EFFECT OF INTEGRATED USE OF PHOSPHORUS FERTILIZERS AND BIOFERTILIZERS ON GROWTH AND YIELD OF GROUNDNUT (*Arachis hypogaea* L.)

Abstract

The present study highlight the effect of integrated use of phosphorus fertilizers and biofertilizers on growth and yield of groundnut (*Arachis hypogaea* L.). A field experiment was conducted during *rabi*, 2022 Wetland farm, S.V. Agricultural College, ANGRAU, Tirupati, Andhra Pradesh. Eight treatments and three replications made up the field experiment's randomized block design. The combined application of biofertilizers and phosphorus fertilizers had a substantial impact on the yield and growth of the groundnut crop. Most of the growth parameters and yield attributes *viz.*, dry matter production, plant height, number of nodules plant^{-1},number of filled pods plant^{-1},number of ill-filled pods plant^{-1} were numerically highest with application of 75% RDP + liquid PSB + AM (T_8) and 100 pod weight, 100 kernel weight, shelling percentage were recorded non-significant. Pod yield and kernel yield were recorded significantly highest with 75% RDP + liquid PSB + AM (T_8) followed by 100% RDP + liquid PSB (T_3).

Keywords: Groundnut, phosphorus, liquid PSB, AM.

Introduction

"Groundnut (*Arachis hypogaea* L.) is one of the major oilseed crops originated in Brazil and mostly grown in many Asian countries. It fixes the atmospheric nitrogen of nearly 72–77% of its N amounting to 150–200 kg N ha^{-1} in 106–119 days in the soil and ameliorates the soil fertility status. India ranks second in terms of production (10.2 million tonnes) as well as consumption (5627.94 tonnes) of groundnut in 6.09 million hectares of area and productivity of 988 kg ha^{-1} and it accounts for nearly 20 per cent of world's groundnut production. Although the soil system is rich in P, 95–99 % of the soil total P is present in an insoluble form and thrives due to binding to the inorganic minerals or organic matter causing about 43 percent of the soils to be deficient in available phosphorus for plant growth" [5,6]. On the other hand, phosphate rock as a raw material for phosphate fertilizer is a limited resource, which also emphasizes the urgent need to improve the availability of soil phosphorus for plant growth. "Concern over security of supply and fluctuating costs of phosphorus fertilizers has resulted in increased interest in microorganisms that aid plant uptake of phosphorus (P) from soil" (Richardson and Simpson, 2011)[7]. Use of only chemical fertilizers can cause soil degradation, nitrogen leaching, water pollution and reduction in soil organic matter content as well as beneficial microbial population and growth. Sole use of chemical fertilizers can increase the cost of cultivation, hence integration of organic, chemical, and biological sources of plant nutrients are essential in management and maintaining of soil health in sustainable agriculture.

Materials and Methods

A field experiment entitled "Effect of integrated use of phosphorus fertilizers and biofertilizers on growth and yield of groundnut (*Arachis hypogaea* L.)" was conducted during *rabi*, 2022 at Wetland farm, S.V. Agricultural College, ANGRAU, Tirupati, Andhra Pradesh which is geographically situated at 13^0 57' 585'' N latitude and 79^0 68' 695" E longitude with an altitude of 183.7 m above the mean sea level, which falls under Southern Agro Climatic Zone of Andhra Pradesh. According to Trolls classification, it comes under the Semi-Arid Tropics (SAT). The experimental soil was sandy loam in texture.

The analytical data indicated that the soil was slightly alkaline in reaction, non-saline, low in organic carbon and nitrogen and medium in available phosphorus and potassium. The experiment was laid out in randomized block design with eight treatments and three replications. The treatments involve combination of phosphorus fertilizers with biofertilizers such as PSB and Arbuscular Mycorrhiza are: Control (T_1), 100% RDP (T_2), 100 % RDP (T_3), 75% RDP + liquid PSB (T_4), 100%RDP + liquid PSB (T_5), 75% RDP + AM (T_6), 50% RDP + liquid PSB + AM (T_7), 75% RDP + liquid PSB + AM (T_8).

