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KS Kavana
M.Sc. (Soil Science), Department of Soil Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahilyanagar, Maharashtra, India

Bhimrao M Kamble
Head, Department of Soil Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahilyanagar, Maharashtra, India

SM Todmal
Assistant professor, Department of Soil Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahilyanagar, Maharashtra, India

PS Bodke
Head, Department of Agronomy, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahilyanagar, Maharashtra, India

Sheetal R Tatpurkar
Assistant professor, Department of Soil Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahilyanagar, Maharashtra, India

ID Ishwarya
Department of Soil Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahilyanagar, Maharashtra, India

Samrudhi P Kamate
Department of Soil Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahilyanagar, Maharashtra, India

G Sumanth
Department of Agricultural Economics, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahilyanagar, Maharashtra, India

Corresponding Author:
KS Kavana
M.Sc. (Soil Science), Department of Soil Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahilyanagar, Maharashtra, India

Effect of foliar application of phosphorus on nutrient uptake, yield and quality parameters of soybean in Inceptisol

KS Kavana[1], Bhimrao M Kamble[2], SM Todmal[3], PS Bodke[4], Sheetal R Tatpurkar[5], ID Ishwarya[6], Samrudhi P Kamate[7], G Sumanth[8]

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Abstract
The research aimed to study effect of foliar application of phosphorus on nutrient uptake and yield of soybean grown in Inceptisol. The field experiment was carried out at research farm of Department of Soil Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra state, India, during *kharif* season, 2025-26. The experiment was laid out in randomized block design with ten treatments and three replications. The treatments were consisting of basal application of different levels of phosphorus *i.e* 100% RDP and 75% RDP along with the two foliar sprays of different sources of phosphorus *viz*; DAP @ 2%, 12:61:0 @ 1%, Nano-DAP @ 0.20% and 0.40% at 30 and 45 DAS. The results revealed that the application of 100% RDP along with two foliar sprays of 12:61:0 @ 1% recorded highest yield and N, P, K uptake of soybean. However, application of 100% RDP along with two foliar sprays of 12:61:0 @ 1% recorded higher net monetary returns (Rs. 77,644 ha^{-1}) and B: C ratio (2.17). The treatment 100% RDP along with two foliar sprays of 12:61:0 @ 1% was statistically at par with 100% RDP along with two foliar sprays of DAP @ 2%. Hence application of 100% RDP through DAP along with two foliar sprays of 12:61:0 @ 1% at 30 and 45 days after sowing is recommended in soybean for achieving higher net monetary returns in Inceptisol.

Keywords: Nutrient availability, Phosphorus levels and sources, DAP, 12:61:0, Nano DAP, Uptake, Soybean, Yield

Introduction

A wonder crop soybean (*Glycine max* (L.) Merr.) is a leguminous crop which belongs to the family *Fabaceae* with sub family Papilionaceae. Soybean is an important crop in human and animal nutrition because it is a major source of edible vegetable oil with high protein rich food in the world. Soybean seed includes approximately 38-43 percentage protein, 18-20 percentage oil, 26 percentage carbohydrate, 4 percentage minerals, and 2 percentage phospholipids. The protein is rich in lysine and oil extracted is edible with high unsaturated fatty acids (Endres, 2001) [1].

Phosphorus is regarded as the second most essential macronutrient for plant growth and development after nitrogen. It is actively involved in a wide range of physiological and biochemical functions, including photosynthetic activity, respiration, energy generation and transfer, cell division and expansion, and biological nitrogen fixation. Adequate phosphorus nutrition is also essential for successful seed germination, early seedling establishment, root and shoot growth, flowering, and seed formation (Muindi, 2019) [2].

When phosphorus is applied to the soil, it forms complexes with iron, aluminium, magnesium, calcium and clay minerals and gets quickly converted to less soluble or insoluble forms. The 20-25 per centage of the applied phosphorus fertilizer is utilized by the crop and the remaining phosphorus may become fixed or converted into less soluble forms. Foliar application is an efficient method of supplying nutrients directly to plants in a liquid form through the leaves (Nasiri *et al.*, 2010) [3]. In comparison with soil application, foliar feeding of micronutrients can be more effective because it requires relatively smaller quantities of nutrients and allows their rapid absorption by plant tissues (Zayed *et al.*, 2011) [4]. Foliar nutrient application is particularly advantageous when nutrient uptake through the root system is inadequate or restricted (Kinaci *et al.*, 2007; Babaeian *et al.*, 2011) [6, 5]. Furthermore, indiscriminate and unbalanced application of chemical fertilizers to soil may contribute to environmental pollution. Therefore, foliar application of nutrients can serve as an environmentally favourable approach for improving nutrient availability while reducing excessive fertilizer inputs to the soil (Bozorgi *et al.*, 2011) [7].

