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Influence of foliar nutrition on growth, yield, nutrient uptake and post-harvest soil available nutirent of blackgram under irrigated condition

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Abstract
Field experiment was conducted at the Sittling Village, Harur Taluk, Dharmapuri District, Tamil Nadu during March - June, 2018 to study the influence of foliar nutrition on performance of blackgram under irrigated condition. The blackgram were subjected to foliar spray of organic and inorganic nutrients with plant growth regulators. The results of the experiment revealed that the growth and yield attributes and nutrient uptake of blackgram were favorably influenced by application of RDF + foliar spray of 2% DAP + 40 ppm NAA+ 0.5% chelated micronutrient at 30 and 45 DAS (T_{11}).

Keywords: nutrition on growth, blackgram under, irrigated condition

Introduction
Pulses are extremely significant in Indian agriculture. India is a leading producer of pulses. It is the world's leading producer, consumer, and exporter of pulses. To raise public awareness about the nutritional value of pulses and their contribution to environmental sustainability, The United Nations Food and Agricultural Organization had proclaimed 2016 as the 'International year of Pulses'. Blackgram is a significant pulse crop farmed in India during all three seasons (kharif, Rabi, and summer). It has a greater protein content (24-26%) and is said to be high in potassium (K), phosphorus (P), and calcium (Ca), as well as a good amount of sodium (Na) (Eswara Raghava Kumari *et al.*, 2018) [2]. Due to several physiological, biochemical, and intrinsic variables related with the crops, the potential of blackgram is quite limited (Devaraju and Senthivel, 2018) [1]. Foliar nutrition spray provides the crop nutrient requirement in efficient way. Foliar technique helps the nutrients to reach the site of utilization directly and gives immediate effect rather than soil application. Aside from that, foliar spray has the advantages of rapid and efficient nutrient usage, elimination of losses through leaching and fixing, and regulation of nutrient uptake by plants (Manonmani and Srimathi, 2009) [4].

Materials and Methods
Field experiment was conducted at the Sittling Village, Harur Taluk, Dharmapuri District, Tamil Nadu to study the influence of foliar nutrition on growth and yield of Blackgram (ADT 5) under irrigated condition during March – June, 2018. The experimental farm is geographically situated at 12° 03' North Latitude and 78° 29' East Longitude at an altitude of + 350 m above mean sea level. The soil of the experimental field is sandy clay loam, low in available Nitrogen, medium in available Phosphorus and high in available Potassium. The blackgram variety chosen for the experimental was ADT 5. Seeds were dibbled adapting a spacing of 30×10 cm with 5×4m plot size. The experiment comprised of eleven treatments viz., control (T_1), Application of RDF alone (T_2), Application of RDF + foliar spray of 2% DAP (T_3), Application of RDF + foliar spray of 2% urea (T_4), Application of RDF + foliar spray of 3% panchakavyam (T_5), Application of RDF + foliar spray of 1% salicylic acid (T_6), Application of RDF + foliar spray of 40 ppm NAA (T_7), Application of RDF + foliar spray of 0.5% chelated micronutrient (T_8), Application of RDF + foliar spray of 2% DAP + 1% salicylic acid (T_9), Application of RDF + foliar spray of 2% DAP + 0.5 % chelated micronutrient (T_{10}) and Application of RDF + foliar spray of 2% DAP + 40 ppm NAA+ 0.5% chelated micronutrient (T_{11}) at 30 and 45 DAS. The experiment was laid out in RBD with three replications. The foliar spraying was done as per treatment schedule on 30 and 45 DAS using hand operated knapsack sprayer and observations *viz*., growth attributes, nodulation, yield attributes and yield values were recorded at appropriate stages of crop.

Results and Discussion
Growth attributes
The growth components *viz.*, plant height, number of branches plant^{-1}, leaf area index, dry matter production and number of effective root nodules plant^{-1} were favourably influenced by the application of RDF + foliar spray of 2% DAP + 40 ppm NAA + 0.5% Chelated micronutrient at 30 and 45 DAS (T_{11}). This treatment was significantly superior in increasing the plant height (36.92 and 41.43 cm), number of branches plant^{-1} (7.30 and

8.71), leaf area index (3.18 and 3.81), dry matter production (2620 and 3554 kg/ha) at 45 DAS and harvest stage respectively and number of effective root nodules plant^{-1} (34.49) at flowering stage (Table 1). The least values of growth attributes were recorded with the treatment (T_1) control. Foliar spray of DAP and chelated nutrients enhanced macro and micronutrient accessibility throughout the crop growth period, which may have aided in escalating translocation into the crops without failure, resulting in improved photosynthetic activity and, ultimately, a significant increase in plant height. The increased number of branches and leaf area index could be attributed to a consistent supply of essential plant nutrients to the crop, as well as the allocation of moisture, a desirable soil physical environment, and the highest possible level of primary nutrients, which stimulated the auxillary buds to establish new shoots, resulting in improved photosynthetic activity. Enhanced food availability to plants led to greater plant growth in terms of plant height and leaf area, which resulted in increased DMP production. The current findings are consistent with those of previous studies of Rajesh *et al.*, (2014) [7], Ramesh *et al*. (2016) [8] and Gunasekar *et al*., 2018) [3].

