



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
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www.agronomyjournals.com
2024; SP-7(12): 613-616
Received: 21-10-2024
Accepted: 23-11-2024

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Influence of foliar spray of DAP and nano DAP on growth and yield of *kharif* soybean (*Glycine max* (L.) Merrill)

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DOI: <https://doi.org/10.33545/2618060X.2024.v7.i12Si.2286>

Abstract

The field experiment was conducted at Research farm, Agronomy section, Rajarshree Chhatrapati Shahu Maharaj college of Agriculture, Kolhapur (Maharashtra), India during the *kharif* season of 2023. The experiment was laid out in randomized block design with eleven treatments replicated three times and conducted with aim of studying the Influence of Foliar Spray of DAP And Nano DAP on Growth and Yield of *Kharif* Soybean (*Glycine max* (L.) Merrill). The soybean variety *Phule Sangam* (KDS 726) was sown by the method of dibbling.

The highest value of growth parameters at 75 DAS were observed in 100% RDF with foliar spray of 4% DAP at 35 and 55 DAS which included plant height (60.08 cm), number of branches (8.42 Plant⁻¹), number of functional leaves (49.27 Plant⁻¹), mean leaf area (38.33 dm²) and plant dry matter (35.39 g). 100% RDF along with foliar spray of 4% Nano DAP and 100% RDF along with foliar spray of 2% DAP showed at par result with it.

Seed yield, straw yield and harvest index was calculated after harvesting on per ha. basis. Significantly superior seed yield (35.52 q ha⁻¹) and straw yield (43.14 q ha⁻¹) observed in the treatment 100% RDF with foliar spray of 4% DAP which was followed by 100% RDF along with foliar spray of 4% Nano DAP and 100% RDF along with foliar spray of 2% DAP at 35 and 55 DAS. Highest harvest index observed in 100% RDF along with foliar spray of 2% DAP at 35 and 55 DAS.

Keywords: Soybean, foliar spray, DAP, Nano DAP, growth, yield

Introduction

Soybean, rightly called as Golden Bean is a most happening crop of twenty first century, occupying premier position among oilseed crops of the country since 2006. It is also the most important oil-bearing leguminous crop of the world. The productivity potential of soybean is higher than that of other legumes. It is a richest source of quality protein which can be used for alleviating protein calorie for malnutrition. Soybean contains around 40% protein with all the essential amino acids beside 18-20% oil. The necessity of integrating soybean in Indian diet is more, considering presence of vitamins and other minerals like calcium, iron and other nutraceutical and health benefitting compounds. Soybean till now has been an export commodity of valuable foreign exchange mainly for its de-oiled cake (DOC), which contributed greatly to the economy of India. Extension Bulletin 18(2023).

Foliar feeding is a technique of feeding plants by applying fertilizer directly to their leaves. Plants are able to absorb essential elements through their leaves. The absorption takes place through their stomata and also through their epidermis. Transport is usually faster through the stomata, but total absorption may be as great through the epidermis. Plants are also able to absorb nutrients through their bark. Efficiency of fertilizers applied to soil is generally low due to various losses and due to fixation. Foliar application of nutrients eliminates the problems of fixation and immobilization. Hence, foliar nutrition is recognized as an important method of fertilization in modern agriculture. Keeping this point in view, a study was undertaken to access the effect of water-soluble fertilizers sprays on growth and yield of soybean and find out the suitable water-soluble fertilizers for spraying on soybean crop (Dikey *et al.*, 2020)^[1].

Research by (Kumar *et al.*, 2013)^[3] found that foliar application of 2% diammonium phosphate (DAP) significantly increased the number of pods per plant, number of seeds per pod, seed index, and overall soybean yield. With these considerations in mind, the current study aimed to investigate effect of foliar spray of DAP on soybean. Whereas Nano fertilizers, developed through nanotechnology, enhance soil fertility, agricultural productivity and crop quality by modifying traditional fertilizers or extracting plant nutrients using various physical, chemical, or biological techniques (Singh M.D., 2017)^[8].

