



ISSN (E): 2277-7695
 ISSN (P): 2349-8242
 NAAS Rating: 5.23
 TPI 2023; 12(10): 469-471
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www.thepharmajournal.com

Received: 24-07-2023
 Accepted: 29-08-2023

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Effect of foliar application of fertilizers on growth and yield attributes of soybean crop

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Abstract

The experiment was conducted during *Kharif* season of the year 2022-23 the field Experiment was conducted at crop research centre farm, Department of agronomy, school of agriculture, ITM University Gwalior, Madhya Pradesh to study the effect of foliar application of nutrients at different stage of crop on growth and yield attributes of soybean under randomized complete block design (RCBD) with three replications. This study aimed to evaluate the performance of ten combination of foliar application of nutrients on soybean crop. The Treatment was T₁: Control, T₂: RDF, T₃: RDF+ Urea @ 2% Spray at 45 DAS, T₄: RDF+ DAP @ 2% Spray at 45 DAS, T₅: RDF+ SOP @ 2% Spray at 45 DAS, T₆: RDF+ 19:19:1 @ 2% Spray at 45 DAS, T₇: RDF+ 13:00:45 @ 2% Spray at 45 DAS, T₈: RDF+ 12:61:00 @ 1% Spray at 45 DAS, T₉: RDF + 00:52:34 @ 1% Spray at 45 DAS and T₁₀: RDF + 19:19:19 @ 1% Spray at 30 DAS+ 13:00:45 @ 1% Spray at 45 DAS.

The experimental field's terrain is well leveled and consistent. The soil texture of the experimental field was sandy loam soil, medium in available nitrogen (163 kg ha⁻¹), medium in available phosphorus (19.40 kg ha⁻¹), medium to high in available potassium (270.80 kg ha⁻¹) and neutral in pH (6.9 pH). The environmental conditions were moderately congenial for normal growth and maturity of soybean crop. The foliar application of fertilizer 19:19:19 @ 1.0% at 30 DAS +13:00:45 @ 1.0% at 45 DAS recorded significantly higher growth, yield attributes and yield of soybean as compare to other treatments and its followed by 19:19:19 @ 2% at 45 DAS which was at par with application 13:00:45 @ 2% at 45 DAS, 12:61:00 @ 1% at 45 DAS and 00:52:34 @ 1% at 45 DAS.

Keywords: Soybean, growth, yield, fertilizers

Introduction

Soybean (*Glycine max* L. Merrill) is known as a Wonder crop, Miracle crop and Golden bean. It is belonging to the order fabales, family fabaceae (Leguminosae), subfamily faboideae (papilionoideae). In India, it is known by several names as bhat, bhatman, bhatmas, kulthi, ramkulthi, bhut, kalitur, teliakulth and gerakalay. It is originated in China. It was introduced to India across the Himalayan Mountains many years ago. Soybean is mainly grown for their seeds and is the second largest oil seed after groundnut in India. Soybean has become a miracle crop of 20th century. Soybean, being full of nutritional value, contains about 40% to 50% high quality protein and 20% to 22% oil. Soybeans also have some essential amino acids (5%), carbohydrates, vitamins and minerals.

The shape of the bean is oval and mostly cream color. It is self-pollinated and short day plant. Nutrients play pivotal role in increasing the grain yield in pulses. Foliar application of major plant nutrients like nitrogen, phosphorus and potassium was found to be as good as soil application. Water-soluble fertilizers are used as chemical fertilizers in sprinkler or drip irrigation systems and for foliar fertilization to increase yield and improve oilseed quality. These are usually combinations of nitrogen, phosphorus, potassium, calcium, magnesium, sulfur and micronutrients in varying ratios. Different water-soluble fertilizers can be used at different crop growth stages either alone or in combination to improve crop productivity. NPK combinations are starter fertilizers (19:19:19), nitrogen- and potassium-containing varieties and monopotassium phosphate (0:52:34); monoammonium phosphate (12:61:0); potassium nitrate (13:0:45) for sugar conversion and disease resistance. Another advanced fertilizer 00:52:34 improves flowering, promotes root growth, and protects against fungi that cause diseases such as powdery mildew. Unlike other fertilizers, potassium nitrate (13:00:45) is not volatile, the nitrogen is in nitrate form, and it has a synergistic effect on calcium and magnesium absorption.

