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EFFECT OF FOLIAR NUTRITION ON PHYSIOLOGICAL AND YIELD PARAMETERS OF BLACKGRAM (*Vigna mungo* (L) Hepper)

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ABSTRACT

An investigation was carried out at S.V. Agricultural College, Tirupati to know the effect of foliar application of aminoacids, growth promoting substances, micronutrients and urea on physiological parameters, yield and its attributes in blackgram. The results revealed that spraying amino acids (arginine and glutamine @ 1000 ppm) either alone or in combinations recorded significantly highest plant height, number of primary branches, number of root nodules, days to 50% flowering, SCMR values, leaf area and total dry matter. However 2 per cent urea spray also recorded on par values. Increased LAI, LAD and CGR by amino acids and 2 per cent urea spray resulted in higher dry matter production and better partitioning efficiency thus resulted significant increase in number of pods, pod yield plant^{-1} and seed yield kg^{-1}.

KEYWORDS: Foliar application - Blackgram- Amino acids – Growth promoting substances – Micro nutrients – Yield parameters.

INTRODUCTION

Blackgram is cultivated in about 3 m ha in India with 1.7 m tonnes of production and 500 kg ha^{-1} productivity in 2013-14. In Andhra Pradesh its area of cultivation is about 0.59 m ha with 0.85 m tonnes of production and 449 kg ha^{-1} of productivity during 2013-14 (www.Indiastat.com). The yield of blackgram is very low due to various inherent physiological and biochemical factors associated with the crop. Besides it is mainly grown in rainfed conditions with poor management practices. Insufficient partitioning of assimilates, poor pod setting due to flower abscission and lack of nutrients during critical stages of crop growth, are some important physical causes for poor yield in this crop.

The growth promoting or regulating chemicals like amino acids, plant hormones and micronutrients manipulate source-sink relationship through increased capacity of source and increased translocation of assimilates to sink. Foliar application of growth regulating or growth promoting chemicals at the critical growth stages of the crop to improve their performance is one of potential options. During the last decade, foliar application of nutrients has become an established method in crop production to increase yield and to improve the quality (Khalilzedeh, 2012). Nutritional spraying on plants decrease the delay between absorption and consumption of elements by plants, which is very important for accelerating the plant growth.

Amino acids are the building blocks of proteins and serve in a variety of important path ways. They are important in many biological molecules, such as forming part of coenzymes, or as precursors for biosynthesis of molecules such as glutamine (Glu) and ornithine, which serve as precursors for nucleotides and polyamines respectively (Alcazar *et al*., 2010). When applied together with amino acids the absorption and transportation of micronutrients inside the plant is easier (Ibrahim *et al.,* 2010). Deficiency of micronutrients during the last three decades has grown in both magnitude and extent because of increased use of high analysis fertilizers, use of high yielding crop varieties and increased cropping intensity. This has become a major constraint to production and productivity of rice, wheat and pulses.

Further, plant hormones are related to play an important role in manipulation of source sink relationship in pulse crops. Auxins help in retention of flowers and pods, thus facilitate increased sink demand. Cytokinins promote extended period of green leaf retention and thus help to attain increased source capacity.

There are many independent studies on effect of either amino acids or micronutrients or plant hormones

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alone. However, very less attention was paid to work out a suitable combination of these growth promoting chemicals for manipulation of source sink relationship in pulses. Besides, there is a dearth of literature on compatibility among micronutrients, amino acids and plant hormones. Thus, the objective of the present study was to know the effect of foliar applied amino acids, growth promoting substances, micronutrients and urea on various physiological and yield parameters of blackgram.

MATERIALS AND METHOD

A field experiment was conducted during *rabi* season of 2014-15 at S.V. Agricultural College Farm, Tirupati. The experiment was laid out in randomized block design with 17 treatments replicated thrice. Where in T_1 was Glutamine + Arginine; T_2 Glutamine; T_3 Arginine ;T_4 Ammonium molybdate + Borax; T_5 Ammonium molybdate; T_6 Borox; T_7 NAA + BAP; T_8 NAA; T_9 BAP; T_{10} Ammonium molybdate + Borox + NAA + BAP; T_{11} Borox+ NAA + BAP; T_{12} Ammonium molybdate + NAA + BAP; T_{13} Glutamine + Arginine + Ammonium molybdate + Borox + NAA + BAP; T_{14} Arginine + Ammonium molybdate + Borox+ NAA + BAP; T_{15} Glutamine + Ammonium molybdate +Boron + NAA + BAP;T_{16} Control *i.e* water spray and T_{17} was Urea spray.

