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Effect of inorganic and bio-fertilizers on nutrient (NPK) content, nutrient (NPK) uptake and available nutrient (NPK) at harvest of summer groundnut (*Arachis hypogaea* L.)

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Abstract
A field experiment entitled, "Effect of inorganic and bio-fertilizers on growth, yield and quality of summer groundnut (*Arachis hypogaea* L.)" was conducted at PG Research Farm, Agronomy Section, R.C.S.M. College of Agriculture, Kolhapur during summer, 2019. The experiment was laid out in factorial randomized block design (FRBD) with three replications and nine treatment combinations of three inorganic fertilizer levels *viz.*, F_1- 75% RDF (18.75:37.5:0 kg ha^{-1}), F_2- 100% RDF (25:50:0 kg ha^{-1}), F_3- 125% RDF (31.25:62.5:0 kg ha^{-1}) and three bio-fertilizers levels *viz.*, B_1- Control, B_2-*Rhizobium* spp.+ PSB (Lignite based), B_3- *Rhizobium* spp.+ PSB (Liquid based). The available N, P and K in soil after harvest, nitrogen content (%) and phosphorous content (%) in kernel and haulm, total uptake of nutrients (N, P_2O_5 and K_2O) by groundnut crop and dry pod and haulm yield were recorded higher due to different inorganic fertilizers levels with application of 125% of RDF ha^{-1}which was comparable with 100% of RDFha^{-1}, significantly over 75% RDF ha^{-1}. The available N, P and K (kg ha^{-1}) in soil after harvest, nitrogen content (%) and phosphorous content (%) in kernel and haulm and total uptake of nutrients (N, P_2O_5 and K_2O) (kg ha^{-1}) by groundnut crop and dry pod and haulm yield were recorded higher due to different bio-fertilizers levels with application of the dual seed inoculation of *Rhizobium* spp. + PSB (Lignite based) as well as *Rhizobium* spp. + PSB (Liquid based).

Keywords: Inorganic fertilizer levels, bio-fertilizer levels, nutrient content, nutrient uptake, available nutrient, dry pod and haulm yield

Introduction
Groundnut (*Arachis hypogaea* L.) belongs to family leguminosae and sub family papillionaceae. The groundnut crop is worlds the 13th most important food crop and 4th most important oilseed crop and 3rd most important source of vegetable protein. India is one of the major producers as well as consumer of groundnut in the world with (69.70 lakh tonnes) after China (166.24 lakh tonnes). In India, groundnut accounts for 45 per cent of the total area cropped under oilseed and 55% of total under oilseed production. During 2018-2019 groundnut was sown in around 40.13 lakh hectares which was 3.25% lower than the corresponding period of last year (41.48 lakh hectares). The groundnut is a commercially and nutritionally very important source of oil. At the global level 50% of the groundnut produced is used for oil extraction, 37% for confectionary use and 12% for seed purpose. In India, 80% of the groundnut produced is used for oil extraction, 11% as seed, 8% as direct food and only 1% of groundnut produce is exported (Anon., 2011) [1]. The groundnut contains 50% oil and 20% protein depends on varieties and climatic conditions (Singh *et al*., 1994) [12]. As the oilseed crops are backbone of Indian economy from time of immemorial to still today. The oilseed is more hungry than thirsty and there is a wide gap in fertilizer demand and applications which results in huge mining of soil fertility leading to complex nutrient imbalances and deficiencies, that is difficult to manage. The grim situation of oilseed nutrient in the country indicates that only about 1/3 of fertilizer needs are actually applied. Thus, there is urgent need for steeping use of major, secondary and micro nutrients (Hedge, 2009) [6]. We can solve this problem by adopting use of inorganic fertilizers according to soil testing report and recommended dose of fertilizers. Along with inorganic fertilizers use of organic fertilizers like bio-fertilizers will also help for improving fertility level of soil.

The indiscriminate use of chemical fertilizers may harm to the soil fertility and productivity, which can be overcome by the use bio-fertilizers. The fertilizers are the king pin in the present system of agriculture. A recent FAO study indicates that between 1965 and 1976 fertilizers were responsible for 50 per cent increase in the crop production in developing countries. Judicious use of fertilizer is an important management practice to increase groundnut production. Balanced uses of fertilizer assume vital important in sustainable agriculture. The fertilizer pays back to the farmer more profit per unit investment. Indian soils are usually low in organic matter and nitrogen. The phosphorus deficiency is less widely spread and potash deficiency generally occurred in limited areas. In cropping system, if a legume like groundnut is a component crop which leaves considerable mineralizable nitrogen in the soil, succeeding crop, if cereal or non-legume can be fertilized with a reduced dose of nitrogen by at least 20 to 25 kg per hectare.

