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Effect of foliar nutrition on yield maximization strategies for irrigated blackgram cv. ADT 3

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Abstract
A field experiment was conducted to study the yield maximization strategies for irrigated blackgram cv. ADT 3, through foliar nutrition during February-April 2016, at the experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai University. The experiment was laid out at randomized block design (RBD) having three replications. The result revealed thatT_8(Foliar application of pulse wonder one per cent on 50 per cent flowering) recorded higher values of growth components (*viz.*, plant height, leaf area index, dry matter production, number of branches per plant), yield attributes (*viz.*, number of branches, number of pods plant^{-1}, number of seeds pod^{-1}), seed and haulm yield. This was followed byT_5 (Foliar application of humic acid two per cent on 50 per cent flowering). The T_1 (Control) resulted in lowest values of these yield components. The highest net return ha^{-1} and benefit cost ratio (2.83) were obtained T_8(Foliar application of pulse wonder one per cent on 50 per cent flowering and T_1 (Control) registered the least net return ha^{-1} and benefit cost ratio (1.49).

Keywords: Maximization, foliar, pulse wonder, humic acid

Introduction
Generally, pulses are rich in protein, fibre, vitamins, minerals and was found to be main source of protein to people. It is the second important constituent of Indian diet next to cereals. Pulses are resistant to adverse climatic conditions and it improves the soil fertility by fixing atmospheric nitrogen in the soil. India is the world's largest producer as well as consumer of the blackgram. Blackgram is cultivated in 35 million hectares of area with an average productivity of 600 kg ha^{-1}. It accounts for about 10 per cent of India's total pulse production MoA (2012) [9]. The productivity of blackgram is low in general due to poor nutrient management and low soil fertility. The slow growth of pulse production in the country could be due to various physiological, biochemical and inherent factors. The growth phase of blackgram is often obstructed by the slow translocation of assimilates with in the crop, insufficient partitioning of assimilates, poor pod setting due to flower abscission and lack of nutrient during critical stages of crop growth play a vital role in blackgram production Mahala *et al.* (2001) [6]. Several strategies have been initiated to boost the productivity of blackgram. One among them is foliar application of organic and inorganic sources of nutrients for exploiting genetic potential of the crop. This is considered to be an efficient and economic method of supplementing part of the nutrient requirement at critical stage. Khodadad and Mostafavi (2012) [3] reported that use of micronutrients like Zinc (Zn), Iron (Fe), Boron (B), Manganese (Mn), Molybdenum (Mo), Copper (Cu), Cobalt (Co) and Nickel (Ni) has now become a common practice to increase crop yield especially under adverse environmental conditions in pulses. Plants deficient in micronutrients may become susceptible to diseases and biotic stresses. Foliar spray of micronutrients improve flowering, pollen production capacity, pollen viability, stigma receptivity and pollen-stigma interaction and also increased the yield parameters like numbers, size and weight of pod and seeds (NaliniPandy and Bhavana Gupta, 2012) [10].

Materials and Methods
Field experiment was conducted in the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, during February-April 2016with three replications. The treatments comprises of T_1-control, T_2-Foliar application of 2 per cent DAP spray on 50 per cent flowering, T_3- Foliar application of NAA @ 30 per cent ppm spray on 50 per cent flowering, T_4- Foliar application of fulvic acid @ 0.5 per cent spray on 50 per cent flowering, T_5- Foliar application of humic acid @ 2 per cent spray on 50 per cent flowering, T_6- Foliar application of panchakavya @ 5 per cent spray on 50 per cent flowering, T_7- Foliar application of vermiwash @ 2 per cent spray on 50 per cent flowering, T_8- Foliar application

of pulse wonder @ 1 per cent spray on 50 per cent flowering. The foliar spraying of DAP @ 2 per cent, NAA @ 30 ppm, fulvic acid spray @ 0.5%, humic acid @ 2%, panchakavya @ 5%, vermiwash @ 2% and pulse wonder @ 1% was done as per treatment schedule on 50% of flowering using hand operated hand sprayer. The following observation were taken to study the impact of foliar nutrient management practices on the growth components, yield attributes, seed and haulm yield of blackgram. The data's are statistically analysed and the following interpretations are arrived.

Results and Discussion

Growth attributes

Among the various treatments imposed in the study, foliar application of pulse wonder spraying 1 per cent (T_8) at all stages of crop growth was found to be significantly superior over other treatment regarding plant height, leaf area index, dry matter production, number of branches per plant on 30, 45 and at harvest respectively(Table 1). The lowest was recorded in control (T_1).

Foliar application of pulse wonder might have provided availability of iron, boron and plant growth hormones for blackgram which in turn might have resulted in vigorous root, cell wall, plasma membrane, enhancement of cell division, tissue differentiation and metabolism of nucleic acid, carbohydrate and shoot initiation reflecting upon enhanced Crop growth and establishment in terms of plant height. This may be due to the combination of nutrients and growth regulators present in pulse wonder. The nutrient and growth regulator present in the foliar spray play a major role in growth development and metabolism of blackgram. This was in conformity with findings of Marimuthu and Surendran (2015) [7].

