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Influence of foliar nutrition on growth and yield of blackgram under rainfed condition

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Abstract
Field experiment was conducted to investigate the effect of foliar nutrition on growth and yield of rainfed blackgram. The treatments *viz.*, foliar spray of 2.0% Urea (T_1), 2.0% MAP (T_2), 1% K_2SO_4 (T_3), 0.3% $MgSO_4$ (T_4), 0.3% MnSO4 (T_5), 0.5% $ZnSO_4$ (T_6), 0.02% Boric acid (T_7), 0.5% $FeSO_4$ (T_8), 0.05% Na_2MoO_4 (T_9), 2.0% 19:19:19 Mixture (T_{10}), Pulse magic @ 10 g/l (T_{11}), Control (T_{12}) and Absolute control (T_{13}). Foliar spray was taken at flowering stage. Basal dosage of fertilizer 25:50 kg N: P_2O_5 ha^{-1} was applied to all plots except absolute control. Among the treatments, foliar spray of Pulse magic @ 10 g/l had the profound effect in improving the growth attributes and further, growth attributes are positively co related to seed yield. Consequetly, foliar spray of Pulse magic @ 10 g/l recorded the highest yield of 1101 kg/ha with a yield increment of 23% over control. The yield enhancement might be due to the improvement in growth traits and yield attributes.

Keywords: Flowering stage, foliar nutrition, pulse magic, seed yield

Introduction
Blackgram is an important short duration pulse crop extensively growing in North eastern dry zone of Karnataka under rainfed condition. It is widely grown as a grain legume and belongs to the family fabaceae and assumes considerable importance from the point of food and nutritional security. The productivity of the crop is declining over years due to various reasons. Among all the yield limiting factors, fertility management is imperative to ensure better crop production on exhausted soils. Farmers generally take up sowing with basal application of nutrients as recommended and there is no regional recommendation of foliar nutrition during crop growth period. Further, soil application of nutrients is often not enough to meet the growing crop demand particularly in short duration crop like blackgram, as it is basically indeterminate in habit of flowering and fruiting, there is a continuous competition for available assimilates between vegetative and reproductive sinks throughout the growth period. Since, the source is highly limited with lowering translocation of assimilates to the growing reproductive parts. Hence, leaf area is a important parameter to obtain higher source in terms of higher assimilation production, it also determines light interception and is an important parameter in deciding plant productivity [4, 8]. Apart from this, major physiological constraints are flower drop and fruit drop [13]. As it is majorly cultivated under rainfed condition even application of fertilizer at right time and right quantity may not be efficient due to soil moisture. When availability of moisture becomes scarce, application of fertilizers through foliar spray resulted in efficient absorption. Though foliar spray is not a substitute to soil application but it certainly be considered as a supplement to soil application [24] and availability of soluble fertilizers make the task easy. Among the methods of fertilizer application, foliar nutrition is recognized as an important method of fertilization, since foliar nutrients usually penetrate the leaf cuticle or stomata and enters the cells facilitating easy and rapid utilization of nutrients [9]. Due to this reason, potential productivity is not achieved and hence there is a need to ensure balanced nutrition at right time to the crop through foliar nutrition. Consequently, applications of nutrient elements through foliar spray at appropriate stages of growth become important for their efficient utilization and better performance of the crop as a balanced fertilization with nutrients in plant nutrition is very important in the production of high yield with high quality seeds [17]. It has been well established that the fertilizer elements which are absorbed through roots can also be absorbed with equal efficiency through foliage [3]. However scare literature is available regarding the response of blackgram to foliar spray of water soluble fertilizers and/ or mixture of fertilizer and plant growth regulator along with soil application of fertilizers. Hence, this study was taken on priority to see the influence of foliar nutrition on blackgram in rainfed condition.

