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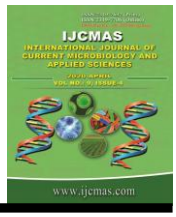

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Response of Soybean (*Glycine max* L. Merrill) to Foliar Application of Nutrients

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A B S T R A C T

An experiment was conducted during the *kharif* season of 2017 to study the Response of Soybean (*Glycine max* L. Merrill) to Foliar Application of Nutrients. The treatments comprised of spraying of water spray + RDF, 2% Urea + RDF, 2% DAP + RDF, 0.5% MOP + RDF, 2% 19:19:19 (NPK) + RDF, 0.1% Molybdenum + RDF, 0.2% Boron + RDF and 0.5% Zinc chillated + RDF at pod initiation stage and RDF only was laid out in Randomized Block Design (RBD) with three replications. Different treatments effects on growth, yield and quality parameters were found significant. Application of 2% Urea + RDF showed highest plant height and application of 2% DAP + RDF produced maximum number of pods per plant. 0.1% Molybdenum + RDF was recorded higher number of root nodules, fresh weight and dry weight of the nodules per plant. Foliar application of 2% 19:19:19 (NPK) + RDF showed the highest seed and stover yield. 2% Urea + RDF showed better performance in oil content and protein content in seeds and also recorded higher amount of available nutrients in soil. The highest net return (Rupees 55290) was obtained from the application of 0.2% Boron + RDF.

Introduction

Soybean (*Glycine max* L. Merrill) or Golden bean or Poor man's meat is an important oil seed crop cultivated since 2800 BC in China. High productivity, profitability and vital contribution towards maintaining soil fertility soybean has occupied an important place in world's oilseed cultivation. Soybean crop occupies highest acreage (11 million ha) among all oilseed crops contributing 37 and 25% of total oilseeds and edible oil production. India being the 5th largest vegetable oil economy in the world and increase in population and improved economic status, the per capita consumption of vegetable oil is increasing rapidly and projected to demand 16.44 and 19.16 kg year^{-1} by 2020 and 2050 respectively. In such scenario, soybean will be playing an important role. In India, soybean production is dominated by Maharashtra and Madhya

Pradesh contributing to 89% of the total production.

In Nagaland, the total area under soybean is 25040 ha with a total production of 31520 tons (Anonymous, 2017).

Effective and efficient use of nutrients is a very important factor which influences crop production. Indiscriminate nutrient mining and improper use of fertilizer has led to soil fertility depletion and induced micronutrient deficiency in many parts of the country. Therefore in order to achieve higher yield and sustain the same over the years, foliar fertilization is a very important means for the emerging nutrient deficiencies. Nutrients applied through foliage play a pivotal role in increasing the seed yield in pulses and oilseeds (Chandrasekhar and Bangaruswamy, 2003). Garcia and Hanway (1976) described soybean yield increase up to 31 % with foliar application of NPK and S during pod filling stage. Keeping above facts in view, the present investigation was planned to study the response of soybean to foliar application of macro and micro nutrients on growth, yield, quality, soil fertility and economics.

Materials and Methods

The field experiment on Response of Soybean (*Glycine max* L. Merrill) to Foliar Application of Nutrients was conducted at the AICRP Soybean Project Farm, SASRD, Nagaland University, Medziphema during the Kharif season of 2017. The experimental soil was sandy loam with low in nitrogen and medium in phosphorus and potassium. The treatments comprising of water spray + RDF, 2% Urea + RDF, 2% DAP + RDF, 0.5% MOP + RDF, 2% 19:19:19 (NPK) + RDF, 0.1% Molybdenum + RDF, 0.2% Boron + RDF and 0.5% Zinc chillated + RDF and RDF only were replicated thrice in randomized block design. The variety used for the experiment was JS 97-52 and was sown on 28th June. Foliar application of nutrients was done at pod initiation stage. Ammonium molybdate and boric acid was used as source of molybdenum and boron. Recommended dose of NPK @ 25, 100 and 50 kg ha^{-1}, respectively was applied as basal dose at the time of sowing.