Results and Discussion

Growth Parameters

It was observed from the data presented in table 1 that combined application of biofertilizers and fertilizers significantly influenced the growth parameters *viz*., dry matter production, plant height, number of nodules plant^{-1} recorded difference when subjected to combined application of phosphorus fertilizers and biofertilizers including control. Further, it was found that numerically highest dry matter production (6073 kg ha-1), plant height (44.70 cm), number of nodules plant^{-1} (71.67) were observed with the T_8 treatment which constitutes 75% RDP + liquid PSB + AM at harvest. Amongst the treatments the maximum growth parameters were recorded with the application of 75% RDP + liquid PSB + AM (T8) might be due to solubilization of unavailable phosphorus to available phosphorus by PSB and AM. It results in overall development of plant in terms of root and shoot might have resulted in higher absorption of nutrients, increased metabolic activity in plants appears to have encouraged meristematic activity by supplying enzymes that led to apical development. (Ravikumar *et al*., 2019 [6]). More dry matter is produced as a result of improved cytokinin and indole acetic acid activity caused by VAM. Similar results were reported by Donga and Mathukia (2021) [1].

Yield attributes

The data pertaining to yield parameters *viz*., number of filled pods plant^{-1}, number of illfilled pods plant^{-1} recorded significant difference with combined application of phosphorus fertilizers and biofertilizers including control (Table 2). Whereas, there was no significant effect on 100 pod weight (g), 100 kernel weight (g) and shelling percentage. Further, it was found that among all the treatments including control, treatment T_8 that constitutes 75% RDP + liquid PSB + AM showed significantly maximum number of filled pods plant^{-1} (12.50) followed by T_3 (100% RDP + liquid PSB) (11.38). The treatments T_5, T_4, T_2, T_6 and T_7 were on par with each other while control (8.03) being the lowest. Significantly the lowest number of illfilled pods plant^{-1} of 3.00 was recorded with the application of 75 % RDP + Liquid PSB + VAM (T_8) followed by 100 % RDP + Liquid PSB (T_3) (3.67). The enhanced availability of metabolites might have promoted better translocation of assimilates to the sink and resulted in improved yield attributes and resulted in a greater number of pods. Proper partitioning can lead to better pod development and, in the context, it can help to reduce the number of ill-filled pods. These results were concomitant with the findings of Vyshnavi *et al*. (2021) [10] and Sunitha *et al*. (2023) [8].

Yield

Pod Yield

Data pertaining to pod yield was given in table 3 and depicted in fig 1. Significantly the highest pod yield of 3704.33 kg ha^{-1} was obtained with the application of 75% RDP + liquid PSB + AM (T_8) followed by T_3(100% RDP + liquid PSB). The treatments T_4, T_2, T_5,T_6 and T_7 treatments were on par with each other. The lowest pod yield of 2518.47 kg ha^{-1} was recorded with the control (T_1). The increase in pod yield following the inoculation of P solubilizing bacteria may be attributable to a rise in P availability brought on by the solubilization of insoluble inorganic phosphate, the breakdown of phosphate-rich organic compounds, and the generation of chemicals that stimulate plant growth. The application of PSB or VAM biofertilizer together with a P source like SSP improved the pod yield, which could be due to increased availability of P and suitably matched the requirement of P by crop. Similar results were reported by (Rakesh *et al*., 2021) [5] Mohanty *et al*. (2022) [3].

Haulm Yield

Data pertaining to haulm yield was given in table 3 and depicted in fig 1. The highest haulm yield of 4936.60 kg ha^{-1} was obtained with the application of 75% RDP + liquid PSB +AM followed by 100 % RDP + liquid PSB (T3) (4876.17 kg ha^{-1}) and 75 % RDP + Liquid PSB (T4) (4748.93 kg ha^{-1}) which in turn was on par with 100 % RDP + Liquid PSB (T5) with the production of 4738.27 kg ha-1. The next best treatment was 100 % RDP (T2)(4662.33 kg ha-1) followed by 75 % RDP + AM (T6)(4510.87 kg ha-1) and 50 % RDP + Liquid PSB + AM (T7)(4395.97 kg ha-1). The lowest haulm yield of 4336.33 kg ha-1 was recorded in control (T1). The increase in haulm yield due to application of 75 % RDP + Liquid PSB + AM might be due to the addition of inorganic phosphorus as well as phosphorus solubilizers and mobilizers may have enhanced plant nutrient absorption and led to the production of higher-quality photosynthates and a greater haulm yield. Similar results were reported by Rajbalasharma *et al*. (2020) [4] .