Materials and methods

The experiment was laid out in factorial randomized block design (FRBD) with three replications and nine treatment combinations of three inorganic fertilizers levels *viz.*, (F_1- 75% RDF (18.75:37.5:0 kg ha^{-1}), F_2- 100% RDF (25:50:0 kg ha^{-1}), F_3- 125% RDF (31.25:62.5:0 kg ha^{-1})and three bio-fertilizers levels *viz.*, (B_1- Control, B_2- *Rhizobium* spp. + PSB (Lignite based), B_3- *Rhizobium* spp. + PSB (Liquid based). The gross and net plot size were 5.4 m x 4.8 m and 4.8 m x 3.6 m, respectively. The soil of the experimental plot was sandy loam in texture, low in available nitrogen (231.24 kg ha^{-1}), moderately high in available phosphorus (24.25 kg ha^{-1}) and moderately high in available potassium (243.16 kg ha^{-1}). The soil was slightly alkaline in reaction (pH 8.23).

The crop, groundnut with variety JL-1085 (Phule Dhani) was sown on 15th of February, 2019 by dibbling method with different inorganic and bio-fertilizer levels. The crop was fertilized as per treatments by using urea and single super phosphate was given by placement method. In general, the summer season was good for crop growth and development. The experimental data was statistically analyzed by using a standard method of “analysis of variance” as reported by Panse and Sukhatme (1967) [9].

Plant analysis: The sample from different plant parts of observational plants were used for chemical estimation of total nitrogen, phosphorus and potassium. The concentration of nitrogen in plant and grain was estimated by Micro Kjeldhal method. The phosphorus was determined by Calorimetric method (Jackson, 1973) [7] and potassium was estimated by flame photometer method.

Collection, preparation and digestion of Plant Samples: The plant samples collected after harvest were cleaned shade dried and then dried in hot air oven at 65 ^{0}C. Further, these samples were milled to considerable fineness in a mill and stored in plastic bags for further analysis. The powdered plant sample 0.5 g passed through 100 mm sieve was pre-digested with concentrated nitric acid overnight. Further, pre-digested samples were treated with tri-acid (Nitric acid: sulphuric acid: perchloric acid in ratio 9:1:4) mixture and kept on sand bath for digestion. After complete digestion the precipitate was dissolved in 6 N HCl and Transferred to the 100 ml volumetric flask through Whatman No. 42 filter paper by thoroughly washing with double distilled water and finally the volume was made to 100 ml and preserved for further analysis.

Nitrogen (N) content estimation

The powdered 0.5 g plant sample was digested with concentrated sulphuric acid and digestion mixture ($CuSO_4$ + K_2SO_4 + selenium powder). The digest was transferred to the micro kjeldhal distillation flask and the ammonia liberated was distilled in presence of alkali collected in 2 per cent boric acid and the distillate was titrated against standard acid (Jackson, 1973) [7].

Phosphorous (P) content estimation

The phosphorus in plant sample was determined by Vanado molybdateoposphoric yellow colour method (Jackson, 1973) [7].

Potssium (K) content estimation

The potassium content in the digested samples was determined by flame photometer after making appropriate dilution (Jackson, 1973) [7].

Uptake studies

The uptake of nitrogen, phosphorus and potassium (kg ha^{-1}) was worked out by multiplying the percentage of these nutrients in grain, straw with the corresponding yields of the respective constituent**:**

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient conc. (\%) x Wt. of dry matter (kg ha}^{-1})}{100}$$

Result and discussion

I) Effect on nutrient (NPK) content (%) in kernel and haulm of groundnut

A. Effect of inorganic fertilizer levels

Increasing fertility levels significantly increased the nitrogen and phosphorous concentration in kernel and haulm of groundnut. The application of 125% RDF being at par with 100% RDF recorded significantly higher nitrogen concentration in kernel and haulm of groundnut, over 75% RDF. Similar results were also reported Chavan *et al*., (2013) [4] and Sharma *et al*., (2013) [11]. The data on mean potassium concentration of groundnut are presented in Table 1 that there was non significant variation in potassium concentration in kernel and haulm of groundnut due to application of different levels of inorganic fertilizer. Similar results were also reported Chavan *et al*., (2013) [4] and Sharma *et al*., (2013) [11].

