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Effect of inorganic phosphorus in combination with bio-inoculants on groundnut crop performance

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Abstract
Yield and yield attributes of groundnut were evaluated with the application of different levels of phosphorus fertilizer along with bio-inoculants during *Rabi* 2021. The experiment was laid out in Randomized Block Design and replicated thrice, conducted at Agricultural College Farm, Bapatla. The treatments comprised of T_1- Control (without P), T_2- 75% RDP, T_3- 100% RDP, T_4- 75% RDP + PSB, T_5- 75% RDP + PSB + VAM, T_6- 100% RDP + PSB, T_7- 100% RDP + PSB+ VAM, T_8 - Control + PSB, T_9 - Control + PSB + VAM.
The results indicated that the combined application of inorganic fertilizer and bio fertilizer proved significantly superior over application of bio fertilizers without adding inorganic phosphorus fertilizer in obtaining better growth and higher yield of groundnut. The yield was increased with the application of 75% RDP + PSB + VAM over 100% RDP alone which indicates that the reduction in RDP *i.e.,* 25% could be able to get the good yield by substituting this with PSB and VAM. The highest shelling percentage and test weight (100 kernel weight) was recorded with the application of 100% RDP + PSB+ VAM (T_7).

Keywords: Groundnut, bio-inoculants, yield, shelling percentage and test weight.

Introduction
Groundnut (*Arachis hypogaea* L.) is one of the most important oilseed crop grown mainly for its edible seeds and it plays a major role in bridging the vegetable oil deficit in the country. It is grown in well drained sandy loam or sandy clay loam soil. This crop has its own importance due to high edible oil content and nutritional value of kernel as human food, and haulm as rich feed for animals. Peanut is very important source of oil (40-45%), protein (26%), carbohydrates (25%), minerals (Phosphorus, calcium and iron) and vitamins (vitamin B complex like thiamine, riboflavin, niacin and vitamin E) in addition to higher proportion of unsaturated fatty acids, including essential fatty acids like linolenic and linoleic acids. Groundnut cake is a valuable organic manure and animal feed (Sharma *et al*., 2020) [11].
In India, area and production of groundnut is 4.91 million hectares and 9.18 million tonnes, respectively. In Andhra Pradesh area under groundnut crop is about 0.66 million hectares and production of 0.85 million tonnes (Anonymous, 2020) [1].
Phosphorous is one among the seventeen essential nutrients and the most important primary plant nutrient which plays a crucial role in many physiological processes of plant such as photosynthesis, respiration and is the important component of ATP, the energy currency of the plants (Ayub *et al.*, 2002) [2].
Bio fertilizers like phosphorus solubilizing bacteria (PSB) and mycorrhiza which solubilize and mobilise soil phosphates and make them available to plants, can improve phosphorus use efficiency. The PSB inoculum is used to increase phosphorus availability to crops. During phosphorus Solubilization, some organic acids are produced which decrease the pH and acid phosphatases convert the organic phosphorus into inorganic form (Khan *et al*., 2009) [8].
In soils, applied phosphatic 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 15-20 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 above context, an experiment was conducted to assess the effect of inorganic phosphorus in combination with bio-inoculants on groundnut crop performance.

Material and Methods
A field experiment was conducted at Agricultural College Farm, Agricultural College, Bapatla during *Rabi*, 2020.

TAG-24 was seeded on sandy clay loam soil with a spacing of 30 cm × 10 cm in a Randomised Block Design with three replications. The experimental soil was sandy clay loam in texture, neutral in reaction, low in organic carbon, low in available nitrogen, medium in available phosphorus and high in available potassium and sufficient in all micronutrients (Zn, Fe, Mn and Cu). The experiment consisted of eight treatments *viz*., T_1- Control (without P), T_2- 75 % RDP, T_3- 100 % RDP, T_4- 75 % RDP + PSB, T_5- 75 % RDP + PSB + VAM, T_6- 100 % RDP + PSB, T_7- 100 % RDP + PSB+ VAM, T_8 - Control + PSB, T_9 - Control + PSB + VAM.

Well decomposed farmyard manure @ 10 t ha^{-1} was applied 15 days before sowing. A recommended dose of nitrogen @ 30 kg ha^{-1} was applied in the form of urea in two equal splits *i.e.,* half as basal and half at 30 days after sowing. The recommended dose of P_2O_5 @ 40 kg ha^{-1} was applied as per the treatments as basal just before sowing through single super phosphate. A recommended dose of 50 kg K_2O ha^{-1} was applied as muriate of potash as basal application. Bio fertilizers *viz.,* PSB @ 1.25 L ha^{-1} and VAM @ 12.5 kg ha^{-1} were mixed with farm yard manure and applied as per the treatments. Recommended cultural practices and plant protection measures were taken throughout the cropping season.