Kernel Yield

Data pertaining to kernel was given in table 3 and depicted in fig 1. The highest of 2643.75 kg ha-1 was obtained with the application of 75% RDP + liquid PSB +AM The next best treatment was 100 % RDP + liquid PSB (T3) (4876.17 kg ha-1) followed by 75 % RDP + Liquid PSB (T4) (2116.57 kg ha^{-1}). The treatments T4, T2, T5, T6 and T7 were on par with other. The lowest kernel yield of 1784.90 kg ha^{-1} was recorded in control (T1). The significant increase in kernel yield was mainly due to the combined application of phosphorus and PSB and AM which plays a major role in energization processes, profuse nodulation and being constituent of ribonucleic acid, deoxyribonucleic acid and ATP, which regulate vital metabolic processes in the plant and also helps in root formation, nitrogen fixation results in a positive effect on photosynthetic organs (Tomar *et al*., 2006, Erman *et al*., 2009) [9, 2].

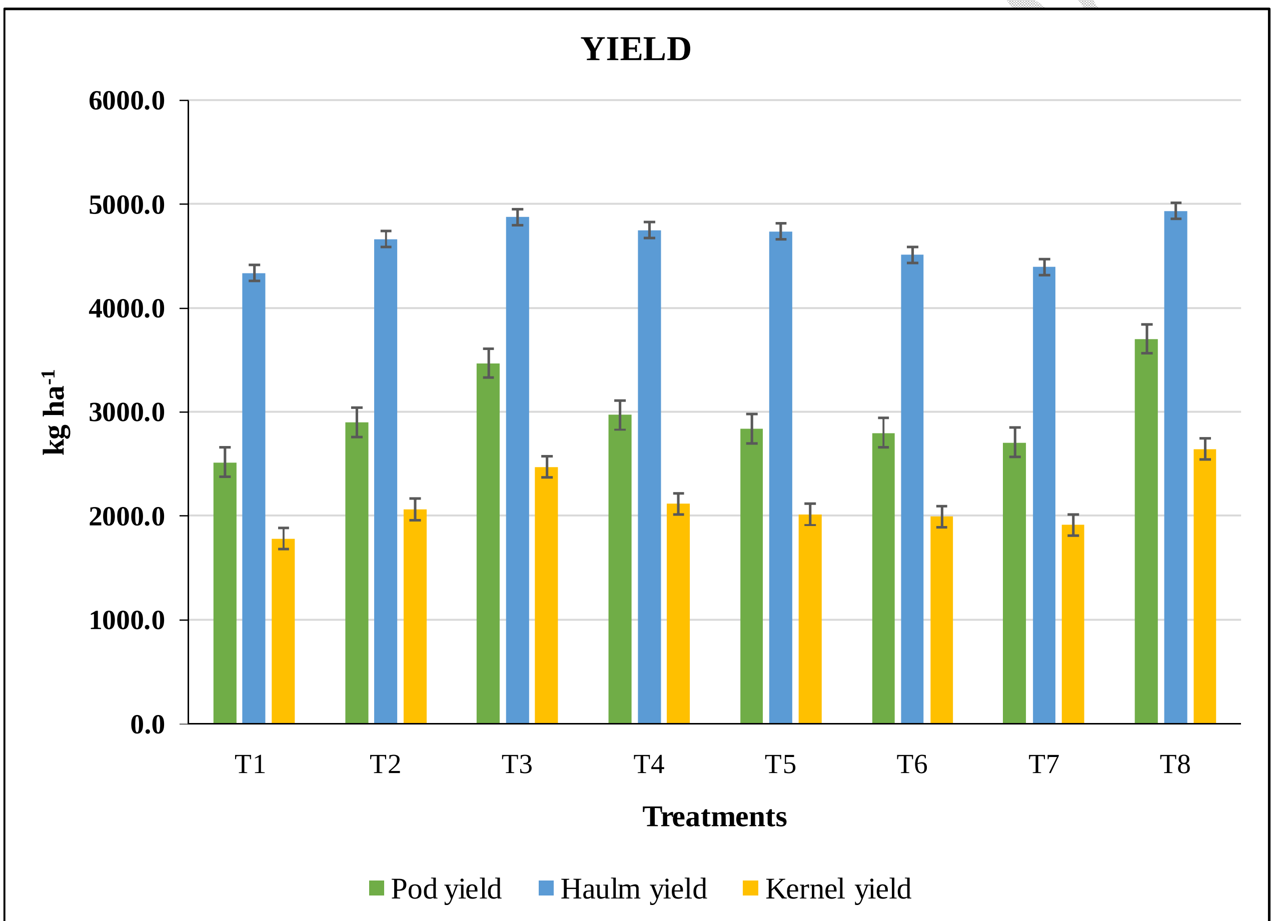

Fig.1 Effect of phosphorus, PSB and AM on pod, haulm and kernel yield (kg ha^{-1}) of groundnut crop.

Table 1: Effect of phosphorus, PSB and VAM on growth parameters of groundnut.

Treatment	**Dry matter Production (kg ha^{-1})**	**Plant height (cm)**	**Number of nodules plant^{-1}**
T_1 : Control	5772	34.10	64.67
T_2 : 100 % recommended dose of phosphorous fertilizers (RDP)	5923	40.80	68.00
T_3 : 100 % RDP + liquid PSB	6003	43.30	69.67
T_4 : 75 % RDP + liquid PSB	5967	42.03	69.00
T_5 : 100 % RDP + Arbuscular Mycorrhiza	5934	41.06	68.67
T_6 : 75% RDP + Arbuscular Mycorrhiza	5887	39.70	66.67
T_7 : 50 % RDP + liquid PSB + Arbuscular Mycorrhiza	5821	38.80	65.67
T_8 : 75 % RDP + liquid PSB + Arbuscular Mycorrhiza	6037	44.70	71.67
S.Em±	11.33	0.439	0.512