B. Effect of bio-fertilizer levels

A perusal of data revealed that the different levels of bio-fertilizer brought significant increase in phosphorus concentration of kernel and haulm of groundnut. The application of dual inoculation of *Rhizobium* spp. + PSB (Lignite based) recorded significantly highest phosphorus concentration in kernel and haulm of groundnut over control. However, it was at par with dual seed inoculation with *Rhizobium* spp. + PSB (Liquid based). Similar results were also reported Chavan *et al*., (2013) [4] and Sharma *et al*., (2013) [11]. The data on mean potassium concentration of groundnut are presented in Table 1 that there was non-significant variation in potassium concentration in kernel and haulm of groundnut due to application of different levels of bio-fertilizer. Similar results were also reported Chavan *et al*., (2013) [4] and Sharma *et al*., (2013) [11].

C. Effect of interaction

The interaction effect between inorganic fertilizer and bio-fertilizers were found to be non-significant in respect of mean nutrient (NPK) content (%) in kernel and haulm of groundnut.

Table 1: Mean N, P and K content of groundnut as influenced by different treatments

Treatments	Nitrogen (%)		Phosphorous (%)		Potassium (%)	
	Kernel	Haulm	Kernel	Haulm	Kernel	Haulm
Inorganic Fertilizers						
F_1- 75% of RDF	3.16	1.43	0.52	0.13	0.34	1.21
F_2- 100% of RDF	3.78	1.87	0.68	0.15	0.46	1.25
F_3- 125% of RDF	3.96	1.93	0.70	0.18	0.57	1.30
S. Em±	0.05	0.02	0.006	0.002	0.02	0.008
C. D. at 5%	0.15	0.07	0.02	0.007	NS	NS
Biofertilizer levels						
B_1– Control	3.08	1.59	0.57	0.12	0.32	1.24
B_2 -*Rhizobium spp*.+ PSB (Lignite based)	3.98	1.87	0.68	0.19	0.59	1.27
B_3-*Rhizobium spp*.+ PSB (Liquid based)	3.83	1.79	0.66	0.16	0.47	1.25
S. Em±	0.05	0.02	0.006	0.002	0.02	0.008
C. D. at 5%	0.15	0.07	0.02	0.007	NS	NS
Interactions (F × B)						
S. Em±	0.15	0.07	0.02	0.07	0.07	0.02
C. D. at 5%	NS	NS	NS	NS	NS	NS
General mean	3.63	1.75	0.64	0.15	0.46	1.25

II) Effect on total uptake of nutrients (N, P_2O_2, K_2O) by groundnut crop (kg ha^{-1})

A. Effect of inorganic fertilizer levels

The application of inorganic fertilizer level 125% RDF recorded significantly highest nutrients (N, P_2O_2, K_2O) of groundnut over 75% RDF. However, it was on par with 100% RDF. Similar result were also reported Bhalu *et al.*, (1993) [3], Patra *et al*., (1995) [10], Chavan *et al*., (2013) [4] and Sharma *et al*., (2013) [11].

B. Effect of bio-fertilizer levels

The application of dual seed inoculation with *Rhizobium* spp. + PSB (Lignite based) recorded significantly highest uptake nutrients (N, P_2O_2, K_2O) of groundnut over control. However, it was comparable with dual seed inoculation with *Rhizobium* spp. + PSB (Liquid based). Similar results were also reported Chavan *et al*., (2013) [4] and Sharma *et al*., (2013) [11].

C. Effect of interaction

The interaction effect between inorganic fertilizer and bio-fertilizers were found to be non-significant in respect of uptake of nutrients (N, P_2O_2, K_2O) by groundnut.