Plant height and dry weight plant^{-1} were recorded at 30, 45 and 60 days after sowing. Nodule count and their fresh and dry weight were taken at flowering stage. After crop maturity, the yield attributing characters and yield data's were recorded. Plant and seed samples were taken from each plot for analysis of N, P, K and S by modified kjeldhal method as described by Black (1965), vanado-molybdate yellow colour method as outlined by Jackson (1973) and flame photometry as described by Chapman and Pratt (1962), respectively. Oil content was estimated by soxhlet extraction unit as per the method described by AOAC, 1980. Protein content (%) was estimated by multiplying per cent N content in seed with the factor 6.25. Soil samples were also collected and analysed for pH, organic carbon, available N, P and K as per the method described by Jackson (1973). Finally the experimental data recorded during the course of investigation were statistically analysed as per standard method prescribed by Cochran and Cox, 1957.

Results and Discussion

Effect on growth attributes

The data on growth attributes of soybean *viz.*, plant height and dry weight plant^{-1} recorded at 30, 45 and 60 days after sowing and number of root nodules plant^{-1}, fresh and dry weight of nodule plant^{-1} recorded at flowering as influenced by foliar application of nutrients are presented in Table 1. Plant height at 30

DAS did not show significant difference however, at 45 and 60 DAS, spraying of 2% Urea + RDF recorded significantly the highest plant height (41.68 and 59.3 cm respectively). This increase in plant height with foliar application can be attributed to the fact that micronutrients enhance plant vigour and strengthen stalk (Das, 1999). The results also confirm with the findings of Kalarani *et al.,* (1991) who reported that foliar spray of 2% urea gave higher plant height at pod filling stage. The effect of treatments on dry weight plant^{-1} was not significant at any of the stages.

Maximum number of nodules (42), fresh weight (0.68 g plant^{-1}) and dry weight (0.37 g plant^{-1}) of root nodules were recorded by the application of 0.1% Mo + RDF. Molybdenum acts as a cofactor for nitrogenase enzyme and nitrate reductase enzymes. Thus Mo is essential for proper proliferation of the root nodules. These results are in close agreement with the findings of Geetha and Velayutham (2009).

Effect on yield, yield attributes, quality and net return

Significant results were observed with foliar application of nutrients in respect of number of pods plant^{-1} and number of filled pods plant^{-1} (Table 2). The highest number of pods plant^{-1} (55.7) and highest number of filled pods plant^{-1} (53.33) was produced by application of 2% DAP + RDF. This result is similar with the findings of Mandic *et al.,* (2015) that studied the effects of foliar fertilization on quantitative traits of soybean and reported that foliar fertilization significantly increased the number of pods plant^{-1}.

The highest seed yield (1554.69 kg ha^{-1}) was recorded with the treatment 2% 19:19:19 (NPK) + RDF and it was 65.55% higher over control and at par with the yield of 0.2% Boron + RDF (1486.89 kg ha^{-1}) and 0.5% MOP + RDF (1422.74 kg ha^{-1}) and significantly higher than remaining treatments. This might be due to increased uptake of nutrients by soybean and effective translocation of nutrients from sink to reproductive area of crop. Similar results were found by Dandge *et al.,* (2018) who recorded higher seed and straw yield (1599 and 2131 kg ha^{-1} respectively) with the application of 2% 19:19:19 (NPK) + RDF at pod initiation stage. Maximum stover yield (2766 kg ha^{-1}) was recorded from the application of 2% 19:19:19 (NPK) + RDF which was 37.08 % more as compared to control and was at par with 0.2% Boron + RDF (2677.00 kg ha^{-1}).

Significant effect of foliar application of nutrients was also noticed in case of protein and oil content. Application of 2% Urea + RDF recorded significantly the highest protein (41.90%) and oil (19.57%) content followed by 2% 19:19:19 (NPK) + RDF (41.10 and 19.14%, respectively). The lowest protein (36.63%) and oil (16.01%) content was from control treatment followed by water spray + RDF (36.77 and 16.25%, respectively).

It is clear that the treatments with foliar application of macro and micro nutrients showed significantly higher seed protein content over control. Heidarian *et al.,* (2011) reported protein content in soybean seed influenced by the application of foliar spray of NPK fertilizer and micronutrient at critical growth stages over control treatment. Kalpanade *et al.,* (2010) reported enhancement of oil content in soybean with the foliar application of N.

Foliar application of nutrients also showed significant increase in net return as compared to control. The highest net return (Rupees 55290) was obtained from the application of 0.2% Boron + RDF.