Material and methods

The field experiment was conducted during *kharif* 2016 at Agricultural Research Station, Kalaburagi, UAS Raichur under rainfed condition. It is situated at a latitude of 17° 34' North, longitude of 76^0 79' East and an altitude of 478 meters above mean sea level. The soil of the experiment site is clayey (Soil pH 8.3; EC 0.21 dSm^{-1}). The available soil nitrogen, phosphorus and potassium were 241, 14.9 and 280 kg ha^{-1}, respectively. The experiment was laid out in Randomized Complete Block Design (RCBD) with 13 treatments. The treatments *viz.,* foliar spray of 2.0% Urea (T_1), 2.0% MAP (T_2), 1% K_2SO_4 (T_3), 0.3% $MgSO_4$ (T_4), 0.3% MnSO4 (T_5), 0.5% $ZnSO_4$ (T_6), 0.02% Boric acid (T_7), 0.5% $FeSO_4$ (T_8), 0.05% Na_2MoO_4 (T_9), 2.0% 19:19:19 Mixture (T_{10}), Pulse magic @ 10 g/l (T_{11}) (Product developed and released by UAS, Raichur for increasing the yield of pulse crops. It contains 10 percent nitrogen, 40 percent phosphorous, 3 percent micronutrient and 20 PPM plant growth regulator), Control (T_{12}) (only recommended dose of fertilizers) and Absolute control (T_{13}) (No fertilizer and no foliar spray) with 3 replications using TAU-1 variety with spacing of 30×10 cm. Foliar spray was carried out at flowering stage. Basal dosage of fertilizer 25:50 kg N: P_2O_5 ha^{-1} was applied to all plots except absolute control. The leaf area per plant was worked out by disc method on dry weight basis [25], TDMP was arrived after keeping the sample in oven at 80° C for 48 hours. Absolute Growth Rate (AGR), Crop Growth Rate (CGR) and Leaf Area Duration (LAD) were calculated by adopting the procedure described by Radford [16], Watson [26] and Power [15], respectively. Harvest index (HI) was also arrived by the ratio of economic yield to the biological yield. The data were analysed statistically using the 'F' test and critical difference (C.D) was calculated [14].

Results and discussion

There was no significant difference upto flowering stage among the treatments except absolute control (T_{13}) realising the importance of nutrition. There were significant differences observed among all the treatments when foliar nutrition was given. The plant height was increased as the life cycle of the crop proceeds due to its indeterminate nature of growth habit. The foliar application of pulse magic and zinc sulphate recorded highest plant height of 35.5 and 31.1 cm, respectively at harvest (Table 1). This is due to the stimulating action of auxin as zinc is promoter of auxin which softens the cell wall by increasing in its plasticity followed by hydrolysis of starch to sugars which lowers the water potential of cell, resulting in the entry of water into the cell causing elongation [10].

The maximum Leaf area at peak flowering contributes to better yielding ability in grain legumes [23], which is a pre-requisite to maximise the photosynthetic activity. Pulse magic (T_{11}) sprayed plants maintained more leaf area (Table 1) at different stages of crop growth and it was highest (5.94 dm^2 $plant^{-1}$) at 55 DAS. As crop reaches towards maturity leaf area declines due to the onset of senescence phenomenon [7, 20]. These results are quite similar in blackgram due to foliar application of combination of nitrogen and PGR [21].

The first prerequisite for higher yields is an increase in the total dry matter production (TDM) per unit area. Dry matter accumulation is an important index reflecting the growth and metabolic efficiency of the plant which ultimately influence the yield of crop. The amount of TDM produced is an indication of the overall efficiency of utilization of resources and better light interception. Due to presence of various nutrients and PGR in pulse magic might have governed the various physiological characters that ultimately increased the dry matter production at various stages of crop growth by increasing the various growth indices and it was more at harvest (23.74 g $plant^{-1}$) due to more dry accumulation dry matter in pods (Table 1). Foliar application of macronutrients along with PGR at flowering stage significantly increased TDM in greengram [1] and this was quite in line with findings of our present results. Similarly, in blackgram higher TDM was recorded due to foliar application of combination of nitrogen and PGR [21].