Table 1: Influence of foliar nutrition on growth attributes of irrigated blackgram

Treatments	Plant height (cm) at harvest		Number of branches plant^{-1} at harvest		Leaf Area Index		Dry Matter Production (kg/ha)		Number of effective root nodules plant^{-1} (FS)
	45 DAS	Harvest	45 DAS	Harvest	45 DAS	Harvest	45 DAS	Harvest	
T_1	27.48	32.56	5.27	5.31	1.99	2.27	1731	2469	20.34
T_2	30.02	34.59	5.79	6.17	2.37	2.67	1934	2714	24.55
T_3	34.98	39.86	6.84	7.98	2.92	3.46	2462	3328	31.97
T_4	33.66	37.98	6.53	7.54	2.78	3.22	2363	3245	29.96
T_5	31.31	35.59	6.08	6.57	2.56	2.87	2107	2926	26.84
T_6	30.36	35.29	5.85	6.38	2.46	2.76	2016	2824	25.53
T_7	33.07	37.02	6.41	7.26	2.73	3.10	2274	3126	28.84
T_8	32.2	36.12	6.27	6.96	2.65	3.02	2186	3018	27.83
T_9	28.77	33.63	5.56	5.75	2.15	2.46	1834	2594	22.38
T_{10}	35.33	40.18	6.99	8.25	2.95	3.53	2512	3424	32.21
T_{11}	36.92	41.43	7.30	8.71	3.18	3.81	2620	3554	34.49
S. Ed	0.58	0.46	0.13	0.19	0.06	0.08	45.29	55.38	0.95
C.D (p=0.05)	1.22	0.97	0.29	0.41	0.13	0.18	94.21	115.2	1.98

Note: DAS – Days after Sowing; FS – Foliar Stage.

Yield attributes and Yield

Among the different treatments, application of RDF + foliar spray of 2% DAP + 40 ppm NAA+ 0.5% chelated micronutrient at 30 and 45 DAS (T_{11}) significantly recorded higher values of Yield attributing characters and Yield. This treatment recorded the highest pod number of 44.96 plant^{-1}, pod length of 6.02 cm, seeds number of 6.61 pod^{-1} and hundred grain weight of 4.34 g at harvest stage. And the recorded grain yield and halum yield was 938 and 1965 (kg/ha) (Table 2). Foliar spray of nutrients and growth regulators (DAP and NAA) improved the number of floral buds, inhibited floral shedding, and increased the number of pods by maintaining optimal bio-physiological conditions in plants. It's possible that number of pods plant^{-1} and pod length is attributable to nutrition supplementation at the critical time without physiological stress. The present findings were consistent with those of Uma Maheswari and Karthik (2017) [11] and Vijaykumar (2018). Suhathiya and Ravichandran (2018) [10] reported that the increased photosynthetic ability, which favoured and improved accumulation of dry matter, as well as efficient portioning of photosynthates towards sink, permitted larger halum and grain yields, could explain the increased yield features with macronutrients and micronutrients. The lowest grain yield observed under control (T1) could be attributed to a shortage of phosphorus and nitrogen delivery to the crop, which influenced the crop's growth and yield components, ultimately influencing on yield. The present results are in agreement with earlier findings of Marimuthu and Surendran (2015) [5], Muthal *et al.*(2016) [6] and Siva *et al.* (2017) [7].