Materials and Methods

A field experiment was carried out at Research Farm, Agronomy Section, RSCM College of Agriculture, Kolhapur, Maharashtra (India) during *kharif* season of the year 2023. The soil of experimental field was sandy clay loam with pH of 7.63, organic carbon 0.61 g/kg, total nitrogen 199.12 kg/ha, available phosphorus 15.25kg /ha and 216.56 kg/ha available potassium content. The crop (Variety *Phule Sangam* (KDS 726)) was raised using RDF @ 50 kg N, 75 kg P₂O₅ and 45 kg K₂O per hectare at the time of sowing. Seeds were sown at the rate of 75 kg ha⁻¹ by dibbling method at a spacing of 45 cm x 5 cm. The gross and net plot sizes were 5.00 × 4.50 m² and 4.50 × 3.60 m² respectively. The experiment was laid out in Randomized Block Design with eleven treatment which replicated thrice. The treatments were allotted in field following the random methods. The treatment comprises Absolute Control, GRDF (50:75:45 N, P₂O₅, K₂O kg ha⁻¹ + FYM @12 t ha⁻¹), 100% RDF (50:75:45 N, P₂O₅, K₂O kg ha⁻¹), 100% RDF +Foliar Spray of Nano DAP @ 2% at 35 and 55 DAS, 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS, 100% RDF+ Foliar Spray of DAP @ 2% at 35 and 55 DAS, 100%RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS, 75% RDF +Foliar Spray of Nano DAP @ 2% at 35 and 55 DAS, 75% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS, 75% RDF +Foliar Spray of DAP @ 2% at 35 and 55 DAS and 75% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS. The application of foliar sprays was carried out in accordance with specific treatments using a knapsack sprayer equipped with a flat fan nozzle, delivering a spray volume of 500 L ha⁻¹.

Results and Discussion

A) Effect of foliar spray of DAP and Nano DAP on growth parameters of soybean

1) Plant Height

100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇)

demonstrated superior growth with heights of 60.08 cm at 45 DAS, comparable to 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅) and 100% RDF+ Foliar Spray of DAP @2% at 35 and 55 DAS (T₆), shows at par result with 100%RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇). The lowest height was recorded in the absolute control (T₁), was 40.29 cm at 75 DAS. This might be due to the basal application of conventional fertilizer along with foliar sprays of DAP and Nano DAP which enhanced the growth of plant to grow faster. Concordant result was reported by Venkatesh and Basu (2011)^[11], Lakshmy (2020)^[4]

2) Number of Branches per plant

The higher branch count (8.42) observed in 100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇). 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅) and 100% RDF+ Foliar Spray of DAP @ 2% at 35 and 55 DAS (T₆) displayed at par result to 100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇) at 75 DAS. Due to foliar application the nutrients get radially available for plant growth. Higher photosynthetic efficiency increased cell division and elongation, this may be contributed to increased no. of branches per plant. Absolute control (T₁) had a significantly lower number of branches (3.65). Concordant result was reported by Sharifi *et al.* (2018)^[6], Dikey *et al.* (2020)^[1].

3) Number of Functional Leaves per plant

The number of functional leaves was effectively influenced by conventional fertilizer application and foliar spray of DAP and Nano DAP. At 75 DAS, 100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇), which received a 4% DAP application, had the higher number of functional leaves, with counts of 49.27. 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅) and 100% RDF+ Foliar Spray of DAP @ 2% at 35 and 55 DAS (T₆) produced results at par to 100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇). This faster nutrient absorption might have increased the enzyme activity and auxin metabolism resulting in higher number of functional leaves. While the Absolute control (T₁) had a significantly lower number of functional leaves (28.56). Concordant result was reported by Shashikumar *et al.* (2013)^[7] Sharifi *et al.* (2018)^[6].

Table 1: Mean growth parameter of soybean influenced by Foliar spray of DAP and Nano DAP

Treatments		Growth Parameter (75 DAS)				
		Plant Height (cm)	No. of Branches (Plant ⁻¹)	No. of Functional Leaves (plant ⁻¹)	Leaf area plant ⁻¹ (dm ²)	Plant Dry Matter (g)
T ₁	Absolute Control	40.29	3.65	28.56	21.67	21.00
T ₂	GRDF (50:75:45 N, P ₂ O ₅ , K ₂ O kg ha ⁻¹ +12 t FYM ha ⁻¹)	46.72	5.54	35.56	26.52	25.84
T ₃	100% RDF (50:75:45 N, P ₂ O ₅ , K ₂ O kg ha ⁻¹)	46.04	5.21	34.72	26.28	24.89
T ₄	100%RDF+ Foliar Spray of Nano DAP @ 2% at 35 and 55 DAS	54.25	5.67	41.71	33.34	30.89
T ₅	100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS	59.72	8.20	47.18	36.55	33.10
T ₆	100% RDF+ Foliar Spray of DAP @ 2% at 35 and 55 DAS	57.24	7.84	44.48	34.39	31.61
T ₇	100%RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS	60.08	8.42	49.27	38.33	35.39
T ₈	75% RDF +Foliar Spray of Nano DAP @ 2% at 35 and 55 DAS	50.53	5.63	35.98	27.46	26.53
T ₉	75% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS	50.91	6.18	37.09	28.95	26.87
T ₁₀	75% RDF +Foliar Spray of DAP @2% at 35and 55 DAS	48.13	6.06	36.86	28.02	26.20
T ₁₁	75% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS	51.24	6.19	37.44	29.07	26.71
S.Em ±		1.86	0.50	2.01	1.50	1.29
CD @ 5%		5.48	1.46	5.94	4.42	3.80
General Mean		51.83	6.23	38.99	30.05	28.09