Table 2: Mean uptake of nutrients (N, P_2O_5 and K_2O) by groundnut as influenced by different treatments

Treatments	Nutrient uptake (kg ha^{-1})		
	Nitrogen	Phosphorous	Potassium
Inorganic Fertilizers:			
F_1- 75% of RDF	89.66	11.89	40.97
F_2- 100% of RDF	135.78	18.31	52.11
F_3- 125% of RDF	144.45	20.77	57.29
S. Em±	1.77	0.24	0.59
C. D. at 5%	5.33	0.72	1.78
Biofertilizer levels:			
B_1– Control	100.32	13.18	44.27
B_2 -*Rhizobium spp*.+ PSB (Lignite based)	139.90	19.61	54.92
B_3-*Rhizobium spp*.+ PSB (Liquid based)	129.67	18.18	51.18
S. Em±	1.77	0.24	0.59
C. D. at 5%	5.33	0.72	1.78
Interactions (F × B):			
S. Em±	5.33	0.72	1.78
C. D. at 5%	NS	NS	NS
General mean	123.30	16.99	50.12

III) Effect on available nutrients (NPK) (kg ha^{-1})

A. Effect of inorganic fertilizer levels

The application of inorganic fertilizer level 125% RDF recorded significantly highest available nutrients (NPK) (kg ha^{-1}) of groundnut over 75% RDF, however, on par with 100% RDF.

B. Effect of bio-fertilizer levels

The application of dual seed inoculation with *Rhizobium* spp. + PSB (Lignite based) recorded significantly superior available nutrients (NPK) (kg ha^{-1}) of groundnut over control. However, it was on par with dual seed inoculation with *Rhizobium* spp. + PSB (Liquid based).

C. Effect of interaction

The interaction effect between inorganic fertilizer and bio-fertilizers were found to be non-significant in respect of available nutrients (NPK) (kg ha^{-1}) of groundnut.

Table 3: Mean available nitrogen, phosphorus and potassium in soil of groundnut after harvest as influenced by different treatments

Treatments	Available nitrogen (kg ha^{-1})	Available phosphorous (kg ha^{-1})	Available potassium (kg ha^{-1})
Inorganic Fertilizers			
F_1- 75% of RDF	241.12	23.51	224.22
F_2- 100% of RDF	255.35	25.97	237.58
F_3- 125% of RDF	258.62	26.01	239.83
S. Em±	1.17	0.15	1.04
C. D. at 5%	3.52	0.45	3.13
Biofertilizer levels			
B_1– Control	241.81	24.05	226.13
B_2 -*Rhizobium spp*.+ PSB (Lignite based)	258.45	25.76	239.28
B_3-*Rhizobium spp*.+ PSB (Liquid based)	254.45	25.68	236.22
S. Em±	1.17	0.15	1.04
C. D. at 5%	3.52	0.45	3.13
Interactions (F × B)			
S. Em±	3.52	0.45	3.13
C. D. at 5%	NS	NS	NS
General mean	251.70	25.16	233.88
Initial status of soil	231.24	24.25	243.16

IV) Effect on yield of groundnut crop

A. Effect of inorganic fertilizer levels

The different fertilizer levels had a significant impact on the dry pod and haulm yield of groundnut. Among the inorganic fertilizers, the application of 125% RDF (31.25:62.5:0 kg NPK ha^{-1}) recorded significantly the highest dry pod and haulm yield of groundnut over 75% RDF (18.75:37.5:0 kg NPK ha^{-1}). However, it was at par with application of 100% RDF (25:50:0 kg NPK ha^{-1}) in case of dry pod and haulm yield. This may be due to efficient and greater partitioning of metabolites and adequate translocation and accumulation of photosynthesis to developing reproductive structure under adequate fertilization that might have resulted in increase in important growth and yield contributing characters *viz.*, plant spread, number of branches, dry matter accumulation, number of pods and kernels and their weight and thousand kernel weight were significantly increased which resulted in increased dry pod yield with higher level of fertilizer. Further, the fertilizer application provided better conductive condition for higher uptake of nutrients. There results are inconformity with the above finding of Tiwari and Dhakar (1997), Bhalerao *et al.*, (1993), Ganamurthy and Balsubramanian (1992) and Chavan *et al.*, (2013) [4].

Table 4: Mean dry pod yield and haulm yield, of groundnut as influenced by different treatments

Treatments	At harvest	
	Dry pod yield (q ha^{-1})	Dry haulm yield (q ha^{-1})
Inorganic Fertilizer Levels		
F_1- 75% of RDF	21.05	29.37
F_2- 100% of RDF	24.60	34.60
F_3- 125% of RDF	24.95	35.48
S. Em±	0.20	0.28
C. D. at 5%	0.60	0.84
Biofertilizer Levels		
B_1– Control	22.18	31.27
B_2 -*Rhizobium spp*.+ PSB (Lignite based)	24.42	34.32
B_3-*Rhizobium spp*.+ PSB (Liquid based)	23.98	33.86
S. Em±	0.20	0.28
C. D. at 5%	0.60	0.84
Interactions (F× B)		
S. Em±	0.60	0.85
C. D. at 5%	NS	NS
General mean	23.53	33.15

