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Effect of nano DAP on growth, yield and yield attributes of chickpea

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Abstract

A pot experiment was conducted during *Rabi* 2023-24 at Department of Soil Science and Agricultural Chemistry, JAU, Junagadh to assess the effect of nano DAP on growth, yield and yield attributes of chickpea. The result revealed that application of 75% RDF + Seed treatment with Nano DAP 5 ml/kg of seed + foliar sprays of Nano DAP 6 ml/lit at 30 DAS found superior over other treatments with respect to plant height (38.63 cm), number of branches per plant (6.45), number of pod per plant (26.83), number of seed per pod (1.54), pod weight per plant (10.31 g), seed yield (9.39 g plant⁻¹) and stover yield (11.95 g plant⁻¹).

Keywords: Chickpea, nano DAP, seed treatment, spraying, growth and yield

Introduction

Chickpea (*Cicer arietinum* L.) is an essential annual pulse crop that belongs to the genus *Cicer*, Family Leguminosae or Fabaceae and also recognized as “Bengal gram”. Chickpea are a vital food because of their high nutritional content, especially in regions of the world that are vulnerable to famine. While the dry seeds can be used to make a wide variety of cuisines, the green seeds are eaten raw, roasted, or boiled, the leaves are eaten as vegetables and drinks are made from the plant exudates. Chickpea is grown in India on 9.59 million ha and produces of 11.04 million tons with national average productivity of 1151 kg/ha during 2023-24. In Gujarat, during the year 2023-24, it was cultivated in an area of 0.62 million ha with production of 1.07 million tons of grains with the average productivity of 1714 kg/ha (Anon., 2024) [3].

Nano-fertilizers are products that help to boost nutrient efficiency on a nanometer scale in the form of nanoparticles. In comparison to conventional granular fertilizer, the particle size of liquid nano-fertilizer is smaller than 30 nanometers. It cuts the amount of conventional fertilizer needed by half or more (Panda *et al.*, 2020) [12].

Foliar therapy comes into direct contact with the leaves and it absorbed by the target organs, it produces a more immediate and targeted response than standard fertilizers. Because of their increased reactivity and potential to penetrate the cuticle, nano fertilizers provide controlled release and delivery (El-Fouly *et al.*, 2001) [5]. It has been demonstrated that foliar feeding is the most effective method of addressing introduction nutritional shortages and boosting crop quality and output. By using less fertilizer on the soil, it also enhances nutrient utilization and lowers pollution. Although gas exchange is possible in leaves, penetration is hindered by their cuticle (Schwab *et al.*, 2016) [17].

Research on the effect of nano DAP on chickpea growth, yield and yield attributes has practical utility in terms of optimizing agricultural practices for increased crop productivity, resource use efficiency and environmental sustainability.

Materials and Methods

The experimental soil was clayey in texture and moderately alkaline in reaction with pH_{2.5} 8.1, EC_{2.5} 0.42 dS m⁻¹. The soil was found medium in organic carbon (0.60%), low in available N (210 kg/ha), medium in available P (30.65 kg/ha). The micro nutrient Fe, Cu, Zn and Mn content of initial soil was 4.09, 1.61, 1.90 and 6.79 mg kg⁻¹ respectively. There were 12 treatments of T₁: Absolute control, T₂: 100% RDF i.e. 20-40-00 N-P₂O₅-K₂O kg/ha, T₃: 75% RDF + Seed

treatment with Nano DAP 5 ml/kg of seed, T₄: 50% RDF + Seed treatment with Nano DAP 5 ml/kg of seed, T₅: T₃ + Foliar sprays of Nano DAP 3 ml/lit at 30 DAS, T₆: T₄ + Foliar sprays of Nano DAP 3 ml/lit at 30 DAS, T₇: T₃ + Foliar sprays of Nano DAP 6 ml/lit at 30 DAS, T₈: T₄ + Foliar sprays of Nano DAP 6 ml/lit at 30 DAS, T₉: 75% RDF + Foliar sprays of Nano DAP 3 ml/lit at 30 and 45 DAS, T₁₀: 50% RDF + Foliar sprays of Nano DAP 3 ml/lit at 30 and 45 DAS, T₁₁: 75% RDF + Foliar sprays of Nano DAP 6 ml/lit at 30 and 45 DAS and T₁₂: 50% RDF + Foliar sprays of Nano DAP 6 ml/lit at 30 and 45 DAS replicated thrice in CRD. In this study, plant height, number of branches per plant, number of pod per plant, number of seed per pod, pod weight per plant, seed yield and straw yield were recorded at harvest.