Material and Methods

The experiment was conducted during *Kharif* season of the year 2022-23 the field Experiment was done at crop research centre farm, department of agronomy, school of agriculture, ITM University Gwalior, Madhya Pradesh to study the effect of foliar application on growth and yield attributes of soybean. The experimental field's terrain is well leveled and consistent. The soil texture of the experimental field was sandy loam soil, medium in available nitrogen (163 kg ha⁻¹), medium in available phosphorus (19.40 kg ha⁻¹), medium to high in available potassium (270.80 kg ha⁻¹) and neutral in pH (6.9 pH). Lower yield was the outcome of the experiment's period of insufficient rainfall for soybean growth and development. The experiment was laid out in randomized complete block design (RCBD). The planting consisted of a total of 30 experimental plots in three replicates. Each trial plot had a gross plot size of 4.5 m x 3.6 m and a net plot size of 3.6 m x 3.4 m. ten treatment combinations were formed considering nine foliar nutrient treatments through different sources with General Recommended Dose of Fertilizers. The recommended dose of fertilizer (20:60:40:20 N: P: K: S kg ha⁻¹) was given to soybean at the time of sowing and Sowing was done by dibbling method on 24th July, 2022. All the foliar spray was given at flowering stage.

The Treatment was T₁: Control, T₂: RDF, T₃: RDF+ Urea @ 2% Spray at 45 DAS, T₄: RDF+ DAP @ 2% Spray at 45 DAS, T₅: RDF+ SOP @ 2% Spray at 45 DAS, T₆: RDF+ 19:19:19 @ 2% Spray at 45 DAS, T₇: RDF+ 13:00:45 @ 2% Spray at 45 DAS, T₈: RDF+ 12:61:00 @ 1% Spray at 45 DAS, T₉: RDF+ 00:52:34 @ 1% Spray at 45 DAS and T₁₀: RDF+ 19:19:19 @ 1% Spray at 30 DAS+ 13:00:45 @ 1% Spray at 45 DAS.

Result and Discussion

Growth attributes of soybean

The growth parameters were significantly influenced with the foliar application of different combination of fertilizers on soybean crop (Table.1) The effect of the different foliar application on growth parameters, namely, plant height, leaf area index, number of branches and dry matter accumulation per plant were significantly affected by foliar fertilizers. Plant height, leaf area index, number of branches, and Dry matter production plant of soybean was significantly affected by foliar application compared to the control. The maximum plant height (64.81 cm) at harvest, leaf area index(5.70) at 90 DAS, number of branches(11.18) at 90 DAS and Dry matter

production plant⁻¹ (32.85 g) was recorded in T₁₀-RDF+19:19:19 (N:P: K) @ 1% 30 DAS + 13:00:45 @ 1% 45 DAS) and its Superior over all the treatment and it followed by T₆- RDF+19:19:19 @ 2% Spray At 45 DAS and minimum plant height(43.81cm) at harvest, leaf area index(3.52) at 90 DAS, number of branches(7.55) at 90 DAS and Dry matter production plant⁻¹ (21.97 g) at harvest was recorded in T₁ absolute control.

The soybean plant experienced luxurious availability of macronutrients with the generally recommended fertilizer dose along with foliar application of water soluble fertilizer 19:19:19 (N:P: K) @ 1% 30 das + 13:00:45 @ 1% 45 Day after sowing as nitrogen is essential for chlorophyll metabolism and directly involved in photosynthesis while phosphorus offers its role in cell division and enlargement and also potassium is essential for carbohydrate metabolism and starch translocation which was reflected in luxuriant growth of soybean. Similar results were reported by Ghare (2014) [3], Jadhav *et al.* (2017) [6], Gutte *et al.* (2018) [4] Sharifi *et al.* (2018) [8], dikey *et al.* (2020) [2].