B. Effect of bio-fertilizer levels

The different bio-fertilizer treatments significantly differed in respect of the pod and haulm yield. The dual inoculation of *Rhizobium* spp. + PSB (Lignite based) recorded the dry pod and haulm yield of groundnut significantly superior over the control. However, it was on par with dual seed inoculation with *Rhizobium* spp. + PSB (Liquid based). The important growth and yield contributing characters *viz.*, plant spread, number of branches, dry matter accumulation, number of pods and kernels and their weight and thousand kernel weight were significantly increased with the application of P-solubilizer treatments with *Rhizobium* inoculation due to additional nitrogen and phosphorous uptake, resulting in increased dry pod yield. Increase in root nodules due to P-solubilizer and nitrifying bacteria also helped in increasing better root development and dry pod yield by fixing more nitrogen and consequently increasing its absorption. These results were found to be in conformity with Mausumi Raychaudari *et al.*, (2003) [8] and Chavan *et al.*, (2013) [4].

C. Effect of interaction

The interaction effect between inorganic fertilizer and bio-fertilizers were found to be non-significant in respect of the dry pod and haulm yield of groundnut.

Conclusions

1. The application of 125% RDF and 100% RDF recorded higher nutrient content, uptake, available nutrient and dry pod and haulm yield of groundnut crop, hence 125% RDF fertilizer levels can be recommended for getting better growth and development of groundnut plant.
2. The dual seed inoculation of *Rhizobium* spp. + PSB (Lignite based) as well as *Rhizobium* spp. + PSB (Liquid based) can be effectively used for seed treatment for better nutrient content, uptake, available nutrient and dry pod and haulm yield of groundnut plant.

References

1. Anonymous. Directorate of Economics and Statics, Department of Agriculture and Corporation, Ministry of Agriculture, GOI 2011,262.
2. Bhalerao PD, Jadhao PN, Fuzele GR. Response of promising groundnut (*Arachis hypoagea* L.) genotypes to fertilizer levels during summer. Indian J Agron 1993;38(3):505-507.
3. Bhalu VB, Sadaria SG, Kaneria BB, Khanpara VD. Effect of nitrogen, phosphorous, and *Rhizobium* inoculation on yield and quality N and P uptake and economic of black gram (*Phaseolus mungo*) Indian J Agron 1993;40(2):316-318.
4. Chavan AP, Jain AK, Mahadkar UV. Direct & residual effect of fertilizers and bio-fertilizers on yield, nutrient uptake and economic of groundnut. Indian J Agron 2013;59(1):53-58.
5. Gananamurthy, Balasubrimanian. Influence of phosphorus and potassium on rainfed groundnut (*Arachis hypoagea* L.). Indian J Agron 1992;37(4):775-757.
6. Hedge DM, Sudhakara babu SN. Declining factor productivity and improving nutrient use efficiency in oilseed. Indian J Agron 2009;54(1):1-8.
7. Jakason ML. Soil chemical analysis, prentice hall of India. Ltd. New Delhi, 1973, 498.
8. Mausumi Raychandhuri, Ngachan SV, Raychaudhari S, Singh AL. Yield response of groundnut (*Arachis hypoagea* L.) to dual inoculation and liming of an acid hill ultisol of Manipur. Indian J Agril Sci 2003;73(2):86-88.
9. Panse VG, Sukhatme PV. Stastical methods for agricultural research workers. ICAR publication, New Delhi, 1967.
10. Patra AK, Tripathy SK, Samvi RC. Response of rainfed groundnut to potassium with levels of nitrogen. J Potassium Res 1995;11(3-4):327-331.
11. Sharma S, Jat NL, Puniya MM, Shivran AC, Choudhary S. Fertility levels and biofertilizers on nutrient concentrations, uptake and quality of groundnut. Ann. Agric. Res. New Series 2013;35(1):71-74.
12. Singh VK, Paliwal AK, Singh RN. Response of groundnut (*Arachis hypoagea* L.) to phosphorous and potassium. Indian J Agron 1994;39(1):66-70.
13. Tiwari RB, Dhakare LL. Productivity and economics of summer groundnut (*Arachis hypoagea* L.) as affected by irrigation, fertilization and weed control. Indian J0 Agron 1997;42(3):490-494.