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Materials and methods

Experimental site

The experiment was conducted at Post Graduate Institute Farm, MPKV, Rahuri. Geographically, the experimental fixed site lies at 19°34' North latitude and 74°64' East longitude and at an altitude of 511m above mean sea level. The tract is lying on the Eastern site of Western ghat zone of Maharashtra.

Collection and analysis of plant samples

The leaf samples were collected separately from each plot during soybean harvest. The samples were oven dried at 60 °C and were analyzed for total N by micro kjeldahl method in H_2SO_4:H_2O_2 (1:1) digestion (Parkinson *et al.*, 1975) [8], total P by vanadomolybdate yellow colour method in H_2SO_4: $HClO_4$: HNO_3 (1:4:10) digestion (Jackson, 1973), total K on flame photometer in H_2SO_4: $HClO_4$: HNO_3 (1:4:10) digestion (Chapman and Pratt, 1961).

Experimental details

The field experiment was laid out in RBD with ten treatments and three replications. The treatments were T_1- absolute control, T_2- GRDF (50:75:45 N: P_2O_5 and K_2O kg ha^{-1} + 10 t ha^{-1} FYM), T_3- 100% RDP + Two foliar sprays of DAP @ 2%, T_4- 100% RDP + Two foliar sprays of 12:61:0 @ 1%, T_5- 100% RDP + Two foliar sprays of Nano – DAP @ 0.20%, T_6- 100% RDP + Two foliar sprays of Nano – DAP @ 0.40%, T_7- 75% RDP + Two foliar sprays of DAP @ 2%, T_8- 75% RDP + Two foliar sprays of 12:61:0 @ 1%, T_9 - 75% RDP + Two foliar sprays of Nano – DAP @ 0.20%, T_{10}- 75% RDP + Two foliar sprays of Nano – DAP @ 0.40%. Phosphorus sources (MAP, DAP and Nano-DAP) were applied as foliar sprays as per treatments at 30 and 45 DAS.

$$\text{Uptake of nutrient (kg ha}^{-1}\text{)} = \frac{\text{Total dry matter (kg ha}^{-1}\text{) x Concentration of nutrient (\%)}}{100}$$

Results and discussion

The research was conducted at Post Graduate Institute Research Farm (Inceptisol), MPKV, Rahuri during *kharif*, 2025-26.

Effect of foliar sprays of different phosphorus sources on total nutrient uptake by soybean at harvest

Nitrogen uptake

The results pertaining to the foliar sprays of different phosphorus sources on total nitrogen uptake depicted in Table 1. The highest total nitrogen uptake (201.43 kg ha^{-1}) was recorded in treatment of 100% RDP along with two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4), among the rest of treatments The significantly lowest total nitrogen uptake (101.97 kg ha^{-1}) was recorded in the treatment absolute control (T_1). Among the different sources of the phosphorus, the highest total nitrogen uptake by soybean was recorded in treatment 100% RDP along with two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4) as compared to other sources of phosphorus (DAP, monoammonium phosphate, Nano-DAP).

The total nitrogen uptake by soybean (201.43 kg ha^{-1}) was highest in 100% RDP + two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4) representing enhancement in N uptake with improved phosphorus nutrition could be explained by the well-established synergism between phosphorus and nitrogen metabolism, wherein adequate P supply promotes root growth and proliferation, thereby increasing the root absorptive surface for nitrate and ammoniacal nitrogen uptake, besides its role in enhancing biological nitrogen fixation through improved nodulation. Additionally, the higher dry matter production and grain and stover yields were recorded in 100% RDP + two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4) provided a greater metabolic sink, further driving nitrogen uptake. These results were corroborated with the findings of Sharifi *et al.* (2018) [9] and Reddy *et al.* (2025) [10].