Table.1 Effect of foliar application of nutrients on growth attributes of soybean

Treatments	Plant height (cm)			Dry weight (g plant^{-1})			Number of root nodules plant^{-1}	Fresh weight of the nodules (g plant^{1})	Dry weight of the nodules (g plant^{1})
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS			
Water spray + RDF	20.17	32.22	48.57	0.95	1.55	5.17	34.33	0.52	0.23
2% Urea + RDF	22.17	41.68	59.33	0.97	2.50	4.30	37.67	0.65	0.34
2% DAP + RDF	20.87	34.50	54.17	0.90	2.33	4.54	37.67	0.54	0.27
0.5% MOP + RDF	19.37	37.48	50.80	0.90	1.67	4.17	37.00	0.57	0.28
2% 19:19:19 (NPK) + RDF	23.43	38.17	58.23	0.90	1.67	6.00	38.00	0.60	0.32
0.1% Molybdenum + RDF	21.27	37.58	51.98	0.81	2.33	5.50	42.00	0.68	0.37
0.2% Boron + RDF	22.70	35.38	58.64	0.88	1.89	6.67	36.00	0.58	0.29
0.5% Zinc chillated + RDF	21.77	35.32	48.30	0.97	2.33	5.17	35.67	0.59	0.30
RDF	19.57	34.09	45.58	0.99	2.00	4.33	32.00	0.55	0.24
SEm±	**1.15**	**0.50**	**2.52**	**0.08**	**0.40**	**1.22**	**1.23**	**0.02**	**0.01**
CD(P=0.05)	**NS**	**1.50**	**7.55**	**NS**	**NS**	**NS**	**3.68**	**0.05**	**0.03**

Table.2 Effect of foliar application of nutrients on yield attributes, yield and quality of soybean

Treatments	Number of pods plant^{-1}	Number of filled pods plant^{-1}	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Protein content (%)	Oil content (%)	Net return (`. ha^{-1})
Water spray + RDF	51.67	48.00	1243.00	2382.00	36.77	16.25	41240
2% Urea + RDF	50.97	47.00	1016.56	2195.00	41.90	19.57	27398
2% DAP + RDF	55.70	53.33	1308.63	2264.33	38.33	18.02	44591
0.5% MOP + RDF	50.59	49.00	1422.74	2506.00	40.56	16.97	51831.2
2% 19:19:19 (NPK) + RDF	43.14	40.67	1554.69	2766.33	41.10	19.14	51862.6
0.1% Molybdenum + RDF	44.42	40.67	1233.77	2474.00	40.65	17.27	37878.2
0.2% Boron + RDF	48.91	45.67	1486.89	2677.00	39.77	17.70	55290.0
0.5% Zinc chillated + RDF	48.50	44.67	1007.14	2139.67	40.75	18.51	25912.6
RDF	43.07	42.00	939.09	2018.00	36.63	16.01	23246.4
SEm±	**0.68**	**0.44**	**82.02**	**54.60**	**0.33**	**0.15**	869.28
CD(P=0.05)	**2.03**	**1.32**	**245.91**	**163.70**	**1.00**	**0.46**	2606.11

Table.3 Effect of foliar application of nutrients on the per cent nutrient content of soybean

Treatments	Seed (%)				Stover (%)			
	N	P	K	S	N	P	K	S
Water spray + RDF	5.88	0.35	1.86	0.28	1.21	0.33	1.91	0.77
2% Urea + RDF	6.70	0.44	1.98	0.32	1.47	0.41	2.17	0.94
2% DAP + RDF	6.13	0.46	2.04	0.29	1.31	0.47	2.14	0.89
0.5% MOP + RDF	6.49	0.44	2.21	0.32	1.21	0.41	2.23	0.81
2% 19:19:19 (NPK) + RDF	6.58	0.48	2.11	0.37	1.38	0.46	2.07	0.92
0.1% Molybdenum + RDF	6.50	0.42	1.91	0.30	1.40	0.38	2.00	0.89
0.2% Boron + RDF	6.36	0.45	1.92	0.31	1.33	0.34	1.99	0.84
0.5% Zinc chillated + RDF	6.52	0.39	1.84	0.28	1.36	0.36	2.00	0.86
RDF	5.86	0.34	1.81	0.27	1.16	0.30	1.87	0.73
SEm±	**0.05**	**0.005**	**0.03**	**0.01**	**0.03**	**0.01**	**0.06**	**0.01**
CD(P=0.05)	**0.16**	**0.015**	**0.10**	**0.02**	**0.09**	**0.03**	**0.17**	**0.02**