Dry matter accumulation (kg ha^{-1}) was obtained by taking five plants from the second row, they were dried first in shade and then in a hot air oven at 65^{0}C till a constant weight was obtained. Then dry weights were recorded and dry matter was expressed in kg ha^{-1}. Haulm yield (kg ha^{-1}) was obtained by plants from the net plot area after harvesting were sun-dried till constant weight was obtained and their weight was recorded as per plot basis. Pod and kernel yield (kg ha^{-1}) was obtained by pods and kernels from the net plot area were cleaned and pod weight was recorded based on dry pod and kernel yield kg per plot. Later the pod and kernel yield per net plot was computed on a hectare basis and expressed in kg ha^{-1}. Shelling percentage was obtained by a random sample of 0.2 kg of pods was taken from net plot produce, shelled and the kernel weight was recorded to work out the shelling percentage and expressed in terms of percentage (%) (Singh and Oswalt. 1995) [12].

$$\text{Shelling percentage} = \frac{\text{Kernel weight}}{\text{Pod weight}} \times 100$$

Test weight (100 kernel no) was obtained by A hundred kernels were taken randomly from the net plot of each treatment and their weight was recorded in grams.

All the data recorded in the study were subjected to statistical analysis using Panse and Sukhatme (1978) [10] adopted in this study. Statistical significance was tested by applying F-test at 0.05 level of probability and critical differences were calculated for those parameters, which were found significant ($p < 0.05$) to compare the effects of different treatments.

Results and Discussion

Dry matter accumulation

The highest dry matter accumulation at peg penetration (3223 kg ha^{-1}) was recorded with the application of 100% RDP + PSB + VAM (T_7) was on par with (T_6)100% RDP + PSB (3180 kg ha^{-1}) and it was significantly superior over all other treatments. Vyshnavi *et al*., 2021 [18] also reported increase in dry matter accumulation with the application of 100% RDP + FYM + PSB + VAM.

Dry matter accumulation in T_5 treatment (75% RDP + PSB + VAM) (2856 kg ha^{-1}) was on par with T_4 (75% RDP + PSB) 2630 kg ha^{-1}) and the significantly lowest dry matter accumulation was observed in Control (without P) (1996 kg ha^{-1}) followed by Control + PSB+ VAM (2060 kg ha^{-1}) and Control + PSB (2038 kg ha^{-1}).

The higher phosphorus availability, which promotes root growth and energy transformation essential for almost all metabolic processes such as photosynthesis, respiration, activation of amino acids for protein synthesis, and carbohydrate metabolism, was primarily responsible for the significant increase in dry matter accumulation when bio fertilizers and levels of phosphorus were applied rather than when no inorganic phosphorus fertilizer was applied (Singh *et al*., 2010) [13]. This could also be due to the use of bio-inoculants, which increase the availability of nutrients like N and P, resulting in increased physiological processes such as cell elongation and the formation of meristematic activity tissues, which improved growth characteristics and dry matter production (Karwasra *et al*., 2007) [7]. Application of PSB resulted in production of growth promoting substances and there by enhanced the availability of phosphorus and other nutrients in soil. VAM increased the activity of phytohormones like cytokinins and indole acetic acid which results in production of more dry matter. Application of phosphatic bio fertilizers along with inorganic phosphorus might have synergistic and additive effect on plant height, leaf area and dry matter production. These results are in accordance with findings of Dileep Kumar *et al.* (2019) [5]. In the absence of phosphorus application, vital metabolic processes like phosphorylation and carbohydrate transformation are adversely affected and decrease the growth attributes of the groundnut crop (Stewart and Williams, 1942) [14].

Haulm Yield

The highest (3989 kg ha^{-1}) haulm yield was recorded with the application of 100% RDP + PSB + VAM (T_7) was on par with T_6 100% RDP + PSB (3842 kg ha^{-1}) and it was significantly superior over all other treatments. Whereas, the significantly lowest haulm yield was observed in control (without P) (2886 kg ha^{-1}).