Table 1. Effect of foliar sprays of different phosphorus sources on total nutrient uptake by soybean at harvest

Tr. No.	Treatment details	Total nutrient uptake (kg ha^{-1})		
		N	P	K
T_1	Absolute control	101.97^{j}	12.12^{j}	37.33^{j}
T_2	GRDF (50:75:45 N: P_2O_5 and K_2O kg ha^{-1} + 10 t ha^{-1} FYM)	161.20^{de}	20.31^{de}	66.57^{de}
T_3	100% RDP + Two foliar sprays of DAP @ 2%	184.31^{b}	24.21^{b}	83.67^{b}
T_4	100% RDP + Two foliar sprays of 12:61:0 @ 1%	201.43^{a}	26.73^{a}	91.75^{a}
T_5	100% RDP + Two foliar sprays of Nano – DAP @ 0.20%	167.71^{cd}	21.54^{cd}	70.49^{d}
T_6	100% RDP + Two foliar sprays of Nano – DAP @ 0.40%	176.17^{bc}	22.98^{bc}	76.92^{c}
T_7	75% RDP + Two foliar sprays of DAP @ 2%	150.52^{efg}	17.98^{fg}	58.99^{fg}
T_8	75% RDP + Two foliar sprays of 12:61:0 @ 1%	156.87^{def}	19.09^{ef}	62.45^{ef}
T_9	75% RDP + Two foliar sprays of Nano – DAP @ 0.20%	137.73^{ghi}	16.23^{hi}	51.31^{hi}
T_{10}	75% RDP + Two foliar sprays of Nano – DAP @ 0.40%	144.53^{fgh}	17.27^{gh}	55.01^{gh}
	SE (m) +	4.13	0.51	1.80
	C.D. (5%)	13.22	1.63	5.76

Phosphorus uptake

The highest total P uptake (26.73 kg ha^{-1}) was recorded in 100% RDP along with two foliar sprays of 12:61:0 @ 1% (T_4), which was significantly superior to rest of the treatments (Table 1). The next highest total P uptake (24.21 kg ha^{-1}) by soybean was observed in 100% RDP along with two foliar sprays of DAP @ 2% at 30 and 45 DAS (T_3), followed by total phosphorus uptake (22.98 kg ha^{-1}) recorded in treatment 100% RDP along with two foliar sprays of Nano – DAP @ 0.40% at 30 and 45 DAS (T_6) and total phosphorus uptake (21.54 kg ha^{-1}) observed in treatment 100% RDP along with two foliar sprays of Nano – DAP @ 0.20% (T_5).

The superior total P uptake by soybean with two foliar sprays of 12:61:0 might be associated with the availability of soluble phosphorus for foliar absorption and its subsequent translocation and utilization in plant metabolic processes. Adequate P supply promoted root growth and energy metabolism, thereby improving the plant's capacity to acquire and accumulate nutrients. The higher P uptake with DAP compared with Nano-DAP might reflect differences in the amount and form of phosphorus delivered through the foliar sprays.

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Within Nano-DAP, the higher uptake with 0.40% compared with 0.20% indicates that increasing the foliar concentration enhanced P acquisition and accumulation. These findings were in line with Devi *et al.* (2012) [11], Meena *et al.* (2021) [12] and El-Azizy *et al.* (2021) [13].

Potassium uptake

The application of 100% RDP along with the two foliar sprays of 1% of 12:61:0 to the soybean gave highest total potassium uptake among the treatments (Table 1). Under 75% RDP, total K uptake ranged from 51.31 to 62.45 kg ha^{-1}, with 75% RDP along with two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_8) recording the highest uptake. The lowest K uptake (37.33 kg ha^{-1}) was observed in absolute control (T_1).

The highest total potassium uptake (91.75 kg ha^{-1}) by soybean was recorded in 100% RDP + two foliar sprays of 12:61:0 @ 1% this superiority of T_4 might be due to favourable P nutritional response produced by 100% RDP combined with foliar 12:61:0, which could have promoted root development, physiological activity and biomass production. A more active root system would enhance the acquisition of soil-derived potassium, while greater biomass provided a larger sink for K accumulation in plant tissues. Similar results were reported by Paikra *et al.* (2018) [14], Bonde *et al.* (2017) [15], Laharia *et al.* (2015) [16] and Rajeshkumar *et al.* (2017) [17].