4) Leaf area per plant (dm²)

At 75 DAS, the largest leaf area was observed in 100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇), with measurements of 38.33 square decimetres (dm²), respectively. 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅) and 100% RDF+ Foliar Spray of DAP @ 2% at 35 and 55 DAS (T₆) exhibited at par to those of 100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇), indicating comparable effectiveness in leaf area development). The increased nutrient absorption might have increased the photosynthetic efficiency. Thus, higher number of leaves contributed to higher leaf area per plant. In contrast, the Absolute Control (T₁) displayed significantly lower leaf area (21.67) at 75 DAS, highlighting a marked disparity in leaf development between the control and the treated plots. Concordant result was reported by Krishnaveni *et al.* (2004) [2], Sritharan *et al.* (2005) [9].

5) Dry Matter per plant (g)

100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇), demonstrated the higher plant dry matter at 75 DAS, with values of 39.27 gram. 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅) and 100% RDF+ Foliar Spray of DAP @ 2% at 35 and 55 DAS (T₆) shows at par result at 75 DAS, indicating similar effectiveness in dry matter accumulation. The increased photosynthetic efficiency enhanced the assimilated product thus accelerating the dry matter accumulation in plant. In contrast, Absolute Control (T₁) recorded significantly lower dry matter (24.66 g), highlighting a distinct disparity in dry matter accumulation compared to the other treatments. Concordant result was reported by Shashikumar *et al.* (2013) [7], Mannan M. (2015) [5], Sruthi *et al.* (2020) [10].

B) Effect of foliar spray of DAP and Nano DAP on yield of soybean

1) Seed yield of soybean (q per ha)

The higher seed yield was recorded in 100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇), which achieved an impressive 35.52 quintals per hectare, a result that was comparable to the yields observed in 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅) and 100% RDF+ Foliar Spray of DAP @ 2% at 35 and 55 DAS (T₆). This outcome was attributed to the application of a 4% DAP foliar spray. Specifically, 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅) and 100% RDF+ Foliar Spray of DAP @ 2% at 35 and 55 DAS (T₆), produced yields of 35.19 and 35.01 quintals per hectare, respectively. This indicates that the foliar spray of DAP at 4% significantly influenced the seed

yield, although 100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇) results were on par with the higher yields of 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅) and 100% RDF+ Foliar Spray of DAP @ 2% at 35 and 55 DAS (T₆). Absolute Control (T₁) exhibits result that were markedly lower compared to the outcomes observed with all other treatments. This discrepancy highlights a significant difference in effectiveness, with Absolute Control (T₁) showing a notably diminished performance relative to the other methods tested. Concordant result was reported by Sruthi *et al.* (2020) [10], Sharifi *et al.* (2018) [6], Mannan, M. (2015) [5].

2) Straw yield of soybean (q per ha)

In the study, it was observed that the treatment incorporating a 4% DAP foliar spray along with 100% Recommended Dose of Fertilizer (RDF) yielded the maximum straw production. Specifically, 100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇), which involved this combination, produced a straw yield of 43.14 quintals per hectare. In comparison, 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅) and 100% RDF+ Foliar Spray of DAP @ 2% at 35 and 55 DAS (T₆), which also employed similar strategies but with slight variations and shown at par result with 100% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS (T₇), achieved straw yields of 42.35 and 42.08 quintals per hectare, respectively, showing results that were statistically comparable to each other. Conversely, the control treatment, labelled as T₁, which did not receive any additional treatment beyond the standard practices, resulted in a significantly lower straw yield of 27.15 quintals per hectare. Concordant result was reported by Sruthi *et al.* (2020) [10], Warpe *et al.* (2022) [12].

3) Harvest index

In the study, the higher harvest index observed in 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅), which was 45.40%, indicates that this treatment achieved a superior ratio of seed yield to total biomass. This high harvest index results from 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅) ability to produce a significantly greater number of seed compared to its straw yield. Essentially, 100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS (T₅) successfully allocated a larger proportion of its total biomass to the seeds rather than to vegetative parts of the plant. This efficient conversion of biomass into harvestable seeds reflects effective resource utilization and optimal growing conditions for this treatment, leading to a higher economic yield. Absolute Control (T₁) demonstrates a significantly weaker performance compared to the other methods evaluated.