The increase in haulm yield due to application of 100 % RDP + PSB + VAM might be due to addition of inorganic phosphorus and phosphorus solubilizes and mobilizers which might have increased the uptake of plant nutrients to manufacture more quality of photosynthates resulting the higher haulm yield. Furthermore, VAM supplies essential nutrients to plants resulting in better growth that leads to increased haulm yield. Similar results were reported by Choudhary *et al.* (2011) [4].

Pod Yield

The highest (2528 kg ha^{-1}) pod yield was recorded with the application of 100% RDP + PSB + VAM (T_7) and the lowest (2008 kg ha^{-1}) was observed with Control (without P) (T_1). Compared to individual application of inorganic phosphorus fertiliser or application of bio-inoculants, combined application of bio-inoculants and inorganic phosphorus fertiliser resulted in better pod yield. There was 20.6% and 13.45 % increased yield in T_7 over T_1 and T_3 without any

application of inorganic phosphorus fertilizer and bio inoculants *i.e.*, Control (without P) and alone application of 100% RDP. This might be due to more efficient and greater partitioning of metabolites, as well as adequate translocation and accumulation of photosynthates to develop reproductive structures under adequate fertilisation, which could result in improvement of important growth and yield contributing characters such as plant spread, number of branches, dry matter accumulation, and increased root nodules due to P-solubilized and nitrifying bacteria. (Chavan *et al.*, 2014) [3]. The increase in pod yield with the inoculation of P solubilizing bacteria might be due to increase in P availability through Solubilization of insoluble inorganic phosphate, decomposition of phosphate rich organic compounds and production of plant growth promoting substances. The application of PSB or VAM bio fertilizer along with P source like SSP increased the pod yield which could be due to increased availability of P which meet the phosphorus requirement of crop.

Kernel Yield

The highest kernel yield (1986 kg ha^{-1}) was recorded with the application of 100% RDP + PSB + VAM ((T_7)) and it was on par with T_6 (1834 kg ha^{-1}) and it was significantly superior over all other treatments. The kernel yield in T_5 treatment (75% RDP + PSB + VAM) (1786 kg ha^{-1}) was on par with T_4 (75% RDP + PSB) (1676 kg ha^{-1}) and T_4 (100% RDP) (1622 kg ha^{-1}). The lowest (1306 kg ha^{-1}) kernel yield was observed with control (without P).

The combined application of PSB and VAM recorded highest yield in 100% RDP + PSB + VAM (T_7) than 100% RDP + PSB (T_6). There was 7.7% yield increase in T_7 over T_6. The yield was increased with the application of 75% RDP + PSB + VAM over 100% RDP alone which indicates that the reduction in RDP *i.e.*, 25% could be able to get the good yield by substituting this with PSB and VAM.

The application of phosphorus, which plays a major role in energisation processes, profuse nodulation, and it is also a constituent of ribonucleic acid, deoxyribonucleic acid, and ATP, which regulate vital metabolic processes in the plant and also aids in root formation, resulted a significant increase in kernel yield. Nitrogen fixation has a positive effect on photosynthetic organs (Tomar *et al.*, 2006) [15]. PSB's action was not only to release plant-available P, but also to produce plant growth-promoting and biologically active substances such as indole acetic acid, gibberllins, and cytokinin which might enhance productivity (Mahanta and Rai, 2008) [9]. The application of phosphorus solubilizing bacteria enhanced the phosphorus availability to plants by mineralizing organic phosphorus in soil and also the production of plant growth-promoting substances (Gaur and Sunitha, 1999) [6]. Similarly, VAM is well known for improving plant P acquisition by accelerating phosphate ion translocation and transfer from the soil solution to the root cells, and ultimately to plant absorption. (Vance *et al*., 2003 [17]; Yan *et al*., 2004) [19].

Shelling Percentage

The highest shelling percentage (77.85 %) was recorded with the application of 100% RDP + PSB + VAM (T_7) followed by 100% RDP + PSB (T_6) (75.38%) and lowest (65.04%) was recorded in Control (without P) (T_1) without any application of inorganic phosphorus fertilizer. Vyshnavi *et al*., 2021 [18] noticed highest shelling percentage in the treatment receiving 100% RDP + FYM + PSB + VAM.

An increase in all yield-attributing characters, as well as higher shelling percentage, could be attributed to more efficient and greater partitioning of metabolites, as well as adequate translocation and accumulation of photosynthates, amino acids, and vitamins to developing reproductive structures under adequate fertilization. (Chavan *et al.*, 2014) [3].