Effect of foliar sprays of different phosphorus sources on yield of soybean

Grain yield

Effect of different phosphorus sources along with recommended dose of fertilizer on grain yield of soybean reported in Table 2 and Fig. 1. The significantly higher grain yield (25.83 q ha^{-1}) was observed in treatment of 100% RDP along with the two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4), however it was statistically at par with grain yield (24.13 q ha^{-1}) recorded in treatment 100% RDP along with the two foliar sprays of DAP @ 2% at 30 and 45 DAS (T_3). Among the different sources of the phosphorus the highest grain yield was obtained in 100% RDP along with two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4) as compared to other sources of phosphorus (DAP and Nano-DAP).

The superiority of grain yield in application of 100% RDP along with the two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4) might be ascribed to the cumulative effect of higher chlorophyll content, greater nodulation and higher number of pods per plant, all of which are yield-contributing characters that translate directly into grain yield. Adequate foliar phosphorus nutrition ensured efficient translocation of photosynthates from source to sink, and better grain filling, particularly since soybean had a high phosphorus requirement during the reproductive and pod-filling stages when root uptake alone often became inadequate under Inceptisol conditions prone to phosphorus fixation. These results were in agreement with Deshbhrata *et al.* (2010) [18], Khanam *et al.* (2016) [19] and Jaybhay *et al.* (2020) [20].

Stover yield

The treatment 100% RDP along with the two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS along with recommended dose of nitrogen and potassium (T_4) recorded significantly highest stover yield (35.56 q ha^{-1}) being statistically at par with stover yield (33.06 q ha^{-1}) observed in treatment 100% RDP along with two foliar sprays of DAP @ 2% (T_3) and stover yield (32.14 q ha^{-1}) recorded in the treatment 100% RDP along with two foliar sprays of Nano – DAP @ 0.40% at 30 and 45 DAS (T_6).

The superiority of stover yield in treatment of 100% RDP along with the two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4) is due to supplying a higher quantum of readily available phosphorus recorded the maximum dry matter accumulation in the vegetative plant parts. stover yield was largely a function of vegetative growth, plant height, leaf area and branching, all of which are enhanced by adequate phosphorus nutrition through better meristematic activity and cell division. The results are in agreement with Ahmed *et al.* (2015) [21], Muthal *et al.* (2016) [22] and Sarika *et al.* (2022) [23].

Table 2. Effect of foliar sprays of different phosphorus sources on yield of soybean

Tr. No.	Treatment details	Yield (q ha^{-1})	
		Grain	Stover
T_1	Absolute control	15.53^{j}	20.13^{j}
T_2	GRDF (50:75:45 N: P_2O_5 and K_2O kg ha^{-1} + 10 t ha^{-1} FYM)	22.48^{bcde}	30.35^{cde}
T_3	100% RDP + Two foliar sprays of DAP @ 2%	24.13^{ab}	33.06^{ab}
T_4	100% RDP + Two foliar sprays of 12:61:0 @ 1%	25.83^{a}	35.56^{a}
T_5	100% RDP + Two foliar sprays of Nano – DAP @ 0.20%	23.14^{bcd}	30.93^{bcd}
T_6	100% RDP + Two foliar sprays of Nano – DAP @ 0.40%	23.70^{bc}	32.14^{bc}
T_7	75% RDP + Two foliar sprays of DAP @ 2%	21.87^{cdefg}	28.93^{defg}
T_8	75% RDP + Two foliar sprays of 12:61:0 @ 1%	22.38^{bcdef}	29.77^{cdef}
T_9	75% RDP + Two foliar sprays of Nano – DAP @ 0.20%	20.79^{efghi}	27.09^{ghi}
T_{10}	75% RDP + Two foliar sprays of Nano – DAP @ 0.40%	21.84^{defgh}	27.22^{fgh}
	SE (m) +	0.64	0.81
	C.D. (5%)	2.04	2.60