Results and Discussion

Effect on growth parameters

Plant height and no. of branches per plant is typical characters of crop which has erect growth habit. Plant height and no. of branches were significantly influenced by nano DAP as foliar spray. The data presented in (Table 1) showed that different treatments significantly influenced growth parameter at harvest. Significantly higher plant height (38.63) was observed by T₇ (T₃ + foliar sprays of Nano DAP 6 ml/lit at 30 DAS), which was found at par with treatments T₁₁ (75% RDF + Foliar sprays of Nano DAP 6 ml/lit at 30 and 45 DAS), T₅ (T₃ + Foliar sprays of Nano DAP 3 ml/lit at 30 DAS) and T₉ (75% RDF + Foliar sprays of Nano DAP 3 ml/lit at 30 and 45 DAS). Significantly lower value observed in T₁ (32.43), which might be due to unavailability of nutrients which might lower the growth of plant and significantly higher number of branches per plant (6.45) was recorded under the treatment T₇ (T₃ + foliar sprays of Nano DAP 6 ml/lit at 30 DAS) which was found at par with treatments T₁₁ (75% RDF + Foliar sprays of Nano DAP 6 ml/lit at 30 and 45 DAS), T₅ (T₃ + Foliar sprays of Nano DAP 3 ml/lit at 30 DAS) and T₉ (75% RDF + Foliar sprays of Nano DAP 3 ml/lit at 30 and 45 DAS). While the treatment T₁ recorded significantly lowest value (4.35).

Similar results were observed by Adhikari *et al.* (2014) [1] that foliar application of nano rock phosphate recorded significant increase in plant height. Rane *et al.* (2015) [14] recorded application of nanoparticle increased the growth characters such as plant height and also increased the growth parameters in *Zea mays*. Similar outcomes observed by Sahithi *et al.* (2023) [15] in marigold increased Nitrogen and Phosphorus availability by foliar spray led to increased root mass, which in turn increased nutrient intake and photosynthetic activity, producing the maximum number of branches possible.

Effect on yield attributes

Application of nano DAP significantly influenced the yield attributes like number of pod per plant and pod weight per plant (Table 1). The highest number of pod per plant (26.83) and pod weight per plant (10.31 g) were noted at T₇ (T₃ + foliar sprays of Nano DAP 6 ml/lit at 30 DAS), which found statistically at par with T₁₁ (75% RDF + Foliar sprays of Nano DAP 6 ml/lit at 30 and 45 DAS), T₅ (T₃ + Foliar sprays of Nano DAP 3 ml/lit at 30 DAS) and T₉ (75% RDF + Foliar sprays of Nano DAP 3 ml/lit at 30 and 45 DAS) in respect to both, while the lowest number of pod per plant (18.55) and pod weight per plant (6.36 g) were noted in treatment T₁.

The data indicated that the different treatment of nano DAP

could not manifest its significant effect on seed per pod at harvest. Even through, the maximum seed per pod (1.54) was observed in T₇ (T₃ + Foliar sprays of Nano DAP 6 ml/lit at 30 DAS). Conversely lowest seed per pod at harvest (1.43) in pod observed in treatment T₁.

Similar results observed by Garud *et al.* (2015) [6] that the foliar application of BOOST- 52 (0:52:34) at 35 and 50 DAS increasing number of pods per plant, by Subhamoy *et al.* (2010) [20] in green gram and Khemshetty *et al.* (2024) [8] in chickpea. Rady *et al.* (2020) [13] showed analogous results in *Phaseolus vulgaris*, where foliar application of nano phosphorus increased pod weight. Baglane (2023) [4] reported that application of 50% RDF of NPK + ST + Two foliar sprays of nano DAP @ 4 ml/lit at 35 & 55 DAS, recorded significantly higher number of pods per plant of soybean. Sebastian (2024) [18] revealed that significantly higher number of pods per plant, number of seed per pod, seed yield and stover yield in soybean were observed with application of 75% RDF + FS of nano DAP @ 6 ml/lit at 30 and 45 DAS.

Effect on seed and stover yield

Chickpea seed and stover yield were significantly influenced due to different treatments tried in the experiment significantly higher seed yield (9.39 g plant⁻¹) and stover yield (11.95 g plant⁻¹) was obtained in treatment T₇ (T₃ + foliar sprays of Nano DAP 6 ml/lit at 30 DAS), which was found at par with T₁₁ (75% RDF + Foliar sprays of Nano DAP 6 ml/lit at 30 and 45 DAS), T₉ (75% RDF + Foliar sprays of Nano DAP 3 ml/lit at 30 and 45 DAS) and T₅ (T₃ + Foliar sprays of Nano DAP 3 ml/lit at 30 DAS) in respect to both. However, significantly lowest seed yield (5.45 g plant⁻¹) and stover yield (7.12 g plant⁻¹) were observed in treatment T₁.

Similar results observed by Saleem *et al.*, (2021) [16] in wheat crop and Singh (2017) [19] reported that the use of nano fertilizers resulted in the improved plant growth, dry matter accumulation, photosynthetic rate, phloem translocation as compared to non-coated traditional fertilizers. The similar results were quoted by Ali and Al Juthery, (2017) [2]. Liu and Lal, (2014) [9] experiment data showed that application of the nanoparticles increased the growth rate and seed yield by 32.6% and 20.4%, respectively, compared to those of soybeans treated with a regular P fertilizer. Adhikari *et al.* (2014) [1] speculated that the yield of grain and straw increment over 100 RDF due to better absorption, interception and utilization of P in the nano-P form as P is released slowly throughout the growth period, resulting in a higher photosynthetic rate and ultimately, a higher biomass yield accumulation.