The foliar nutrition has significant influenced on growth indices *viz.,* AGR, CGR and LAD at all growth stages (Table 2). Dry matter production per unit time was an indication of AGR. Among the treatments, foliar spray of pulse magic @ 10 g/ l (T_{11}) recorded a maximum AGR (0.723 g day^{-1}) followed by 19:19:19 mixture @ 2% (T_{10}) (0.470 g day^{-1}) at 55 DAS-Harvest. Similarly, in pigeonpea due to urea spray similar findings were reported [2]. Crop production is determined by CGR as a function of light interception by the leaf area of a crop [27] and is influenced by leaf area index, photosynthetic rate and leaf angle. Interaction of phytohormones and nutrients on growth and development of crop plants cause positive responses on plant growth rate [11]. Similarly, in the present study the higher CGR (0.095 g dm^{-2} day^{-1} at 35-55 DAS and 0.239 g dm^{-2} day^{-1} at 55 DAS-Harvest) was obtained with foliar application of combination of nutrients and PGR (T_{11}) and in blackgram similar results were obtained due to foliar application of mixture of nutrients and PGR. Sritharan *et al.* (2015) in blackgram also reported the same due to foliar application of urea followed by combination of nutrients and PGR [18].

Maintenance of higher LAD has a positive effect on dry matter production and ultimately resulting in higher yield [5]. The increase in CGR due to chemical spray may be attributed to increased LAD produced by them. The increasing LAD could be attributed to retention of leaves for longer duration. Similarly, the increase in leaf area duration was observed in blackgram due to foliar application mixture of nutrients and PGR was observed in blackgram [18].

Seed yield governed by number of factors which have direct or indirect impacts. The improvement in seed yield is achieved through improvement in yield attributing characters *viz.,* pod weight per plant, number of pods per plant, number of seeds per pod, pod length and test weight.

In the present investigation, foliar application of pulse magic @ 10g/l (T_{11}) has increased the yield attributing characters and it may be due to the higher leaf area as it is a major source for supplying assimilates to developing organs and seeds in crops. These results of positive relationship between leaf area and seed yield (Fig. 1) are similar to the present findings in mungbean [12]. Foliage applied macro and micronutrients at critical stages of the crop were effectively absorbed and translocated to the developing pods, producing more number of pods and better filling in soybean [6]. Similarly, higher number of pods per plant (38.0) were absorved in pulse magic foliar spray and it is due to the application of nutrients at reproductive stage has helped in more translocation of photosynthates to the developing pods which has also helped in better filing thus increasing number of seeds per pod (8.7), due to increase in number of seeds per pod there was increase in pod length (6.1 cm) and due to the better filling of seeds test weight of the seeds has also increased to the extent of 13 percent. Due to increase in yield attributing characters, which finally increased the seed yield (1101 kg ha^{-1}) **(**Fig. 1 and

Table 3) to the extent of 23 percent compared to control. The similar results of increment in yield due to foliar application of pulse magic in pigeonpea was reported [22]. Application of nutrients and growth regulator increased the grain yield and thereby resulting increased HI values. The increased HI (38.91) might be due to the increased mobilization of metabolites to reproductive sinks. In conclusion, the present study demonstrated that foliar spray of pulse magic @ 10 g/l at flowering stage was found to be optimum for obtaining maximum yield in blackgram and it can also be concluded that there exists a positive co-relation between leaf area an seed yield.

Table 1: Influence of foliar nutrition at flowering stage on plant Height, Leaf area and Total dry matter production at various growth stages in blackgram.