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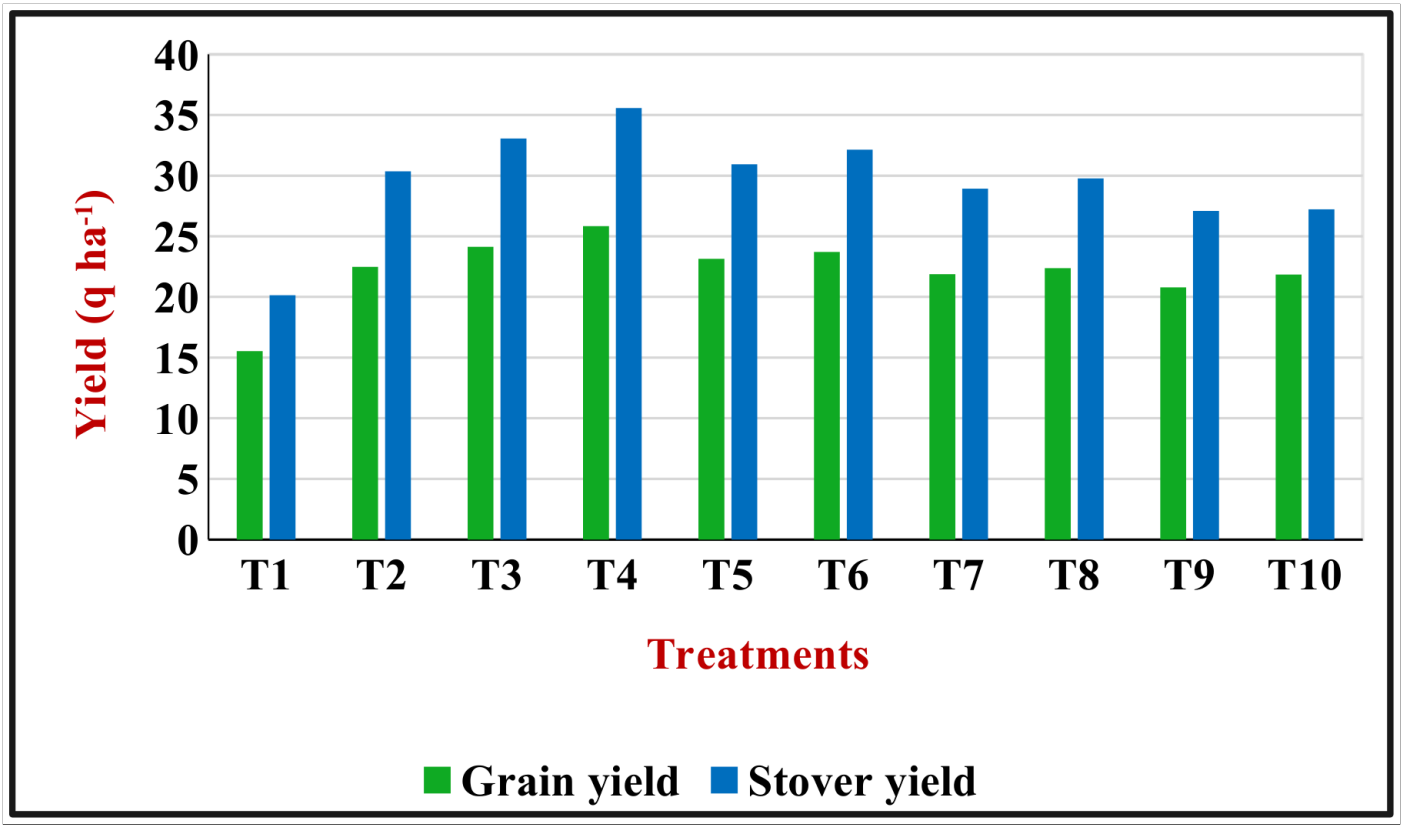


Figure 1. Effect of foliar sprays of different phosphorus sources on grain and stover yield of soybean

Effect of foliar sprays of different phosphorus sources on quality parameters of soybean

Protein content

Protein content of soybean seeds with different treatments is depicted in Table 3. The numerically highest protein content (37.57 %) and protein yield (840.41 kg ha^{-1}) was recorded in 100% RDP along with two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4) and it was followed by protein content (37.30 %) and protein yield (782.81 kg ha^{-1}) observed in treatment 100% RDP along with two foliar sprays of DAP @ 2% at 30 and 45 DAS (T_3). The lowest protein content (35.44 %) and protein yield (485.65 kg ha^{-1}) was observed in absolute control (T_1). Although the difference was statistically non-significant. Since, phosphorus, being a key component of nucleic acids and a co-factor in nitrogen assimilation and protein synthesis pathways, would be expected to marginally favoured protein accumulation. These findings were in general agreement with Dhage *et al.* (2014) and Khaswa *et al.* (2014) [24].