Similar outcomes observed by Girigoud *et al.*, (2023) [9] in pigeon pea he observed that greatly enhanced stalk yield, most likely as a result of the best possible blend of traditional and nano fertilizers, which improve stalk productivity by supplying nutrients in a regulated and demand-driven way. Increased crop biomass is 59 results and discussion the outcome of this precise nutrient delivery, which also enhances target activity and controls plant development. Meena *et al.* (2020) [11] reported in increased grain and straw yield of wheat after the application of nano fertilizers which may be attributed to increased growth hormone, enhanced metabolic process and photosynthetic activities due to applications of nano fertilizers. Nano-fertilizers are considered as biological pumps of the plants to promote nutrients and water absorption in crop plants Ma *et al.* (2009) [10].

Table 1: Effect of nano DAP on growth and yield attributes of chickpea

Treatments	Plant height (cm)	Number of branches per plant	Number of pod per plant	Number of seeds per pod	Pod weight per plant (g)
T1: Absolute control	32.43	4.35	18.55	1.43	6.36
T2: 100% RDF i.e. 20-40-00 N-P2O5-K2O kg/ha	35.36	5.45	23.95	1.47	8.01
T3: 75% RDF + Seed treatment with Nano DAP 5 ml/kg of seed	35.14	5.47	23.68	1.49	8.62
T4: 50% RDF + Seed treatment with Nano DAP 5 ml/kg of seed	33.54	4.81	21.20	1.48	7.30
T5: T3 + Foliar sprays of Nano DAP 3 ml/lit at 30 DAS	37.91	5.80	25.86	1.52	9.82
T6: T4 + Foliar sprays of Nano DAP 3 ml/lit at 30 DAS	34.50	4.95	22.16	1.48	7.89
T7: T3 + Foliar sprays of Nano DAP 6 ml/lit at 30 DAS	38.63	6.45	26.83	1.54	10.31
T8: T4 + Foliar sprays of Nano DAP 6 ml/lit at 30 DAS	34.90	4.75	22.84	1.47	7.60
T9: 75% RDF + Foliar sprays of Nano DAP 3 ml/lit at 30 and 45 DAS	37.51	5.72	25.44	1.51	9.40
T10: 50% RDF + Foliar sprays of Nano DAP 3 ml/lit at 30 and 45 DAS	33.86	4.87	21.31	1.44	8.30
T11: 75% RDF + Foliar sprays of Nano DAP 6 ml/lit at 30 and 45 DAS	38.16	5.92	26.15	1.53	9.57
T12: 50% RDF + Foliar sprays of Nano DAP 6 ml/lit at 30 and 45 DAS	35.20	4.80	23.77	1.46	8.29
S.Em. $\pm$	1.04	0.32	0.85	0.03	0.37
CD at 5%	3.03	0.93	2.50	NS	1.07
CV%	5.05	10.5	6.31	3.58	7.53

Table 2: Effect of nano DAP on seed and stover yield of chickpea

Treatments	Seed yield (g plant ⁻¹)	Stover yield (g plant ⁻¹)
T1: Absolute control	5.45	7.12
T2: 100% RDF i.e. 20-40-00 N-P2O5-K2O kg/ha	7.38	9.08
T3: 75% RDF + Seed treatment with Nano DAP 5 ml/kg of seed	7.68	9.95
T4: 50% RDF + Seed treatment with Nano DAP 5 ml/kg of seed	6.44	8.52
T5: T3 + Foliar sprays of Nano DAP 3 ml/lit at 30 DAS	8.86	10.94
T6: T4 + Foliar sprays of Nano DAP 3 ml/lit at 30 DAS	6.91	9.36
T7: T3 + Foliar sprays of Nano DAP 6 ml/lit at 30 DAS	9.39	11.95
T8: T4 + Foliar sprays of Nano DAP 6 ml/lit at 30 DAS	6.77	9.32
T9: 75% RDF + Foliar sprays of Nano DAP 3 ml/lit at 30 and 45 DAS	8.78	11.17
T10: 50% RDF + Foliar sprays of Nano DAP 3 ml/lit at 30 and 45 DAS	7.06	8.69
T11: 75% RDF + Foliar sprays of Nano DAP 6 ml/lit at 30 and 45 DAS	8.93	11.01
T12: 50% RDF + Foliar sprays of Nano DAP 6 ml/lit at 30 and 45 DAS	7.40	9.11
S.Em. $\pm$	0.28	0.35
CD at 5%	0.81	1.03
CV%	6.31	6.34

Conclusion

From the forgoing results, it can be concluded that growth, yield and yield attributes of chickpea were adversely affected due to foliar spray of nano DAP. An application of 75% RDF + Seed treatment with Nano DAP 5 ml/kg of seed + foliar sprays of Nano DAP 6 ml/lit at 30 DAS gave better mitigating effect and resulted higher chickpea growth and yield.

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