50 | 109.05 | 5.45 | 0.67 | 6.24 | 12.35 | 34.76 | 3.75 | 16.54 | 54.86 |
| $T_9$: $T_8$ + PSB | 60.75 | 4.39 | 48.04 | 113.18 | 5.93 | 0.69 | 6.48 | 13.10 | 36.26 | 3.78 | 17.25 | 56.99 |
| S Em $\pm$ | 3.35 | 0.19 | 1.50 | 11.16 | 0.31 | 0.019 | 0.28 | 0.34 | 1.87 | 0.14 | 0.50 | 2.07 |
| CD (P=0.05) | 10.05 | 0.58 | 4.51 | 3.72 | 0.93 | 0.057 | 0.84 | 1.03 | 5.61 | 0.44 | 1.50 | 6.23 |

**Table 2:** Effect of phosphorus levels through integrated nutrient management (INM) packages on Ca, Mg and S uptake by groundnut plant parts at harvest of groundnut

| Treatments | kg ha $^{-1}$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ca | | | | Mg | | | | S | | | |
| | Haulm | Shell | Kernel | Total | Haulm | Shell | Kernel | Total | Haulm | Shell | Kernel | Total |
| $T_1$: 20 kg $P_2O_5$ $ha^{-1}$ | 17.60 | 1.61 | 19.26 | 38.47 | 7.95 | 0.84 | 9.32 | 18.11 | 1.95 | 0.06 | 1.36 | 3.36 |
| $T_2$: 75 % of 20 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM | 24.76 | 2.71 | 22.27 | 49.74 | 10.89 | 1.40 | 11.25 | 23.54 | 2.59 | 0.10 | 1.67 | 4.34 |
| $T_3$: $T_2$ + PSB | 33.60 | 3.86 | 28.86 | 66.32 | 13.68 | 1.97 | 15.06 | 30.71 | 3.34 | 0.14 | 2.07 | 5.55 |
| $T_4$: 30 kg $P_2O_5$ $ha^{-1}$ | 39.35 | 5.04 | 35.92 | 80.31 | 16.96 | 2.58 | 21.35 | 40.89 | 4.00 | 0.18 | 2.34 | 6.52 |
| $T_5$: 75 % of 30 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM | 45.63 | 6.67 | 42.46 | 94.76 | 19.61 | 3.38 | 24.20 | 47.19 | 4.73 | 0.24 | 2.54 | 7.50 |
| $T_6$: $T_5$ + PSB | 56.35 | 8.74 | 52.78 | 117.87 | 24.82 | 5.33 | 29.42 | 59.57 | 6.87 | 0.36 | 3.39 | 10.62 |
| $T_7$: 50 kg $P_2O_5$ $ha^{-1}$ | 48.48 | 7.70 | 42.00 | 98.18 | 20.66 | 3.81 | 26.51 | 50.97 | 5.29 | 0.25 | 3.03 | 8.56 |
| $T_8$: 75 % of 50 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM | 49.19 | 7.39 | 46.55 | 103.13 | 21.12 | 3.90 | 27.83 | 52.85 | 5.73 | 0.26 | 3.17 | 9.15 |
| $T_9$: $T_8$ + PSB | 51.77 | 7.62 | 47.34 | 106.73 | 21.78 | 4.05 | 28.91 | 54.75 | 5.81 | 0.26 | 3.32 | 9.39 |
| S Em $\pm$ | 2.74 | 0.33 | 1.53 | 3.21 | 1.23 | 0.22 | 0.85 | 1.40 | 0.23 | 0.02 | 0.11 | 0.26 |
| CD (P=0.05) | 8.22 | 0.98 | 4.60 | 9.64 | 3.69 | 0.66 | 2.55 | 4.22 | 0.69 | 0.05 | 0.34 | 0.77 |

## Conclusion

The results showed that application of different levels of phosphorus application along PSB significantly enhanced the uptake of nutrient uptake by various parts of groundnut. Application of 75 % of 30 kg $P_2O_5$ $ha^{-1}$ through CF + 25 % through FYM + PSB increased the nutrient content in plant parts compared to rest of the other treatment. It could be concluded that among the three levels of phosphorus application 30 kg $ha^{-1}$ was superior with respect to nutrient uptake.

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