Table 2: Mean seed yield, mean straw yield and harvest index of soybean influenced by Foliar spray of DAP and Nano DAP

	Treatments	Seed yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Harvest Index (%)
T ₁	Absolute Control	17.74	27.15	39.44
T ₂	GRDF (50:75:45 N, P ₂ O ₅ , K ₂ O kg ha ⁻¹ + 12 t FYM ha ⁻¹)	24.80	33.99	42.17
T ₃	100% RDF (50:75:45 N, P ₂ O ₅ , K ₂ O kg ha ⁻¹)	24.11	32.46	42.67
T ₄	100% RDF +Foliar Spray of Nano DAP@2% at 35 and 55 DAS	29.77	37.02	44.55
T ₅	100% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS	35.19	42.35	45.38
T ₆	100% RDF+ Foliar Spray of DAP @ 2% at 35 and 55 DAS	35.01	42.08	45.40
T ₇	100%RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS	35.52	43.14	45.07
T ₈	75% RDF +Foliar Spray of Nano DAP @ 2% at 35 and 55 DAS	26.88	33.36	44.51
T ₉	75% RDF +Foliar Spray of Nano DAP @ 4% at 35 and 55 DAS	28.97	35.85	44.18
T ₁₀	75% RDF +Foliar Spray of DAP @ 2% at 35 and 55 DAS	28.10	35.33	44.32
T ₁₁	75% RDF +Foliar Spray of DAP @ 4% at 35 and 55 DAS	29.24	36.58	44.42
	S.Em±	1.83	1.43	-

CD @ 5%	5.40	4.22	-
General Mean	28.67	36.30	43.83

Conclusion

The application of 100% RDF along with foliar spray of 4% DAP resulted in the highest growth (plant height, number of branches, number of functional leaves, mean leaf area and plant dry matter) and yield (seed yield and straw yield) of soybean compared to all other treatments, though it was on par with 4% Nano DAP and 2% DAP alongside 100% RDF.

Sci. 2022;34(14):13-18.

Acknowledgment

The authors would like to express their sincere gratitude to the Agronomy Section at RSCM College of Agriculture, Kolhapur, Maharashtra, India, for facilitating the smooth execution of field, laboratory, and experimental work, as well as providing essential resources for this research.

A heartfelt thanks to Dr. J. P. Bholane for the initial review of the manuscript and the authors are also thankful to Prof. K. D. Gorad for helping with plant and soil chemical analysis.

References

1. Dikey HH, Wankhade RS, Patil K, Shelke S. Response of different nutritional foliar sprays on growth and yield of soybean. *Int J Curr Microbiol App Sci.* 2020;9(7):4106-4110.
2. Krishnaveni SA, Palchamy A, Mahendran S. Effect of foliar spray of nutrients on growth and yield of green gram (*Phaseolus radiatus*). *Legume Res.* 2004;27(2):149-150.
3. Kumar K, Vaiyapuri M, Mohamed Amanullah, Gopalaswamy G. Influence of foliar spray of nutrients on yield and economics of soybean (*Glycine max* L. Merrill). *J Biol Sci.* 2013;13:563-565.
4. Lakshmy MP, Ao Engrala, Gadi Yabi, Singh AK. Response of soybean (*Glycine max* L. Merrill) to foliar application of nutrients. *Int J Curr Microbiol Appl Sci.* 2020;9(4):494-500.
5. Mannan M. Foliar and soil fertilization effect on seed yield and protein content of soybean. *Bangladesh Agron J.* 2015;17(1):67-72.
6. Sharifi SK, Lalitha BS, Qasimullah R, Kumar GP, Manjanagouda SS. Effect of foliar application of water-soluble fertilizer on growth and yield of soybean (*Glycine max* L. Merrill). *Int J Pure Appl Biosci.* 2018;6(5):766-770.
7. Shashikumar R, Basavarajappa SR, Salakinkop SR, Hebbar M, Basavarajappa MP, Patil HY. Influence of foliar nutrition on performance of black gram (*Vigna mungo*), nutrient uptake and economics under dry land ecosystems. *Legume Res.* 2013;36(5):422-428.
8. Singh MD. Nano-fertilizers: A new way to increase nutrient use efficiency in crop production. *Int J Agric Sci.* 2017;9(7):0975-3710.
9. Sritharan N, Aravazhi A, Anitha, Vangamudi M. Effect of foliar spray of nutrients and plant growth regulators (PGRs) for yield maximization in black gram. *Madras Agric J.* 2005;92(4-6):301-307.
10. Sruthi DSVS, Singh S, Tiwari D, Kavya P. Effect of foliar spray of nutrients and plant growth regulators on growth and yield of green gram (*Vigna radiata* L.). *The Bioscan.* 2020;15(2):253-256.
11. Venkatesh MS, Basu PS. Effect of foliar application of urea on growth, yield and quality of chickpea under rainfed conditions. *J Food Legumes.* 2011;24(2):110-112.
12. Warpe S, Jakku P, Sonawane DA, Ghodke PB, Ubale SP. Effect of fertilizer levels and foliar nutrition on growth and yield of soybean (*Glycine max* (L.) Merrill). *Int J Plant Soil*