Yield attributes and yield

The yield and yield attributes were significantly influenced with the foliar application of different combination of fertilizers on soybean crop (Table.2) The soybean crop applied with general recommended fertilizer dose along with a foliar application fertilizer T₁₀-RDF+19:19:19 (N:P: K) @ 1% 30 DAS + 13:00:45 @ 1% 45 days after sowing produced the significantly highest number of seed per pod (3.95) , number of pod per plant (80.45) , seed yield (2430.07 kg ha⁻¹) and straw yield (3601.90 kg ha⁻¹) compared to the other nutrient management treatment and its superior compared to remain treatment and its followed by T₆ - RDF+19:19:19 @ 2% Spray At 45 DAS The general recommended fertilizer dose for soybean resulted in significantly lower number of seed per pod (2.67), number of pod per plant (41.80), grain yield (998.82 kg ha⁻¹) and straw yield (1842.10 kg ha⁻¹) during the experiment. Yield attributes are the symbol of vigorous plant growth. Optimum application of nutrients through soil and foliar fertilizer application of soybean when treated with generally recommended fertilizer dose along with foliar fertilizer T₁₀-RDF+19:19:19 (N: P: K) @ 1% 30 DAS + 13:00:45 @ 1% 45 days after sowing provided easy availability for uptake of macronutrients. Efficient use of nitrogen contributed to chlorophyll metabolism and increased carbohydrate production.

Table 1: Effect of foliar application on growth attributes of soybean at harvest stage

Treatments	Plant height (cm)	Leaf area index	No. of branches	Dry matter accumulation plant ⁻¹ (g)
Control	43.81	3.52	7.55	20.97
RDF (100%)	50.15	4.18	8.62	24.62
RDF+Urea @ 2% Spray At 45 DAS	51.33	4.37	8.92	26.25
RDF+DAP @ 2% Spray At 45 DAS	52.88	4.50	9.15	26.79
RDF+SOP @ 2% Spray At 45 DAS	54.61	4.64	9.40	27.15
RDF+19:19:19 @ 2% Spray At 45 DAS	59.65	5.18	10.30	30.05
RDF+13:00:45 @ 2% Spray At 45 DAS	57.23	5.01	10.11	29.69
RDF+12:61:00 @ 1% Spray At 45 DAS	56.28	4.95	10.00	29.10
RDF+00:52:34 @ 1% Spray At 45 DAS	55.16	4.70	9.51	27.52
RDF+19:19:19 @ 1% Spray at 30 DAS+13:00:45 @ 1% Spray At 45 DAS	64.81	5.70	11.18	32.85
SEm ±	1.49	0.16	0.27	0.85
CD (p<0.05)	4.50	0.49	0.81	2.55

Phosphorus is essential for the respiration mechanism that promotes increased photosynthesis and is essential for seed formation. Potassium plays an important role in the conversion of starch and protein synthesis. This was reflected

in the production of a higher number of seed per pod, number of pod per plant, grain yield and straw yield in soybean. The results are closely related to Jadhav and Kulkarni (2016) [5], Gutte *et al.* (2018) [4] and warpe *et al.* (2022) [10].

Table 2: Effect of foliar application on yield attributes of soybean.

Treatments	No. of Pods plant ⁻¹	No. of Seed Pods ⁻¹	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)
Control	41.80	2.67	998.82	1842.10
RDF (100%)	56.50	3.00	1675.40	2855.53
RDF+Urea @ 2% Spray At 45 DAS	59.14	3.15	1812.46	3026.20
RDF+DAP @ 2% Spray At 45 DAS	61.35	3.25	1848.30	3032.80
RDF+SOP @ 2% Spray At 45 DAS	63.61	3.29	1887.77	3050.70
RDF+19:19:19 @ 2% Spray At 45 DAS	72.67	3.60	2170.43	3340.63
RDF+13:00:45 @ 2% Spray At 45 DAS	70.45	3.45	2081.47	3230.90
RDF+12:61:00 @ 1% Spray At 45 DAS	67.72	3.38	1989.37	3135.47
RDF+00:52:34 @ 1% Spray At 45 DAS	65.50	3.31	1948.20	3107.57
RDF+19:19:19 @ 1% Spray at 30 DAS+13:00:45 @ 1% Spray At 45 DAS	80.45	3.95	2430.07	3601.90
SEm ±	2.39	0.10	76.16	80.15
CD ($p < 0.05$)	7.20	0.30	226.28	240.43

Conclusion

On the basis of conducted field experiment at CRC-1, ITM, University. It may be concluded that the application of RDF (20:60:40: 20 N: P: K: S Kg ha⁻¹) along with foliar application of 19:19:19 @ 1% Spray at 30 DAS+13:00:45 @ 1% Spray at 45 DAS was observed to be superior with respect to higher growth and yield attributes of soybean over the rest of treatments.

Acknowledgments

I am grateful to the administration of School of Agriculture, ITM University Gwalior (M.P.) who provided assistance and support throughout every phase of my research project.

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