Oil content

Oil content of soybean seeds with different treatments is depicted in Table 3. The higher value of oil (20.76%) and oil yield (46.53 kg ha^{-1}) was observed in 100% RDP along with two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS along with recommended dose of nitrogen and potassium (T_4), while the minimum oil (17.19%) and oil yield (23.57 kg ha^{-1}) was recorded in absolute control (T_1). This might be due to phosphorus played an important role in fatty acid biosynthesis and in energy transfer reactions of the lipid biosynthetic pathway, and the greater availability of phosphorus through the combined soil and foliar route under 100% RDP along with two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4) evidently favoured oil accumulation in the developing seed to a greater extent than protein accumulation. These results were corroborated with the findings of Shahid *et al.* (2009) [25] and Bajya *et al.* (2025) [26].

Table 3. Effect of foliar sprays of different phosphorus sources on quality parameters of soybean

Tr. No.	Treatment details	Protein (%)	Oil (%)	Protein yield (kg ha^{-1})	Oil yield (kg ha^{-1})
T_1	Absolute control	35.44	17.19	485.65	23.57
T_2	GRDF (50:75:45 N: P_2O_5 and K_2O kg ha^{-1} + 10 t ha^{-1} FYM)	36.24	18.47	709.13	36.17
T_3	100% RDP + Two foliar sprays of DAP @ 2%	37.30	20.37	782.81	42.75
T_4	100% RDP + Two foliar sprays of 12:61:0 @ 1%	37.57	20.76	840.41	46.53
T_5	100% RDP + Two foliar sprays of Nano – DAP @ 0.20%	36.50	18.68	735.67	37.65
T_6	100% RDP + Two foliar sprays of Nano – DAP @ 0.40%	36.77	19.65	757.27	40.46
T_7	75% RDP + Two foliar sprays of DAP @ 2%	35.97	18.18	685.89	34.64
T_8	75% RDP + Two foliar sprays of 12:61:0 @ 1%	36.24	18.45	706.62	35.96
T_9	75% RDP + Two foliar sprays of Nano – DAP @ 0.20%	35.70	17.56	652.00	32.10
T_{10}	75% RDP + Two foliar sprays of Nano – DAP @ 0.40%	35.97	18.04	685.33	34.41
	SE (m) +	0.44	0.76	19.56	2.04
	C.D. (5%)	NS	NS	62.58	6.53

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Effect of foliar sprays of different phosphorus sources on economics of soybean

The pooled mean gross returns, net returns and B:C ratio were computed and depicted in Table 4. It was observed that the highest gross return (Rs. 143768 ha^{-1}), net return (Rs. 77644 ha^{-1}) was recorded in the treatment 100% RDP along with two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4). However, the application of foliar spray of 12:61:0 recorded the higher B:C ratio (2.17) over the rest of other treatments. These results were close in conformity with earlier workers Sharif *et al.* (2018) [9], Garud *et al.* (2015) [27] and Sachin *et al.* (2024) [28].

Table 4. Effect of foliar sprays of different phosphorus sources on economics of soybean

Tr. No.	Treatment details	Cost of cultivation (Rs. ha^{-1})	Gros returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C Ratio
T_1	Absolute control	41970	86259	44290	2.06
T_2	GRDF (50:75:45 N: P_2O_5 and K_2O kg ha^{-1} + 10 t ha^{-1} FYM)	64124	125052	60928	1.95
T_3	100% RDP + Two foliar sprays of DAP @ 2%	64664	134287	69623	2.07
T_4	100% RDP + Two foliar sprays of 12:61:0 @ 1%	66124	143768	77644	2.17
T_5	100% RDP + Two foliar sprays of Nano – DAP @ 0.20%	66408	128668	62260	1.94
T_6	100% RDP + Two foliar sprays of Nano – DAP @ 0.40%	68692	131819	63127	1.92
T_7	75% RDP + Two foliar sprays of DAP @ 2%	63646	121552	57906	1.91
T_8	75% RDP + Two foliar sprays of 12:61:0 @ 1%	65106	124443	59337	1.91
T_9	75% RDP + Two foliar sprays of Nano – DAP @ 0.20%	65390	115498	50108	1.77
T_{10}	75% RDP + Two foliar sprays of Nano – DAP @ 0.40%	67674	121202	53528	1.79
	SE (m) +		3546.12	3546.12	
	C.D. (5%)		10536.06	10536.06	