Table.4 Effect of foliar application of nutrients on soil fertility

Treatments	pH	Organic carbon (%)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})	Available S (kg ha^{-1})
Water spray + RDF	4.81	1.71	306.67	17.43	213.33	15.75
2% Urea + RDF	4.95	1.84	332.33	22.30	232.97	16.22
2% DAP + RDF	4.95	1.88	328.67	22.70	234.67	16.54
0.5% MOP + RDF	4.88	1.84	327.67	20.97	236.60	16.16
2% 19:19:19 (NPK) + RDF	4.95	1.97	320.67	21.53	237.73	16.55
0.1% Molybdenum + RDF	4.86	1.83	319.00	19.13	227.30	16.19
0.2% Boron + RDF	4.91	1.82	309.00	18.07	228.90	15.69
0.5% Zinc chillated + RDF	4.81	1.83	309.33	18.57	223.80	16.72
RDF	4.87	1.69	303.00	17.50	210.33	16.55
SEm±	**0.10**	**0.02**	**2.26**	**0.53**	**1.20**	**0.29**
CD(P=0.05)	**NS**	**0.05**	**6.77**	**1.58**	**3.61**	**NS**

Effect on N, P, K and S content in seed and stover

Foliar application of nutrients showed significant increase in N content in seed (Table 3). Maximum N content in seed (6.70 %) was obtained from the application of 2% Urea + RDF and it was followed by spraying of 2% 19:19:19 (NPK) + RDF (6.58%). Increase in nitrogen content in seeds of soybean by foliar application of urea might be due to the additional supply of nitrogen

through foliar spray. This result is agreed with the findings of Agrawal and Narang (1975) who reported that top dressing and foliar application of urea enhanced the N uptake in soybean seeds. Highest P content in seed (0.48 %) was obtained with the application of 2% 19:19:19 (NPK) + RDF followed by 2% DAP + RDF (0.46%), 0.2% Boron + RDF (0.45%) and 0.5% MOP + RDF (0.44%). The effect on K content in seed by foliar application of nutrients was also found to be significant where application of 0.5% MOP + RDF recorded the maximum K content in seed (2.21%).

The enhancement of K content in seed may be due to the increase in the availability of K. The data also revealed that there was a significant effect on S content in seed. The maximum content of S in seed (0.37%) was recorded from the application of 2% 19:19:19 (NPK) + RDF.

N content in stover was highest (1.47%) with 2% Urea + RDF followed by 0.1% Mo + RDF and 2% 19:19:19 (NPK) + RDF. Nagajyothi *et al.,* (2013) reported higher uptake of N by soybean plants with the foliar application of urea @ 2 % at flowering and at early pod development stages.

Maximum P in stover (0.47 %) was recorded in 2% DAP + RDF followed by 2% 19:19:19 (NPK) + RDF. Mazhar and Antonio (2000) showed increment of tissue N–P–K composition, nutrient uptake, photosynthesis, or plant weight with foliar application of nutrients. Maximum K in stover (2.23 %) was recorded with the application of 0.5% MOP + RDF. Similar result has been reported by Pande *et al.,* (2014) who revealed that foliar application of potassium increased K concentrations in leaf tissues. Maximum S in stover (0.94%) was recorded from the application of 2% Urea+ RDF.

Effect on Soil fertility

The data on soil fertility presented in Table 4 show significant effects on available nitrogen in soil by the foliar nutrition. The highest available N in soil (332.33 kg ha^{-1}) was observed in the treatment 2% Urea + RDF followed by 2% DAP + RDF (328.67 kg ha^{-1}) and 0.5% MOP + RDF (327.67 kg ha^{-1}). The highest available phosphorus (22.7 kg ha^{-1}) in the soil was recorded with 2% DAP + RDF followed by 2% Urea + RDF and 2% 19:19:19 (NPK) + RDF. Similar result was reported by Muthuvel *et al.,* (1985) who suggested that application of foliar application of DAP @ 2% and urea @ 1% increased available N, P and K status of the soil. The highest available potassium in soil (237.73 kg ha^{-1}) was recorded with the application 2% 19:19:19 (NPK) + RDF followed by 0.5% MOP + RDF (236.60 kg ha^{-1}) and 2% DAP + RDF (234.67 kg ha^{-1}). No significant effect on available S content in soil was observed due to foliar nutrition.

Data on soil pH also did not show significant effect due to foliar application of nutrients. However, organic carbon in the soil at harvest showed significant effect where the highest organic carbon (1.97 %) was observed in the application of 2% 19:19:19 (NPK) + RDF.