Test Weight (100 Kernel Weight)

The highest test weight (42.44 g) was recorded with the application of 100% RDP + PSB + VAM (T_7) and it was on par with (42.08g) 100% RDP + PSB (T_6),75% RDP + PSB + VAM (T_5) (41.23g) and 75% RDP + VAM (T_4) (39.12 g) and lowest (35.00g) was observed in control (without P), (T_1).

The significant increase in kernel weight was mostly due to a better nutritional environment, which might have altered carbohydrate metabolism favourably, resulted in higher nutrient uptake and ultimately, increased groundnut kernel weight (Vala *et al.*, 2017) [16].

Conclusion

The combined application of inorganic phosphorus fertilizer and bio inoculants improved the yield and yield attributes of groundnut crop. The highest yield was recorded with the application of 100% RDP + PSB + VAM (T_7) followed by 100% RDP + PSB (T_6). The yield was increased with the application of 75% RDP + PSB + VAM over 100% RDP alone which indicates that the reduction in RDP *i.e.*, 25% could be able to get the good yield by substituting with PSB and VAM.

Table 1: Effect of inorganic phosphorus in combination with FYM and bio-inoculants on dry matter accumulation and yield attributes of groundnut

Treatments	Dry matter accumulation (kg ha^{-1})	Haulm yield (kg ha^{-1})	Pod yield (kg ha^{-1})	Kernel yield (kg ha^{-1})	Shelling percentage (%)	100 kernel weight (g)
T_1- Control (without P)	1996	2886	2008	1306	65.04	35.00
T_2- 75% RDP	2102	3360	2167	1546	71.34	36.06
T_3- 100% RDP	2200	3363	2188	1622	74.13	37.09
T_4- 75% RDP + PSB	2630	3565	2238	1676	74.89	39.12
T_5- 75% RDP + PSB + VAM	2856	3656	2383	1786	74.95	41.23
T_6- 100% RDP + PSB	3180	3842	2433	1834	75.38	42.08
T_7- 100% RDP + PSB+ VAM	3223	3989	2528	1986	77.85	42.44
T_8- Control + PSB	2038	3018	2184	1424	65.2	35.14
T_9- Control + PSB + VAM	2060	3126	2123	1496	70.47	35.26
S.Em (±)	92.67	101	67	62.38	2.59	1.71
CD (p = 0.05%)	278	302	202	187	7.78	5.13
CV (%)	6.62	5.10	5.18	6.58	6.23	7.76

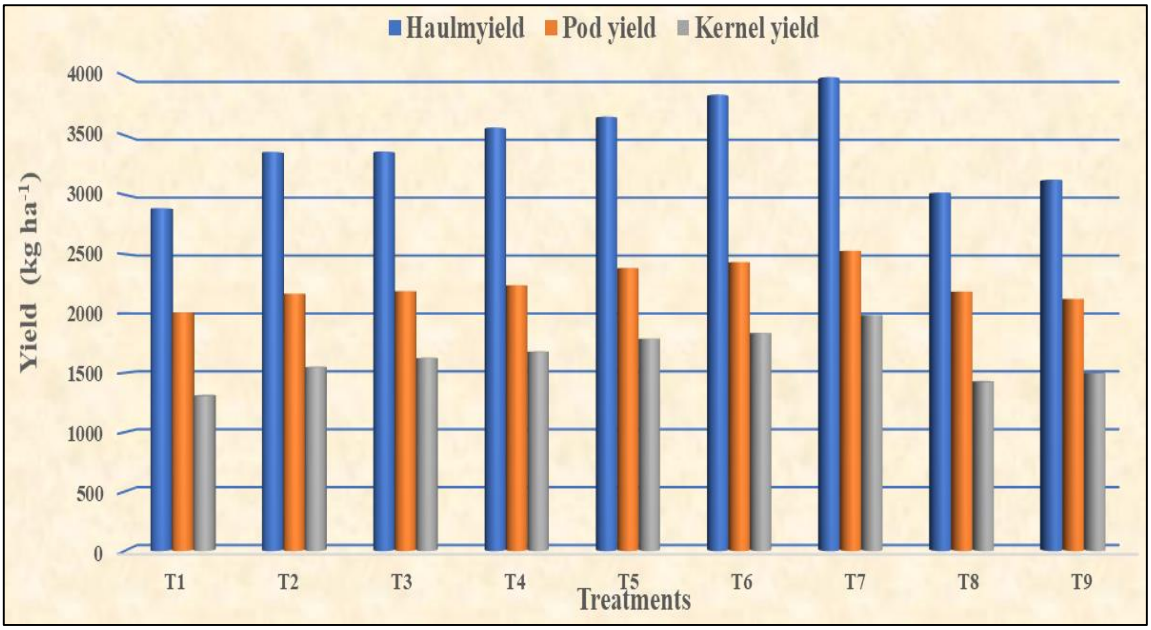

Fig 1: Effect of inorganic phosphorus in combination with bio-inoculants on yield of groundnut