Treatments	Plant height (cm)			Leaf area (dm^2 $plant^{-1}$)			Total dry matter (g $plant^{-1}$)		
	35 DAS	55 DAS	At harvest	35 DAS	55 DAS	At harvest	35 DAS	55 DAS	At harvest
T_1	8.4	26.2	28.5	2.78	5.35	1.41	3.52	8.27	16.77
T_2	8.3	26.1	29.4	2.79	5.38	1.42	3.55	8.34	17.48
T_3	8.5	25.3	29.0	2.80	5.23	1.34	3.55	8.04	15.85
T_4	8.4	25.8	28.8	2.82	5.19	1.32	3.58	7.96	15.23
T_5	8.2	26.5	29.6	2.83	5.17	1.29	3.57	7.92	15.03
T_6	8.4	31.3	35.1	2.73	5.40	1.38	3.45	8.28	15.80
T_7	8.2	26.0	29.4	2.78	4.63	1.09	3.50	7.05	11.14
T_8	8.4	26.1	29.6	2.81	5.25	1.36	3.56	8.08	15.23
T_9	8.3	25.4	28.6	2.77	4.70	1.12	3.52	7.17	11.42
T_{10}	8.4	25.8	29.2	2.83	5.48	1.44	3.57	8.52	17.89
T_{11}	8.3	31.7	35.5	2.75	5.94	1.60	3.51	9.26	23.74
T_{12}	8.1	25.2	28.3	2.74	4.54	1.07	3.48	6.93	10.73
T_{13}	5.7	17.0	19.0	1.87	2.70	0.87	2.32	4.17	6.07
S.Em (±)	0.2	1.8	1.8	0.09	0.14	0.04	0.11	0.23	0.89
C.D. at 5%	0.8	5.2	5.3	0.26	0.43	0.14	0.32	0.67	2.59

DAS- Days after sowing

Table 2: Influence of foliar nutrition at flowering stage on Absolute growth rate, Crop growth rate and Leaf area duration at various growth stages in blackgram

Treatments	Absolute Growth Rate (g day^{-1})		Crop Growth Rate (g dm^{-2} day^{-1})		Leaf Area Duration (Days)	
	35 DAS-55 DAS	55 DAS- At harvest	35 DAS-55 DAS	55 DAS- At harvest	35 DAS-55 DAS	55 DAS- At harvest
T_1	0.237	0.427	0.078	0.140	27.0	22.5
T_2	0.241	0.453	0.080	0.150	26.7	22.6
T_3	0.224	0.390	0.074	0.129	26.2	21.9
T_4	0.219	0.363	0.071	0.120	26.8	21.6
T_5	0.218	0.353	0.072	0.117	25.9	21.5
T_6	0.242	0.373	0.080	0.124	26.5	22.6
T_7	0.177	0.207	0.058	0.068	23.6	19.1
T_8	0.225	0.360	0.074	0.118	27.5	22.0
T_9	0.181	0.213	0.060	0.070	24.1	19.4
T_{10}	0.247	0.470	0.081	0.155	27.0	23.1
T_{11}	0.286	0.723	0.095	0.239	28.8	25.0
T_{12}	0.172	0.190	0.057	0.063	23.5	18.7
T_{13}	0.092	0.097	0.030	0.031	16.4	11.9
S.Em (±)	0.012	0.037	0.004	0.012	0.5	0.6
C.D. at 5%	0.036	0.111	0.011	0.035	1.6	1.8

DAS- Days after sowing

Table 3: Influence of foliar nutrition at flowering stage on yield components and yield in blackgram.

Treatments	Pod weight $plant^{-1}$ (g)	No. of pods $plant^{-1}$	No. of seeds pod^{-1}	Pod length (cm)	Test weight (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
T_1	11.28	30.8	6.9	5.1	51.0	1002	2727	36.74
T_2	11.94	32.3	7.0	5.1	49.7	1013	2782	36.99
T_3	10.55	29.3	6.8	5.0	50.5	982	2711	36.22
T_4	10.02	29.0	6.6	4.8	49.4	979	2721	36.31
T_5	9.90	28.8	6.7	4.9	49.9	976	2718	35.92
T_6	10.38	29.9	6.8	5.0	49.4	986	2711	36.37
T_7	6.66	25.2	4.9	3.6	47.0	909	2669	34.07
T_8	9.88	29.9	6.7	4.9	49.7	985	2712	36.34
T_9	6.87	25.6	5.0	3.7	47.7	913	2672	34.54
T_{10}	12.27	33.0	7.1	5.2	51.0	1018	2736	37.22
T_{11}	17.58	38.0	8.7	6.1	55.1	1101	2829	38.91
T_{12}	6.33	24.3	4.8	3.6	48.4	894	2665	33.17
T_{13}	3.09	17.0	3.0	2.2	16.6	482	1629	29.61
S.Em (±)	0.86	1.5	0.5	0.2	1.3	27	81	1.06
C.D. at 5%	2.52	4.3	1.5	0.7	4.0	80	238	3.08

