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Research Communication

Effect of foliar nutrition on productivity and profitability of soybean (*Glycine max*)

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ABSTRACT

A field experiment was conducted during the rainy (kharif) season of 2015 at Raipur to evaluate the effect of foliar nutrition on productivity and profitability of soybean [*Glycine max* (L.) Merr.] under Vertisols of Chhattisgarh plains. The experiment was laid out in randomized block design with 3 replications. The results revealed that application of recommended dose of fertilizer (RDF) + spray of diammonium phosphate (DAP) @ 2% at pod-initiation stage of crop growth resulted significantly higher number of pods/plant (68), number of seeds/pods (3.02), seed index and higher grain yield (2.16 t/ha) compared to the application of RDF + water spray and RDF. The foliar application of RDF + spray of DAP @ 2% resulted in significantly higher net returns of ₹ 60,279, with benefit: cost ratio of 3.07.

Key words: Foliar spray, Micronutrients, Quality, Soybean Yield

Soybean is recognized as golden bean because of its high nutritional values and economic importance. It is one of the most important oilseed crops in the world, generally grown as a rainy season crop under rainfed situation. The crop also helps in increasing the fertility level of soil through symbiotic nitrogen fixation. Thus, it is a "miracle bean" having many advantages. Foliar spraying is one alternative approach through in which micro-nutrients are made available to crop in liquid form through foliage (Nasiri *et al.,* 2010). Foliar application of micro-elements is more beneficial than soil application. Since application rates are lesser as compared to soil application, same application could be obtained easily, and crop reacts to nutrient application immediately (Zayed *et al.,* 2011). Foliar spraying of micro-elements is very helpful when the roots cannot provide essential micro-nutrients to the crop (Kinaci and Gulmezoglu, 2007). Foliar sprays of nutrients are better than soil application (Bozorgi *et al.,* 2011). Foliar application of macro- and micro- nutrients are more beneficial to legumes (Zayed *et al.,* 2011). However adequate information on the effect of foliar application of nitrogen, phosphorus, potassium, molybdenum, boron and zinc on soybean are not available for Chhattisgarh agro-climatic condition. Therefore, a study was carried to see the effect of foliar nutrition N, P, K, Mo, B and Zn at pod initiation stage on growth and yield of soybean.

A field experiment was conducted during the rainy (kharif) season of 2015 at the Research-cum-Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, to evaluate the effect of foliar nutrition on productivity and profitability of soybean under vertisols of Chhattisgarh plains. The experiment was laid out in randomized block design with 3 replications. The treatments were allotted in field following random methods. The soil was clayey in nature, neutral in pH and had low nitrogen, medium phosphorus and high in potassium content. Nine treatments consisted of various combination of nutrition application of recommended dose of fertilizer (RDF) + water spray at pod initiation, RDF + urea 2% spray at pod initiation RDF + diammonium phosphate (DAP) 2% spray at pod initiation, RDF + muriate of potash (MoP) 0.5% at pod initiation, RDF + NPK (19:19:19) 2% at pod initiation, RDF + molybdenum 0.5% at pod initiation, RDF + boron 0.5% at pod initiation, RDF + zinc chelated 0.5% at pod initiation, and RDF alone. Recommended dose of fertilizer was applied as basal dose and micronutrients were applied as foliar spray at pod-initiation stage.

Among the treatments, significantly higher number of pods/plant was observed with application of RDF + spray

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of water and RDF + spray of DAP @ 2% at pod initiation, followed by application of RDF + spray of urea @ 2%, and application of RDF + spray of molybdenum @ 0.5%. Seeds/pod were significantly higher under the application of RDF + spray of DAP @ 2%, followed by application of RDF + spray of urea @ 2%, which was statistically comparable to the application of RDF + water spray, application of RDF + spray of urea @ 2%, application of RDF + spray of MoP, 0.5%, application of RDF + spray of NPK (19:19:19), application of RDF + spray of molybdenum @ 0.5%, application of RDF + spray of boron 0.5%, application of RDF + spray of zinc 0.5% and RDF only. Significantly higher number of seeds/pod, and seeds/plant were recorded with RDF + spray of DAP @ 2% than RDF alone.