The concentration of the chemicals was fixed irrespective of its application either alone or in combination. The concentrations used in the experiment were - Glutamine @1000 ppm, Arginine @1000 ppm, Ammonium molybdate @ 0.3 %, Borax @ 0.5 %, NAA @ 100 ppm and BAP @ 50 ppm and urea @ 2%. Concentration of different spray solutions were decided based on literature search. In the control treatment 100 % recommended dose of fertilizers were supplied as basal dose and in the rest of the treatments fertilizers were applied @ 75% RDF. The experiment was conducted in sandy clay loam soil with a plot size of 2x6 mt following standard package of practices. Black gram variety PU-31 was selected for the study. The spacing adopted was 30 x 10 cm. Three irrigations were given to the crop *i.e*., at sowing, 20 DAS and at flowering stage.

Foliar application of growth promoters (NAA & BAP), micronutrients (borax & ammonium molybdate) and amino acids (argnine & glutamine) as described in experimental details was done at vegetative stage, flowering stage and pod formation stage *i.e*. at 20 DAS, 40 DAS & 60 DAS respectively. Morphological, physiological and yield observations were recorded at 15 days interval. Destructive sampling of 5 plants from each replication was done.

The experimental data were analyzed by the method of analysis of variance following RBD as per the procedure outlined by Panse and Sukhtame (1985). Significance was tested by comparing F-value at 5 % level of probability wherever F- test was significant.

RESULTS AND DISCUSSION

I) Morpho -physiological parameters

a) Plant height (cm)

There was a significant difference observed among different treatments with respect to plant height. At 45 DAS, T_1 (Glutamine @ 1000 ppm + Arginine @ 1000 ppm) recorded significantly highest plant height (15.39 cm) followed by T_3 (Arginine @ 1000 ppm) (13.93 cm), T_2 (Glutamine @ 1000 ppm) (13.91 cm) and T_{17} (Urea spray 2per cent)) (12.95 cm). T_{15} (Glutamine @1000 ppm + Ammonium molybdate @ 0.3per cent +Borax @ 0.5 per cent + NAA @100 ppm + BAP @ 50 ppm)recorded significantly lowest plant height (7.84 cm). Similar trend was observed at 60 DAS and at 75 DAS.

b) Number of primary branches

As per the results it was found that amino acids (glutamine and arginine) either alone or in combination (T_1, T_2 & T_3), urea 2 percent spray (T_{17}), ammonium molybdate (0.3 per cent) (T_5) and Borax (0.5 per cent) (T_6) either alone or in combination were proved to be effective in influencing the number of primary branches. T_{15} (the combination of glutamine, ammonium molybdate, Borax, NAA and BAP) showed antagonistic effect on crop growth. This might be due to the incompatible reaction of the components or over dose of their concentrations.

T_1 (Glutamine @ 1000 ppm + Arginine @ 1000 ppm) recorded significantly higher number of primary branches (6.13) compared to control (4.66).

c) Days to 50% flowering

Significantly early flower initiation was observed in T_3 (35.00) followed by T_2 (35.67), T_1 (35.67), and T_{17} (36.33) when compared to control (43.33). A significant late flowering was observed in T_8 (49.67) followed by T_7 (48.33) compared to control. However, the remaining treatments were found to be at par with control.

d) Leaf area

Irrespective of the treatments applied, leaf area increased continuously from 15 to 60 DAS and thereafter decreased at 75 DAS. At 30 DAS T_1 recorded significantly high leaf area (103.39 cm^2), followed by T_2 (19.51 cm^2) and T_3 (91.06 cm^2) compared to control. Significantly low leaf area was observed in T_{15} (27.45 cm^2) followed by T_{14} (30.29 cm^2.). Almost a similar trend was observed at 45, 60 and 75 DAS.

e) Leaf area index

The results indicated that the LAI was continuously increased from 15 DAS to 60 DAS and decreased thereafter at 75 DAS irrespective of the treatments applied. However at 30 DAS, T_1 (0.345) recorded significantly higher LAI followed by T_2 (0.305) and T_3 (0.304) compared to control (0.27). T_{15} recorded significantly lower LAI (0.092) followed by T_{14} (0.101). A similar trend was observed at 45, 60 and 75 DAS. (Figure.1)

f) SPAD Chlorophyll Meter Readings (SCMR values)

At 30 DAS T_1 recorded significantly highest SCMR (51.86) and T_{15} recorded significantly lowest SCMR (33.2) compared to that of control (43.5). A similar trend was observed at 45 DAS. Further, at 60 and 75 DAS T_{15} recorded a significantly lowest SCMR (32.73) values. The results indicated that amino acids (glutamine and arginine) either alone or in combination, urea 2 percent spray, ammonium molybdate (0.3 per cent) and Borax (0.5per cent) either alone or in combination, NAA alone and in combination with BAP were proved to be effective in influencing SPAD Chlorophyll meter readings . T_{14} and T_{15} (the combination of glutamine or arginine, ammonium molybdate, borax, NAA and BAP) showed antagonistic effect on crop growth. This might be due to the incompatible reaction of the components or over dose of their concentrations.