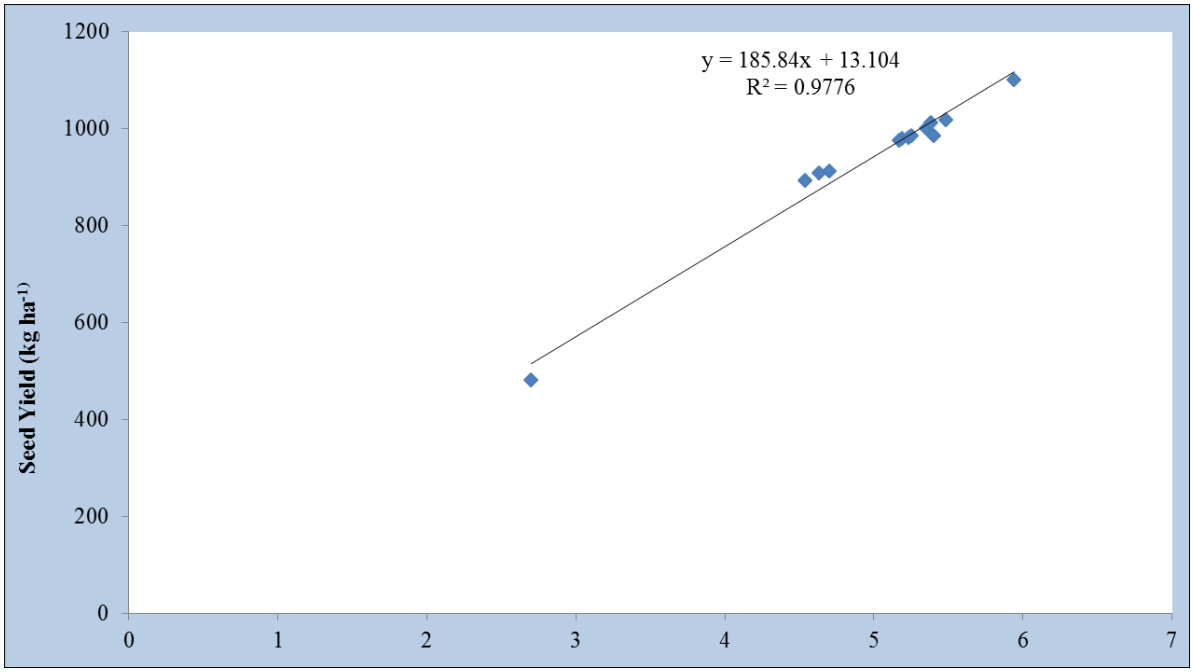

Fig 1: Correlation between leaf area at 55 DAS and seed yield

References

1. Chandrasekhar CN, Bangarusamy U. Maximizing the yield of mungbean by foliar application of growth regulating chemicals and nutrients, Madras Agric. J., 2003; 90(1-3):142-145.
2. Gagandeep K, Navita G, Jagmeet K, Sarvjeet S. Growth efficiency and yield of pigeonpea (*Cajanus cajan* L.) as affected by foliar application of mineral nutrients, J. Pl. Sci. Res., 2015; 2(2):1-9.
3. Ganapathy M, Baradhan G, Ramesh N. Effect of foliar nutrition on reproductive efficiency and grain yield of rice fallow pulses, Legume Res., 2008; 31(2):142-144.
4. Gifford RM, Thorne JH, Hitz WD, Giaquinta, RT. Crop productivity and photoassimilate partitioning, Science, 1984; 24:801-808.
5. Gopal Singh G, Jainarain Singh. Effect of seasonal changes on growth parameters of greengram. Indian J. Plant Physiol., 1982; 25(4):382-389.
6. Jayabel A, Revathy M, Saxena, MG. Effect of foliar nutrition on nutrient uptake pattern in soybean, Andhra Agric. J. 1999; 46:243-244.
7. Kalarani MK. Senescence regulation in soybean, M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, 1991.
8. Koester RP, Skoneczka JA, Cary TR, Diers BW, Ainsworth EA. Historical gains in soybean (*Glycine max* Merr.) seed yield are driven by linear increases in light interception, energy conversion and partitioning efficiencies, J. Exp. Bot. 2014; 65:3311-3321.
9. Latha MR, Nadanassababady T. Foliar nutrition in crops, Agric. Rev. 2003; 24(3):229-234.
10. Meena MK, Chetti MB, Naik DS. Nawallagatii CM. Role of plant growth regulators in agriculture: A review on morpho-physiological, quality and yield parameters in Crops. Res. J. Agric. Sci., 2012; 3(2):316-321.
11. Mir MR, Mobin M, Khan NA, Bhat MA, Lone NA, Bhat KA *et al*. Crop responses to interaction between plant growth regulators and nutrients. J. Plant Physiol. 2010; 2:9-19.
12. Mondal MMA, Fakir MSA, Ismail MR. Ashrafuzzaman. Effect of defoliation on growth, reproductive characters and yield in mungbean, Austrailian J. Crop Sci. 2011; 5(8):987-992.
13. Ojeaga OO, Ojehomon. Fruit absicission in cowpea (*Vigna ungiculata* (L) wasp.). J. Exp. Bot. 1972; 23:751-761.
14. Panse VG, Sukhatme PV. Statistical methods for agricultural workers, Indian Council of Agrcultural Research, New Delhi. 1967, 145-150.