Table 1: Effect of foliar nutrition on growth characters of irrigated blackgram

Treatments	Plant height (cm)			LAI			Dry matter accumulation (kg ha^{-1})			Number of branches plant^{-1}
	30 DAS	45 DAS	Harvest	30 DAS	45 DAS	Harvest	30 DAS	45 DAS	Harvest	
T_1	11.67	24.46	35.99	0.97	1.19	1.63	993	1483	1863	2.17
T_2	14.51	28.55	42.85	1.94	2.72	3.92	1641	2300	3309	6.83
T_3	13.99	27.76	41.55	1.86	2.44	3.55	1440	2038	3074	5.94
T_4	12.21	25.23	37.39	1.24	1.45	1.94	1058	1567	2199	3.13
T_5	15.14	29.39	44.22	2.02	3.11	4.53	1798	2439	3601	7.81
T_6	13.42	26.9	40.17	1.75	2.01	2.97	1291	1892	2991	5.31
T_7	12.77	26.08	38.76	1.52	1.71	2.35	1153	1676	2593	4.33
T_8	15.70	30.18	45.53	2.19	3.52	4.92	1936	2638	3836	8.54
S.Ed	0.21	0.34	0.51	0.02	0.07	0.10	20.73	29.46	42.55	0.22
C.D (p=0.05)	0.45	0.73	1.09	0.05	0.15	0.21	44.46	63.18	91.25	0.46

The foliar application of pulse wonder might have promoted higher uptake and utilization of essential plant nutrients for enhanced photosynthates production and further crop canopy establishment. It might be the probable reason for resultant enhanced values of leaf area index with this treatment. The enhancement effect of foliar application might be attributed to the favorable influence of these nutrients on metabolism and biological activity and its stimulation effect on photosynthetic pigments and enzymes activity which in turn encourage vegetative growth of plants Michail *et al.* (2004) [8]. The appreciable increments in respect of plant height and leaf area index noticed in this treatment have positively reflected upon enhanced crop dry matter production. The results are in line with findings of Arif *et al.* (2006) [1] and Kobrace *et al.* (2011). The absence of micronutrients, plant hormones and auxin in control (T_1) might be the reason for the lower value of growth components. Similar findings were reported by Nautiyal and Chatterjee (2004) [11].

Yield attributes and yield

Among the treatments foliar application of one per cent pulse wonder spray (T_8) significantly recorded higher number of seeds pod^{-1} thus resulted in higher grain yield and haulm yield (Table 2). Foliar application of micronutrients have important role in increasing the number of seeds pod^{-1}. This is due to the increase photosynthetic activity and translocation of photosynthate or nutrients rapidly to the grain. These findings are in accordance with the results of Kumar *et al.* (2008) [5] and Seifinader Ghali *et al.* (2011). Poor accumulation of photosynthesis from source to sink due to absence of N, P and K, micro nutrients in control (T_1) might have resulted in lower values of varied.

The increased yield might be due to enhanced yield attributes like number of pods plant^{-1}, number of seeds pods^{-1} and due to increased uptake of nutrients by effective translation of nutrients from sink to reproductive area of crop which inturn reflected on enhanced seed yield of blackgram. These findings are in accordance with the result of Pandey and Gupta (2013) [12].

Foliar application of various nutrients had significant influence on the haulm yield. The haulm yield enhancement was due to the continuous supply of nutrients which in turn increased the leaf area and dry matter production resulting in higher haulm yield. The results are in line with the findings of Shanti *et al.* (2008) [14] in blackgram.

Moreover the presence of molybdenum stimulated rhizobium activity resulting in this increased the nitrogen concentration in the plant. This increased the nitrogen content in plants. The zinc present in pulse wonder enhanced the tissue potassium concentration there by increased NPK uptake. This was in accordance with finding EI-Fouly *et al.* (2001) [2].

Foliar application of pulse wonder @ 1 per cent on 50 per cent flowering (T_8) recorded the highest N, P and K uptake which might be due to the easy available and absorption of foliar nutrients without spending much energy for their transport and without any loss in transits.

Table 2. Effect of foliar nutrition on growth characters of irrigated blackgram

Treatments	Number of seeds pod^{-1}	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
T_1	5.12	436	1468
T_2	7.03	785	1714
T_3	6.73	713	1677
T_4	5.58	506	1505
T_5	7.44	841	1757
T_6	6.46	676	1649
T_7	6.09	578	1536
T_8	7.96	891	1802
S.Ed	0.12	8.74	11.06
C.D (p=0.05)	0.27	18.74	23.72

Economics

Through registering higher seed yield, foliar application of pulse wonder @ 1 per cent on 50 per cent flowering (T_8) recorded the higher monetary returns in terms of net income (Rs. 46161) and benefit cost ratio (Rs. 2.83), followed by the cost benefit cost ratio was observed under the control treatment might be due to reduced seed yield resulting in lesser gross income and net returns (Table 3).

Table 3: Effect of foliar nutrition on irrigated blackgram on net income (Rs.ha^{-1}) and benefit cost ratio

Treatments	Cost of Cultivation (Rs.ha^{-1})	Gross Income (Rs.ha^{-1})	Net Income (Rs.ha^{-1})	BCR
T_1	23344	34880	11536	1.49
T_2	24424	62800	38376	2.57
T_3	24239	57040	32801	2.35
T_4	23630	40480	16850	1.71
T_5	24737	67280	42543	2.71
T_6	24103	54080	29977	2.24
T_7	23893	46240	22349	1.93
T_8	25119	71280	46161	2.83

Conclusion

In the light of the above facts, it may be concluded foliar application of pulse wonder spray at one per cent on 50 per cent flowering had a remarkable effect on the growth, yield components, seed and haulm yield and nutrient uptake of blackgram with the higher monetary returns of net income (Rs. 46161) and benefit cost ratio (Rs. 2.83). It is an effective practice for augmenting higher yield in blackgram.

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