Conclusions

The maximum nutrient uptake, yield and net returns (77644 Rs. ha^{-1}) and B:C ratio (2.17) was recorded by the application of 100% RDP along with two foliar sprays of 12:61:0 @ 1% at 30 and 45 DAS (T_4). Hence the application of 100% RDP (75 kg ha^{-1}) + two foliar sprays of 12:61:0 @ 1% or 2% DAP at 30 and 45 DAS along with recommended dose of nitrogen (50 kg ha^{-1}), potassium (45 kg ha^{-1}) and 10 t FYM ha^{-1} to soybean for achieving higher net monetary returns is recommended in Inceptisols.

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Disclaimer

The findings and conclusions presented in this research paper are based on a field experiment conducted during *Kharif* 2025-26 at the Post Graduate Institute Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra. The results are specific to the experimental conditions, soil type, soybean variety Phule Sangam (KDS-726) and treatments evaluated in the present investigation. Since the study was conducted for a single season, further multi-season and multi-location studies are required before making broader recommendations.

Conflict of interest

The authors declare no conflicts of interest, and no external funding or sponsorship influenced the study design, data collection, analysis, publication decision, or manuscript preparation.

References

1. Endres JG. Soy protein products: characteristics, nutritional aspects, and utilization. The American Oil Chemists Society. 2001:1-13.
2. Mwende Muindi E. Understanding soil phosphorus. International Journal of Plant and Soil Science. 2019;31(2):1-18.
3. Nasiri Y, Zehtab-Salmasi S, Nasrullahzadeh S, Najafi N, Ghassemi-Golezani K. Effects of foliar application of micronutrients (Fe and Zn) on flower yield and essential oil of chamomile (*Matricaria chamomilla* L.). Journal of Medicinal Plants Research. 2010;4(17):1733-1737.
4. Zayed A, Salem M, Sharkawy M. Effect of different micronutrient treatments on rice (*Oryza sativa* L.) growth and yield under saline soil conditions. World Journal of Agricultural Sciences. 2011;7(2):179-184.
5. Babaeian M, Esmaeilian Y, Tavassoli A, Asgharzade A, Sadeghi M. Effects of water stress, manure and chemical fertilizer on grain yield and grain nutrient content in barley. Scientific Research Essays. 2011;6(17):3697-3701.
6. Kinaci E, Gulmezoglu N. Grain yield and yield components of triticale upon application of different foliar fertilizers. Interciencia. 2007;32(9):624-628.
7. Bozorgi HR, Azarpour E, Moradi M. Effects of bio, mineral nitrogen fertilization and foliar zinc spraying on yield and yield components of faba bean. World Applied Science Journal. 2011;13(6):1409-1414.
8. Parkinson JA, Allen SE. A wet oxidation procedure suitable for the determination of nitrogen and mineral nutrients in biological material. Communications in Soil Science and Plant Analysis. 1975;6(1):1-11.
9. Sharifi SK, Lalitha BS, Prajwal Kumar GK, Qasimullah R. Effect of foliar application of water-soluble fertilizer on nutrient uptake and economics of soybean (*Glycine max* L.). International Journal of Chemical Studies. 2018;6(4):2306-2309.
10. Reddy KS, Shivay YS, Kumar D, Parida BK, Bora R, Borate RB, Alekhya G. Nano-DAP augments productivity, phosphorus use efficiency, and profitability of spring wheat. Scientific Reports. 2025;15(1):24771.