15. Power JE, Wills WO, Granes DL, Reichman GA. Effect of soil temperature, phosphorus and plant age on growth analysis of barley, Agron. J. 1967; 59:231-234.
16. Radford DJ. Growth analysis formulae: their use and abuse, Crop Sci. 1967; 7:171-175.
17. Sawan ZM, Hafez SA, Basyony AE. Effect of phosphorus fertilization and foliar application of chelated zinc and calcium on seed, protein and oil yields and oil properties of cotton, J. Agric. Sci., 2001; 136:191-198.
18. Shashikumar R, Basavarajappa SR, Salakinkop, Hebbar M, Basavarajappa MP, Patil HY. Influence of foliar nutrition on performance of blackgram (*Vigna mungo* l.) nutrient uptake and economics under dry land ecosystems, Legume Res., 2013; 36(5):422-428.
19. Sritharan N, Rajavel M, Senthilkumar R. Physiological approaches: Yield improvement in blackgram, Legume Res., 2015; 38(1):91-95.
20. Sujatha KB. Effect of foliar spray of chemical and bioregulators on growth and yield of greengram, M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, 2001.
21. Surendar KK, Vincent S, Vanagamudi M, Vijayaraghavan. Physiological effects of nitrogen and growth regulators on crop growth attributes and yield of blackgram (*Vigna mungo* L.), Bull. Env. Pharmacol. Life Sci. 2013; 2(4):70-76.
22. Teggelli RG, Salagunda S, Ahamed BZ. Influence of pulse magic application on yield and economics of transplanted pigeonpea, Int. J. Sci. Nat. 2016; 7(3):598-600.
23. Thandapani V. Leaf growth attributes as comparative physiological factors for the genotypes of greengram in relation to yield, Madras Agric. J. 1985; 72:126-132.

24. Upadhyay VB, Koshta LD, Bisen CR, Sachidanand B. Studies on response of arhar (*Cajanus cajan* (L.) Millsp) to foliar spray of DAP under rainfed condition, JNKVV Res. J. 1992; 26(1):60-61.
25. Vivekanandan AS, Gunasena HPM, Sivananyagam T. Statistical evaluation of accuracy of three techniques used in estimation of leaf area of crop plants, Indian J. Agric. Sci. 1972; 42:857-860.
26. Watson DJ. The physiological basis of variation in yield, Adv. Agron. 1952; 4:101-105.
27. Whigham DK. Soybean. In: Proc. of Symposium on Potential Productivity of Field Crops under Different Environment. IRRI, Los Banos, 1983; 22-26:205-225.