In conclusion based on the result of this experiment it has been found that with the conjunctive application of 2% Urea + RDF showed highest plant height while 2% DAP + RDF produced maximum number of pods $plant^{-1}$. Foliar spray of 0.1% Mo + RDF recorded the highest number of root nodules, fresh weight and dry weight of the nodules $plant^{-1}$, while the highest seed and stover yield was produced by 2% 19:19:19 (NPK) + RDF. Foliar application of macro and micro nutrients improved soil fertility status compared to control. Application of 2% urea + RDF showed more available nutrients in

soil at harvest. The foliar application of nutrients found to be economical. The highest net return (Rupees 55290) was obtained from the application of 0.2% boron + RDF.

References

Agrawal, S. K. and Narang, R. S. 1975. Effect of levels of P and N on soybean varieties. *Journal of Research, Haryana Agricultural University*. 5(4): 303-308.

Anonymous. 2017. Statistical Handbook of Nagaland. Directorate of Economic Statistics, Government of Nagaland, Kohima.

Black, C. A, 1965. Methods of soil analysis. Part 1, American Society of Agronomy. Madison, Wisconsin, USA. 1572 p.

Chandrasekhar, C. N. and Bangarusamy, U. 2003. Maximizing the yield of mung bean by foliar application of growth regulating chemicals and nutrients. *Madras Agricultural Journal*. 90 (1-3): 142-145.

Chapman, H. D. and Pratt, P. F. 1962. Methods of analysis for soils, plants and water, University of California Agriculture Division.

Cochran, W. G. and Cox, G. M. 1957. Experimental Designs. *Willsey, New York*.

Dandge, M. S., Ingle, Y.V., Peshattiwar, P. D. and Dikey, H. H. 2018. Effect of foliar nutrition on soybean productivity. *International Journal of Chemical Studies*. 6(1): 1290-1292.

Garcia, R. L. and Hanway, J. J. 1976. Foliar fertilization of soybean during the seed-filling period. *Agronomy Journal*. 68: 653-657

Geetha, P. and Velayutham, A. (2009). Refinement of nutrient management techniques for growth, yield and nutrient uptake of rice fallow black gram. *Madras Agricultural Journal*. 96(1-6): 163-166.

Heidarrian, A. R., Kord, H., Khodadad, M., Amir, P. L. and Faezeh, A. M. 2011. Investigating Fe and Zn foliar application on yield and its components of soybean (*Glycine max)* at different growth stages. *Journal of Agricultural Biotechnology and Sustainable Development*. 3(9): 189-197.

Jackson, M. L. 1973. Soil Chemistry Analysis. Prentice Hall of India Pvt. Ltd., New Delhi, pp:503

Kalarani, M. K. (1991). Senescence regulation in soybean. M.Sc.(Ag.) Thesis, *Tamil Nadu Agricultural University*. 38: 92-95.

Kalpanade, V. G., Durge, D. V. and Thorat, A. W. 2010. Effect of foliar application of chemical fertilizer on growth parameters of soybean. *Anonymous Plant Physiology*. 24(1): 8-12.

Mandic, V. A., Simic, V., Krnjaja, Z., Bijelic, Z., Tomic, A., Stanojkovic, D. and Ruzic, M. 2015. Effect Of foliar fertilization on soybean grain yield. *Biotechnology in Animal Husbandry ISSN*. 31 (1): 133-143.

Mazhar, U. and Antonio M. P. 2000. Soybean yield and nutrient composition as affected by early season foliar fertilization. *Agronomy Journal*. 92 (1): 16-24.

Muthuvel, P., Sivasamy, R. and Subramanian, V. 1985. Mitigating the adverse effect of drought in rainfed blackgram. *Madras Agricultural Journal*.72 (1): 22-24.

Nagajyothi, C. H., Ravichandra, K. and Babu, K. S. 2013. Effect of foliar supplementation of Nitrogen and Zinc on soybean (*Glycine max*) yield, quality and nutrient uptake. *Indian Journal of Dryland Agriculture Research and Development*. 2: 46-48.

Pande, M., Mudlagiri, B. G. and Nacer, B. 2014. Effect of foliar and soil application of Potassium fertilizer on soybean seed protein, oil, fatty acids, and minerals. *American Journal of Plant Sciences*. 5: 541-548.

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