CD@5%	34.35	1.33	1.55

Table 2: Effect of phosphorus, PSB and VAM on pod, haulm and kernel yield of groundnut.

Treatments	**Pod yield (kg ha^{-1})**	**Haulm yield (kg ha^{-1})**	**Kernel yield (kg ha^{-1})**
T_1 : Control	2518.47	4342.70	1784.90
T_2 : 100 % recommended dose of phosphorous fertilizers (RDP)	2903.30	4662.33	2064.40
T_3 : 100 % RDP + liquid PSB	3470.43	4876.17	2473.43
T_4 : 75 % RDP + liquid PSB	2971.17	4748.93	2116.57
T_5 : 100 % RDP + Arbuscular Mycorrhiza	2839.45	4738.27	2015.80
T_6 : 75% RDP + Arbuscular Mycorrhiza	2801.63	4510.87	1994.92
T_7 : 50 % RDP + liquid PSB + Arbuscular Mycorrhiza	2709.50	4396.00	1914.34
T_8 : 75 % RDP + liquid PSB + Arbuscular Mycorrhiza	3704.33	4936.60	2643.75
S. Em ±	52.59	18.671	37.066
CD @5 %	159.5	56.63	112.43

Table 3: Effect of phosphorus, PSB and VAM on yield attributes of groundnut.

Treatments	Filled pods	Ill-filled pods	100 pod weight(g)	100 kernel weight (g)	Shelling %
T_1	8.03	6.00	94.90	39.33	70.87
T_2	10.00	4.33	97.00	40.33	71.10
T_3	11.38	3.67	97.33	39.67	71.27
T_4	10.57	4.30	96.97	40.67	71.23
T_5	10.70	3.97	97.33	40.33	71.00
T_6	9.12	4.67	96.00	39.67	71.20
T_7	9.07	5.17	96.33	40.00	71.14
T_8	12.50	3.00	97.50	40.67	71.37
S. Em ±	0.331	0.211	11.199	0.381	0.1
CD @5 %	1.00	0.64	**NS**	**NS**	**NS**

Recommended dose of fertilizer: 20- 50- 0 kg N- P_2O_5- K_2O ha^{-1}

Conclusion

Finally, it can be said that the growth and yield characteristics of the groundnut crop were improved by the application of 75% RDP + liquid PSB + AM (T8) compared to 100% RDP and control. It suggests that a 25% reduction in RDP could still produce a satisfactory yield when PSB and VAM are used in its place.

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