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RESPONSE OF GROUNDNUT (*Arachis hypogaea* L.) TO VARIED LEVELS OF PHOSPHORUS AND NANO DAP

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ABSTRACT

A field experiment entitled "Response of groundnut (*Arachis hypogaea* L.) to varied levels of phosphorus and nano DAP" was conducted at Dryland Farm, S.V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh, India during *rabi,* 2023-24. The experiment was laid down in the randomized block design and replicated thrice. The results showed that significantly higher plant height, leaf area index, dry matter production, pod and haulm yield were recorded with application of 50 % RDP through DAP as basal + seed treatment with nano DAP @ 4 ml kg^{-1} + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS, which was found to be on par with 50 % RDP through DAP as basal + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS. Significantly lower values were recorded in control (No application of P).

KEYWORDS: Haulm yield, Nano DAP, Phosphorus, Pod yield, Seed treatment.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is known as king of vegetable oilseed crops and plays an important role in meeting the demand of edible oil across the world. Among the oilseed crops, groundnut is the 4th most predominant oilseed crop and 13th crucial food crop of the world. Groundnut seed contains 47-50% oil, 26% protein and 11.5% starch.

Groundnut is cultivated in almost all tropical and subtropical nations in the world. India is the top producing nation in the world accounting for 27.3% of production and 39.3 % area. It is grown over 4.9 million ha in India with the production of 9.25 million tonnes with an average productivity of 1893 kg ha^{-1}. Andhra Pradesh produces around 0.78 million tonnes from an area of 0.87 million ha with a productivity of 894 kg ha^{-1}. (Directorate of Economics and Statistics, Andhra Pradesh. 2022-2023).

Among various problems that hinder the productivity of groundnut nutrient management is the major problem. Nitrogen is a paramount element for plants since it is an essential for formation of amino acids which are building blocks of proteins and it is the limiting factor for crop growth, development and yield.

Phosphorus promotes biomass synthesis, stimulate root development and helps for partitioning of photosynthates between source and sink and low soil phosphorus levels significantly limit the growth and development of legume crops. However, phosphatic fertilizers are not only expensive, but their availability is also less than their demand.

Nano phosphatic fertilizers have the potential to significantly contribute to the endeavour to reduce the use of chemical fertilizers and to increase the phosphorus availability and other essential nutrients to the crops (Balachandrakumar *et al*. 2024 and Bakry *et al.* 2022). Reducing fertilizer particle size will boost the efficacy of amendments which in turn increase fertilizer contact with plants and thus increase nutrient uptake. As a result, it is crucial to consider strategies for preserving phosphatic fertilizers without sacrificing economic returns.

Application of bulk fertilizers like DAP and other associated fertilizers leads to losses from volatilization, leaching and runoff. Nano fertilizers dissolve more readily in water and may enhance fertilizer use by plants by increasing uptake and distribution. Seed treatment and foliar fertilization helps to increase the efficiency of applied fertilizer.

MATERIAL AND METHODS

A field experiment entitled "Response of groundnut (*Arachis hypogaea* L.) to varied levels of phosphorus and nano DAP" was conducted during *rabi*, 2023-24 in Dryland Farm of S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The present experiment was laid out in a randomized block design with eight treatments and three replications. The treatments comprised of Control (No application of P) (T_1), RDP through DAP as basal (40 kg P_2O_5 ha^{-1}) (T_2), 75 % RDP (30 kg P_2O_5 ha^{-1}) through DAP as basal + seed treatment with Nano DAP @ 4 ml