The foliar sprays of 2% DAP at flower-initiation and pod-formation stage might have helped in reduction of flower drop, which turn in significantly increased the number pods/plant, as reported by Ganapathy *et al.,* (2008). Optimum availability of all nutrients at flower-initiation and pod-formation stages of crop growth might have caused efficient translocation of photosynthates from source to sink. Decrease in flower drop due to prolonged assimilatory activity of leaves might be another possible reason for higher number of pods/plant. The foliar application of nitrogen and phosphorus at the initial stages might have resulted in effective absorption and their translocation to the pods resulting in more number of pods/plant, as reported by Solaiappan *et al.,* (2002) in red gram. The application of RDF + spray of DAP @ 2% spray also increased the seeds/plant, which was significantly superior to the other treatments. The lowest number of pods/plant, seeds/pod, and seeds/plant were recorded from RDF alone, as also reported by reported by Kumar *et al.,* (2013). The maximum pods/plant were observed with the foliar application of RDF + spray of DAP @ 2% at flowering and pod initiation stage increase the number of pods/plant could be attributed to significant effect of microelements on reproductive organs, such as stamens and pollens-grains. Soybean is a self-pollinated crop and application of Mo helped develop more number of flowers and also helped in complete fertilization process and finally resulted in pods/plant in soybean as reported by Nadergholi *et al.* (2011).

Significantly maximum seed yield and stover yield were recorded from the plot where recommended dose of fertilizer was applied along with spray of DAP @ 2% as compared to the other treatment. The increase in seed yield was the highest might be owing to increase in dry-matter accumulation, number of branches/plant, pods/plant, seeds/pod, seeds/plant, and seed weight. The highest factor for the higher values of these parameters might be owing to increased uptake of nutrients by crop owing to effective translocation of nutrients from sink to reproductive area of crop of soybean, as also reported by Abbas *et al.* (1994).

The maximum gross returns (₹79,911/ha), net returns (₹60,279/ha) and benefit: cost ratio (3.07) were recorded with RDF + spray of DAP @ 2% in soybean. The increase in gross and net returns is obviously owing to higher seed yield. Less input cost and higher economical yield might be resulted in increased benefit: cost ratio. The maximum cost of cultivation (₹34,382/ha) was recorded under application of RDF + spray of molybdenum @ 0.5% of soybean among the different treatments. However, the minimum gross returns (₹67,335/ha), net returns (₹32,953/ha) and benefit: cost ratio (0.96) were observed with RDF + spray of molybdenum @ 0.5% due to burning effect on

Table 1. Yield-attributing characters, yield and economics of soybean as influenced by foliar sprays of micronutrients

Treatment	Pods/ plant	Seeds/ pod	Seeds/ plant	Seed yield (t/ha)	Stover yield (t/ha)	Cost of cultivation ($\times 10^3$ ₹/ha)	Gross returns ($\times 10^3$ ₹/ha)	Net returns ($\times 10^3$ ₹/ha)	Benefit: cost ratio
RDF + water spray at pod initiation	68	2.04	138.2	2.04	2.75	19.4	75.5	56.1	2.89
RDF + urea 2% spray at pod initiation	67	2.93	196.3	2.11	2.83	19.5	77.7	58.2	2.99
RDF + DAP 2% spray at pod initiation	68	3.02	205.3	2.15	2.94	19.7	79.9	60.3	3.07
RDF + MoP 0.5% at pod initiation	65	2.88	187.5	2.10	2.86	19.5	78.1	58.7	3.02
RDF + 19:19:19 (NPK) 2% at pod initiation	62	2.78	172.3	2.04	2.75	21.7	75.6	53.10	2.49
RDF + molybdenum 0.5% at pod initiation	67	2.84	189.3	1.90*	2.47	34.4	67.4	32.10	0.96
RDF + boron 0.5% at pod initiation	63	2.69	169.2	1.97	2.63	20.1	72.9	52.1	2.49
RDF + zinc chelated 0.5% at pod initiation	64	2.65	169.8	1.98	2.68	21.3	73.7	52.5	2.47
RDF only	62	2.00	124.0	1.93	2.60	19.2	71.5	52.4	2.73
SEm±	0.83	0.022	0.425	5.53	7.54	–	20.06	20.06	0.09
CD (P=0.05)	2.24	0.067	1.274	15.34	20.9	–	NS	NS	NS

RDF, Recommended dose of fertilizer; DAP, diammonium phosphate; MoP, muriate of potash; *burning on leaf

leaves as compared to the control (RDF only). Similar result was also reported by Kumar *et al.* (2015). Spray of DAP @ 2% twice at flower-initiation and pod formation stages of crop growth resulted in higher gross returns (₹36,500/ha) and net returns (₹20,090/ha), followed by foliar spray of local variety at flower initiation and pod formation stages of crop growth with gross returns of ₹33,125/ ha and net returns of ₹15,675/ha. Water spray recorded the least gross returns and net returns and the B: C ratio (2.22) was higher under the treatments where DAP @ 2% was applied twice at flower initiation and pod formation stages of crop growth.

The results revealed the application of recommended dose of fertilizer along with foliar spray of DAP 2% resulted in significantly higher number of pods/plant, seeds/ pod, seeds/plant, and seed yield (t/ha) and stover yield (t/ ha).

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