Table 2: Influence of foliar nutrition on yield attributes and yield of irrigated blackgram

Treatments	Number of pods plant^{-1}	Pod length (cm)	Number of seeds pod^{-1}	Hundred grain weight (g)	Grain yield (kg/ha)	Haulm yield (kg/ha)
T_1	19.12	3.55	3.65	3.78	554	1303
T_2	26.17	4.21	4.50	3.92	658	1454
T_3	39.53	5.48	6.02	4.20	845	1849
T_4	36.15	5.11	5.59	4.14	795	1765
T_5	29.84	4.60	4.82	3.99	718	1579
T_6	27.95	4.39	4.68	3.96	689	1522
T_7	34.16	4.98	5.31	4.07	765	1705
T_8	32.15	4.87	5.02	4.05	737	1638

T_9	22.67	3.89	4.09	3.87	598	1375
T_{10}	41.04	5.63	6.10	4.23	860	1875
T_{11}	44.96	6.02	6.61	4.34	938	1965
S.Ed	0.69	0.19	0.19	-	14.92	32.88
C.D (p=0.05)	3.52	0.32	0.41	NS	31.03	68.38

NS - Non Significant

Nutrient uptake and nutrient status of post-harvest soil

The significantly higher plant nutrient uptake values was recorded with treatment (T_{11}) application of RDF + foliar spray of 2% DAP + 40 ppm NAA+ 0.5% chelated micronutrient at 30 and 45 DAS. The nitrogen, phosphorus and potassium uptake values of treatment (T_{11}) were 69.3, 11.8 and 52.2 (kg/ha) respectively (Table 3). Easy availability and absorption of foliar nutrients in the plant system enhanced the growth of the crop and the crop thereby leading to better uptake of nutrients. Also, it's possible that the treatment of micronutrients in the form of foliar spray worked well and helped the plant absorb other nutrients in a balanced proportion, resulting in higher N, P, and K concentrations in the plant. Whereas the lower values were recorded with the treatment (T_1) control due to non-availability of appropriate delivery of nutrients to the crop, particularly nitrogen and phosphorus. The results of the present finding are in agreement with the report of Girish Chandra Pathak *et al*. (2012) and Mudalagiriyappa *et al*. (2016) [6]. However the available nitrogen in the experimental field was low, the available phosphorus was medium, and the available potassium was high, the recorded values of available post-harvest soil nutrients status of different treatments were significant. Among the different treatments, application of RDF + foliar spray of 2% DAP + 40 ppm NAA+ 0.5% chelated micronutrient at 30 and 45 DAS (T_{11}) significantly recorded higher post-harvest soil available nutrients values of 220.7, 19.0 and 242.6 (kg/ha) of N, P and K respectively (Table 4). The treatment (T_1) control recorded the least values. The increase the higher nutrient uptake, better growth and yield parameters and full dose of NPK which maintained available soil nutrient status, besides that foliar application of DAP and chelated micronutrient at critical stage might compensate the crop nutrient requirement. The outcomes are consistent with the findings of Ramesh *et al*., (2016) [8], Krishnaprabhu (2018) and Paikra *et al*. (2018).

Table 3: Influence of foliar nutrition on nutrient uptake of irrigated blackgram

Treatments	Nutrient uptake (kg ha^{-1})		
	N	P	K
T_1	39.3	6.7	27.0
T_2	45.6	8.6	32.1
T_3	61.7	10.9	48.75
T_4	52.5	10.2	37.2
T_5	47.5	8.9	33.8
T_6	46.8	8.7	32.7
T_7	51.8	10.0	36.7
T_8	51.0	9.7	36.0
T_9	42.3	7.3	29.3
T_{10}	62.5	11.2	49.6
T_{11}	69.3	11.8	52.2
S.Ed	1.24	0.25	0.68
C.D (p=0.05)	2.61	0.54	1.42

Table 4: Influence of foliar nutrition on post-harvest soilavailable nutrients of irrigated blackgram

Treatments	Post-harvest soil available nutrients (kg ha^{-1})		
	N	P	K
T_1	154.5	14.6	180.9
T_2	205.3	15.7	193.6
T_3	198.2	18.1	227.9
T_4	194.9	17.9	219.3
T_5	180.1	16.8	204.9
T_6	179.2	16.5	206.1
T_7	193.8	17.7	218.5
T_8	181.5	16.9	207.3
T_9	165.5	15.5	192.3
T_{10}	208.5	18.4	231.4
T_{11}	220.7	19.0	242.6
S.Ed	4.88	0.16	4.7
C.D (p=0.05)	10.15	0.33	9.78

Conclusion

Based on the findings of this study, it can be determined that the use of RDF + foliar spray of 2% DAP + 40 ppm NAA + 0.5% Chelated micronutrient (T_{11}) at 30 and 45 DAS under irrigated conditions, greatly altered the growth, yield, nutrient uptake, and economics of blackgram. In case of salicylic acid, it showed phytotoxic effect on the crop as an evidenced by reduction in growth and yield characters in the application of RDF + foliar spray of 1% salicylic acid + 2% DAP (T_9) when compared to the application of RDF + foliar spray of 1% salicylic acid (T_6). Hence, there was a need to study the interaction of DAP and salicylic acid at various levels.

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