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kg^{-1} + Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_3), 50 % RDP (20 kg P_2O_5 ha^{-1}) through DAP as basal + seed treatment with Nano DAP @ 4 ml kg^{-1} + Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_4), 75 % RDP (30 kg P_2O_5 ha^{-1}) through DAP as basal + Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS(T_5), 50 % RDP (20 kg P_2O_5 ha^{-1}) through DAP as basal + Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_6), Seed treatment with Nano DAP @ 5 ml kg^{-1} + Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_7) and Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_8). The soil of the experiment field was sandy loam in texture, neutral in soil reaction, low in organic carbon (0.27 %) and available nitrogen (157 kg N kg ha^{-1}), medium in available phosphorus (19.9 kg P_2O_5 ha^{-1}) and potassium (235 kg K_2O ha^{-1}). The test variety of groundnut used in present investigation was Vishista (TCGS-1694). Recommended dose of fertilizer used in the experiment was 30-40-50 N, P_2O_5, K_2O kg ha^{-1}. Recommended dose of nitrogen and potassium were applied as basal to all the treatments, where phosphorus was applied as per treatments. Seed treatment with nano DAP @ 4 ml kg^{-1} and @ 5 ml kg^{-1} and nano DAP was sprayed @ 2 ml l^{-1} of water at 25 DAS as per treatments. The crop was sown by hand dibbling with spacing of 30 cm between rows and 10 cm between plants. Five plants were randomly selected in each plot for taking observations on growth parameters at 25, 50, 75 DAS and at harvest. Yield was recorded in each plot by harvesting separately as per treatment and the values were converted into hectare basis and expressed in kg ha^{-1}. The data recorded on various parameters of groundnut during the course of investigation was statistically analyzed following the analysis of variance for randomized block design as suggested by Panse and Sukhatme (1985). Statistical significance was tested with 'F' value at five per cent level of probability. Critical difference (CD) for the significant sources of variation was calculated at five per cent level of significance. The treatmental differences those were non-significant were denoted by "NS".

Plant height was recorded from five randomly tagged plants and mean was expressed in cm. Five plants were selected outside the net plot area, leaving the extreme border row for destructive sampling to generate data on leaf area and dry matter production at different stages of crop growth. Leaf area of five destructively sampled plants from border rows was measured by using LI-COR model, LT-300 leaf area meter with transparent conveyor belt and electronic digital display. After computing the leaf area (cm^2), leaf area index was calculated by using the following formula as suggested by Watson (1952).

$$LAI = \frac{\text{Leaf area (cm}^2)}{\text{Unit land area (cm}^2)}$$

For dry matter production plants were shade dried and then dried in hot air oven at 60^{o}C to a constant weight and expressed as kg ha^{-1}.

The pods and haulm obtained from the net plot area of each treatment and five sampled plants were thoroughly sun dried, cleaned, weighed and expressed in kg ha^{-1}.

RESULTS AND DISCUSSION

Plant Height

The results of the experiment revealed that among different treatments, soil application of 50 % RDP through DAP as basal + seed treatment with nano DAP @ 4 ml kg^{-1} + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_4) recorded significantly higher plant height, which was in par with 50 % RDP through DAP as basal + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_6). The significantly higher plant height might be due to optimum soil application of conventional phosphorus and seed treatment along with foliar spray of nano DAP fertilizer with large permeability and high concentration of nanoparticles that might penetrate into plant leaves and play an important role in promoting plant growth parameters, where nitrogen has a positive role in increasing the activity of meristematic tissues and cell division and its importance in building amino acids such as tryptophan, which is the basis for building auxins that contribute to cell division and expansion which ultimately resulted in higher growth parameters. While lower plant height was recorded with control (No application of P) (T_1), this might be due to unavailability of required quantity of nutrients for growth and development of the plant. These results are in conformity with the findings of Kumar *et al.* (2022), Aziz *et al.* (2021) and Alqader *et al*. (2020).