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11. Devi KN, Singh LNK, Devi TS, Devi HN, Singh TB, Singh KK, Singh WM. Response of soybean [*Glycine max* (L.) Merrill] to sources and levels of phosphorus. Journal of Agricultural Sciences. 2012;4(6):44-53.
12. Meena RH, Jat G, Jain D. Impact of foliar application of different Nano-fertilizers on soil microbial properties and yield of wheat. Journal of Environmental Biology. 2021;42(2):302-308.
13. El-Azizy FA, Habib AAM. Effect of Nano phosphorus and potassium fertilizers on productivity and mineral content of broad bean in North Sinai. Journal of Soil Sciences and Agricultural Engineering. 2021;12(4):239-246.
14. Paikra IS, Lakpale R, Singh P, Kumar V. Effect of foliar nutrition on uptake of nutrients and economics of soybean. International Journal of Bio-resource and Stress Management. 2018;9(3):365-367.
15. Bonde AS, Gawande SN. Effect of integrated nutrient management on growth, yield and nutrient uptake by soybean (*Glycine max*). Annals of plant and Soil Research. 2017;17(2):154-158.
16. Laharia GS, Hadole SS, Meena SM, Aage AB. Interactive effect of phosphorus and zinc on nutrient uptake and nutrient use efficiency of soybean. International Journal of Tropical Agriculture. 2015;33(4):3731-3735.
17. Rajeshkumar S, Durairaj SN, Kannan V. Effect of crop geometry and foliar nutrition on growth and yield of irrigated blackgram. International Journal of Current Microbiology and Applied Sciences. 2017;6(11):4084-4094.
18. Deshbhratar PB, Singh PK, Jambhulkar AP, Ramteke DS. Effect of sulphur and phosphorus on yield, quality and nutrient status of pigeonpea (*Cajanus cajan*). Journal of Environmental Biology. 2010;31(6):933-937.
19. Khanam M, Islam MS, Ali MH, Chowdhury IF, Masum SM. Performance of soybean under different levels of phosphorus and potassium. Bangladesh Agronomy Journal. 2016;19(1):99-108.
20. Jaybhay SA, Varghese P, Taware SP. Influence of foliar application of nutrient on growth, yield, economics, soil nutritional status and nutrient uptake of soybean. Legume Research-An International Journal. 2020;44(11):1322-1327.
21. Ahmed AE, Hassan AO, Raddad EY. Effect of different p hosphorus sources and methods of application on growth, nodulation and yield of soybean (*Glycine max* (L) Merr.). American Journal of Agricultural Research. 2015;2(1):1-7.
22. Muthal YC, Deshmukh SL, Sagvekar VV, Shinde JB. Effect of foliar application of macronutrient and micronutrients on yield attributes, yield and economics of kharif greengram (*Vigna radiata* L.). International Journal of Tropical Agriculture. 2016;34(7):2143-2148.
23. Sarika TW, Prasanna J, Sonawane DA, Ghodke PB, Ubale SP. Effect of fertilizer levels and foliar nutrition on growth and yield of soybean (*Glycine max* (L.) Merrill). International Journal of Plant Sciences. 2022;34(14):13-18.
24. Khaswa SL, Dubey RK, Singh S, Tiwari RC. Growth, productivity and quality of soybean [*Glycine max* (L) Merrill] under different levels and sources of phosphorus and plant growth regulators in sub humid Rajasthan. African Journal of Agricultural Research. 2014;9:1045-1051.
25. Shahid QM, Farrukh M, Haroon ZK, Anjum SA. Performance of soybean (*Glycine max* L.) under different phosphorus levels and inoculation. Pakistan Journal of Agricultural Sciences. 2009;46(4):237-241.
26. Bajya N, Manuja S, Meenakshi NK, Rameshwar A. Effect of nitrogen and phosphorus levels with Nano-DAP on yield and quality of groundnut (*Arachis hypogaea* L.). Himachal Journal of Agricultural Research. 2025;51(2):58–262.
27. Garud HS, Awasarmal VB, Pawar SU, Bhusawar PV. Yield economics and quality of soybean as influenced by foliar and soil application of phosphatic fertilizer. International Journal of Tropical Agriculture. 2015;33(2):709-712.
28. Sachin R, Patil S, Yadahalli G, Nandagavi R, Vidyavathi G. Assessing the growth and yield responses of rainfed pigeonpea (*Cajanus cajan* L.) to Nano-DAP fertilizer application. Journal of Farm Sciences. 2024;37(2):129-136.

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