References

1. Anonymous. Agricultural statistics at a glance (2019-2020). Government of India, Ministry of Agriculture and the Farmers Welfare. Department of Agriculture, Cooperation and Farmers Welfare; c2020.
2. Ayub M, Nadeem MA, Sharar MS, Mahmood N. Response of maize (*Zea mays* L.) fodder to different levels of nitrogen and phosphorus. Asian Journal of Plant Sciences. 2002;1:352-354.
3. Chavan AP, Jain NK, Mahadkar UV. Direct and residual effects of fertilizers and bio fertilizers on yield, nutrient uptake and economics of groundnut (*Arachis hypogaea* L.) - rice (*Oryza sativa* L.) cropping system. Indian Journal of Agronomy. 2014;59(1):53 -58.
4. Choudhary SK, Jat MK, Sharma SR, Singh P. Effect of INM on soil nutrient and yield in groundnut field of semi-arid area of Rajasthan. Legume Research. 2011;34(4):283-287.
5. Dileepkumar R, Singh V. Effect of phosphorus and sulphur using PSB on groundnut (*Arachis hypogaea* L.) in calcareous soils. International Journal of Current Microbiology and Applied Science. 2019;8(10): 591-597.
6. Gaur KA, Sunita G. Phosphate solubilizing microorganisms – An overview. Current Trends Life Science. 1999;23:151-164.
7. Karwasra RS, Yadav AS, Kumar Y. Effect of phosphorus and sulphur on greengram (*Phaseolus radiatus* L.). Haryana Journal of Agronomy. 2007;22(2):164-165.
8. Khan AA, Jilani G, Akhtar MS, Naqvi SMS, Rasheed M. Phosphorus solubilizing bacteria: Occurrence, mechanisms and their role in crop production. J agric biol Sci. 2009;1(1):48-58.
9. Mahanta D, Rai RK. Effects of sources of phosphorus and bio fertilizers on productivity and profitability of soybean (*Glycine max* L.) – wheat (*Triticum aestivum* L.) system. Indian Journal of Agronomy. 2008;53:279-284.
10. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. ICAR. New Delhi; c 1978. p. 199-211.
11. Sharma R, Sarita, Bamboriya JS, Yadav SS. Nutrient uptake, quality and traits and yield of groundnut as influenced by integrated phosphorus management. International Journal of Bio-resource and Stress management. 2020;11(2):195-200.
12. Singh F, Oswalt DL. Groundnut Production Practices, ICRISAT Training and Fellowships Programmer, India; c 1995.
13. Singh G, Sekhon HS, Ram H, Sharma P. Effect of farmyard manure, phosphorus and phosphate solubilizing bacteria on nodulation, growth and yield of Kabuli chickpea. Journal of Food Legumes. 2010;23:226-229.
14. Stewart AB, Williams EG. Time of application of fertilizer with special reference to superphosphate. Journal of Agricultural Sciences; c1942. p. 52-56.
15. Tomar SS, Jain PC, Agarwal RL. Effect of nutrient management practices on yield and quality of soybean. Research Crops. 2006;7(1):96-99.
16. Vala FG, Vaghasia PM, Zala KP, Buha DB. Effect of integrated nutrient management on productivity of summer groundnut (*Arachis hypogea* L.). International Journal of Current Microbiology and Applied Science. 2017;6(10):1951-1957.
17. Vance CP, Uhde-Stone C, Allan DL. Phosphorus acquisition and use: critical adaptions by plants for securing a non-renewable resource. New Phytology. 2003;157:423-447.
18. Vyshnavi A, Rao PM, Kumari AL, Lakshman K. Impact of phosphorus management along with FYM and bio-inoculants on yield and yield attributes of groundnut. The Pharma Innovation Journal. 2021;10(8):393-397.
19. Yan X, Liao H, Beebe SE, Blair WM, Lynch JP. QTL mapping of root hair and acid exudation traits and their relationship to phosphorus uptake in common bean. Plant Soil. 2004;265:17-29.