Leaf Area Index

Significantly higher values of leaf area index were observed with 50 % RDP through DAP as basal + seed treatment with nano DAP @ 4 ml kg^{-1} + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_4), which was however at par with 50 % RDP through DAP as basal + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_6). Optimum phosphorus application may influence plant growth from cellular to the whole plant level and foliar application of nano DAP at the hour of need might have enabled the plants to maintain high chlorophyll content,

Table 1. Growth parameters and yield of groundnut as influenced by varied levels of phosphorus and nano DAP

Treatments	Plant height (cm)		Leaf area index		Dry matter production (kg ha^{-1})		Yield (kg ha^{-1})	
	75 DAS	Harvest	75 DAS	Harvest	75 DAS	Harvest	Pod yield	Haulm yield
T_1 : Control (No application of P)	23.3	24.0	2.19	1.77	2606	4900	1917	2443
T_2 : RDP through DAP as basal	27.1	28.9	2.57	2.09	3056	5800	2383	2900
T_3 : 75% RDP through DAP as basal + seed treatment with Nano DAP @ 4 ml kg^{-1} + Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS	31.7	33.9	3.06	2.46	3743	7100	3016	3567
T_4 : 50 % RDP through DAP as basal + seed treatment with Nano DAP @ 4 ml kg^{-1} + Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS	35.9	41.0	3.45	2.90	4216	8126	3643	4167
T_5 : 75% RDP through DAP as basal + Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS	31.0	33.0	2.93	2.40	3587	6956	2890	3400
T_6 : 50% RDP through DAP as basal + Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS	34.7	38.3	3.35	2.71	4160	7766	3403	4023
T_7 : Seed treatment with Nano DAP @ 5 ml kg^{-1}+ Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS	27.9	29.2	2.67	2.14	3198	6266	2497	3033
T_8 : Nano DAP spray @ 2 ml l^{-1} of water at 25 DAS	23.9	25.3	2.28	1.86	2706	5100	2017	2567
SEm±	0.89	1.03	0.082	0.069	103.5	196.9	93.6	99.5
CD (P=0.05)	2.7	3.1	0.24	0.21	314	57	281	299

number of leaves plant^{-1} and ultimately higher leaf area index. Lower leaf area index recorded with control (No application of P) (T_1). This is in conformity with the works of Choudhary *et al.* (2022) and Rashmi and Prakash (2023).

Dry Matter Production

Application of 50 % RDP through DAP as basal + seed treatment with nano DAP @ 4 ml kg^{-1} + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_4) recorded significantly higher dry matter accumulation, which was at par with 50 % RDP through DAP as basal + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_6). The significant increase in dry matter production with soil application of 50 % RDP along with seed treatment and foliar nano DAP fertilization might be due to the fact that, tiny size of nano fertilizers might result in better absorption of nutrients and synergism between nitrogen and phosphorus helps to improve nutrient uptake leading to increased plant growth mechanisms, such as photosynthetic activity and chlorophyll synthesis resulting in higher plant height, photosynthetic area and vegetative growth, which ultimately reflected in the form of higher dry matter production. Similar observations were recorded by Maheta *et al.* (2023) and Sharma *et al.* (2022). The control (No application of P) (T_1) registered the least dry matter production.

Pod and Haulm Yield

The highest pod and haulm yield of groundnut was recorded with 50 % RDP through DAP as basal + seed treatment with nano DAP @ 4 ml kg^{-1} + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_4), which was comparable with 50 % RDP through DAP as basal + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_6). Higher pod yield might be due to increased yield components.

The optimum and balanced nutrient availability was ensured throughout the crop period, particularly during the critical stages of the crop, by applying conventional and nano fertilizers in combination. Increased uptake leads to optimal growth of plants and improved metabolic processes, such as photosynthesis, which increases the accumulation of photosynthates and their translocation to the economically productive parts of the plant. This process leads to higher growth parameters, yield attributing characters and yield by enhancing the translocation of assimilates to seeds all of which contribute to increased pod and haulm yield. Similar results were reported by Bhargavi and Sundari (2023) and Chinnappa *et al.* (2023). The lower pod yield recorded with control (No application of P) (T_1).

Higher growth parameters and yield were obtained with application of 50 % RDP through DAP as basal + seed treatment with nano DAP @ 4 ml kg^{-1} + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_4), which was comparable with 50 % RDP through DAP as basal + nano DAP spray @ 2 ml l^{-1} of water at 25 DAS (T_6). Application of nano DAP at right time and right quantity helped in better growth and yield of groundnut. Thus 50 % of phosphorus can be saved by seed treatment with nano DAP and foliar spray of nano DAP. The nano DAP fertilizers are new genera of fertilizers which even in small quantity are equal to large volume of conventional fertilizers and are having high surface area by which they are absorbed by the plant system and thereby improving growth and yield of groundnut.

LITERATURE CITED

Alqader Saleh, Al-jobourilaythmazin, Eshoaa H. 2020. Effect of nitrogenous and urea nano-hydroxyapatite fertilizer on growth and yield of two cultivars of broad bean (V*icia faba* L.). *Euphrates Journal of Agricultural Sciences*. 12(2): 598-618.

Aziz, B.R., Zrar, D.B. 2021. Effect of foliar application of nano-NPK fertilizer on growth and yield of bean (*Vicia faba* L.). *Journal of Pure Applied Science*. 33(4): 90-99.

Bakry, B.A., El-Nwehy, S.S., Afify, R.R., Ibrahim, O.M and El-Aziz, M.A. 2022. Preparation, characterization and evaluation of nano phosphorus foliar application on peanut production under sandy soil. *Asian Journal of Plant Sciences.* 423-431.

Balachandrakumar, V., Sowmiya, K., Shofiya, M., Gopika, K and Nithika, M. 2024. Impact of nano DAP and Zn EDTA on cowpea growth and yield. *International Journal of Plant and Soil Science*. 36(6): 317-326.

Bhargavi, G and Sundari, A. 2023. Effect of nano urea on growth and yield of rice (*Oryza sativa* L.) under SRI in the Cauvery delta zone of Tamil Nadu. *Crop Research*. 58(1&2): 12-17.

Chinnappa, S.A., Krishnamurthy, D., Ajayakumar, M.Y., Ramesha, Y.M and Ravi, S. 2023. Response of nano fertilizers on growth, yield and economics of *kharif* sorghum. *The Pharma Innovation Journal.* 12(9): 761-765.

Choudhary, P., Singh, D., Kaushik, M.K., Sharma, S.S., Jain, H.K., Saharan, V., Singh, D.P., Sharma, R.K. 2022. Production, productivity and quality of maize (*Zea mays* L.) as affected by foliar application of zinc-based nano-fertilizer and different fertility levels. *The Pharma Innovation Journal*. 11(2):1878-1882.

Directorate of Economics and Statistics, Planning Department, Government of Andhra Pradesh. 2022-2023. *Agricultural statistics at a glance.*

Kumar, N., Manuja, S., Sankhyan, N.K., Kumar, P., Kumar, A. and Sharma, T. 2022. Effect of application of Nano-DAP and conventional fertilizers on rice yield. *Sustainable Agricultural Innovations for Resilient Agri-Food Systems*. 373.

Maheta, A., Gaur, D and Patel, S. 2023. Effect of nitrogen and phosphorus nano fertilizers on growth and yield of maize (*Zea mays* L.). *The Pharma Innovation Journal.* 12(3): 2965-2969.

Panse, V.G and Sukhatme, P.V. 1985. *Statistical methods for Agricultural workers*. Indian Council of Agricultural Research, New Delhi. 187-202.

Rashmi, C.M and Prakash, S.S. 2023. Effect of nano phosphorus fertilizers on growth and yield of maize (*Zea mays* L.) in Central Dry Zone of Karnataka. *Mysore Journal of Agricultural Science.* 57(2): 286-293.

Sharma, S.K., Sharma, P.K., Mandeewal, R.L., Sharma, V., Chaudhary, R., Pandey, R and Gupta, S. 2022. Effect of foliar application of nano urea under different nitrogen levels on growth and nutrient content of pearlmillet (*Pennisetum glaucum* L.). *International Journal of Plant* and *Soil Science*. 34(20): 149-155.

Watson, D.J. 1952. The physiological basis of variation in yield. *Advances in Agronomy*. 6: 103-109.