g) Leaf area duration (cm^2 day^{-1})

At 15-30 DAS, T_1 recorded significantly highest LAD (3.07) where as T_{15} (1.17) recorded significantly lowest LAD compared to control (2.53) (Figure.2). However, at 30-45 DAS compared to control (6.55), T_1 (8.86) recorded significantly highest LAD followed by T_2 (7.54) and T_3 (7.46). Significantly lowest LAD was recorded by T_{15} (2.57). A similar trend was observed at 45-60DAS and 60-75 DAS.

T_1 (20.5) followed T_3 (18.8), T_{17} (18.1) and T_2 (18.0) were found to recorded a higher leaf area duration even at 60-75 DAS. The Leaf Area Duration (LAD) during later stage of growth had positive effect on pod filling, resulting to more number of pods per plant.

h) Total dry matter

At 30 DAS T_1 recorded significantly higher total dry matter (2.50) followed by T_2 (2.23) and T_3 (2.21) compared to control (1.81). Significantly lowest total dry matter was produced in T_{15} (1.02) followed by T_{14} (1.19). (Table 1).

A similar trend was observed at 45, 60 and 75 DAS. During most of the crop growth period T_4 recorded total dry matter at par with control.

II) Yield parameters

Pod yield (g $plant^{-1}$) was found significantly higher in T_1 (11.96g) compared to that of control (10.54g) followed by T_3 (11.21g), T_2 (10.75g), T_{17} (10.67g), T_4 (10.20g), T_5 (9.82g), T_6 (9.71g), T_7 (9.36g), T_8 (9.09g), T_9 (8.89g), T_{11} (8.76g) and T_{10} (7.78g). All these treatments were at par with control (10.54).A significant variation among treatments was observed in number pods $plant^{-1}$ and test weight where as seed number per pod did not differ significantly.

A significant difference among various treatments with respect to seed yield (Kg ha^{-1}) was recorded. Highest seed yield was observed in T_1 (751.3 Kg ha^{-1}), followed by T_2 (709.7 Kg ha^{-1}), T_3 (697.1 Kg ha^{-1}), T_{17} (672.5 Kg ha^{-1}), T_6 (645.0 Kg ha^{-1}), T_5 (610.5 Kg ha^{-1}), T_4 (587.8 Kg ha^{-1}), T_7 (572.2 Kg ha^{-1}), T_8 (545.8 Kg ha^{-1}), T_9 (526.1 Kg ha^{-1}) T_{10} (501.9 Kg ha^{-1}) and T_{11} (506.1 Kg ha^{-1}). They were found to be at par with control (672.5 Kg ha^{-1}) (Table 2).

Significantly lowest Pod yield (g $plant^{-1)}$ and seed yield (kg ha^{-1}) was recorded in T_{15} (7.14 and 467.2) followed by T_{14} (7.16 and 480.0), T_{12} (7.75 and 490.56) and T_{13} (7.60 and 490.2).

The results are in conformity with Li Yunsheng *et al.*, (2015) in snap bean,Surendar *et al.,* (2013) in blackgram, Saeed *et al.*, (2005) in soybean and Bhattacharya *et al.*, (2004) in blackgram and green gram.

CONCLUSION

Spraying of amino acids either alone or in combination (Glutamine, Arginise and Glutamine + Arginise) and 2 per cent urea might supply a readily

Table 1. Effect of foliar application of amino acids, growth promoting substances, micronutrients and urea on total dry matter (g plant^{-1}) at different growth stages of Blackgram

S. No.	Treatments	Total dry matter(g plant^{-1})				
		15 DAS	**30 DAS**	**45 DAS**	**60 DAS**	**75 DAS**
1	Glutamine @ 1000 ppm+ Arginine @ 1000 ppm (T_1)	0.193	2.50	5.10	7.76	9.79
2	Glutamine @ 1000 ppm (T_2)	0.197	2.23	4.68	7.11	9.26
3	Arginine @ 1000 ppm (T_3)	0.198	2.21	4.53	6.99	9.16
4	Ammonium molybdate @ 0.3% + Borax @ 0.5 % (T_4)	0.183	1.78	3.77	6.22	7.62
5	Ammonium molybdate @ 0.3% (T_5)	0.196	1.67	3.20	5.86	6.93
6	Borax@ 0.5 % (T_6)	0.190	1.58	2.69	5.46	6.25
7	NAA @100 ppm + BAP @ 50 ppm (T_7)	0.184	1.51	2.36	5.10	5.93
8	NAA @100 ppm (T_8)	0.195	1.44	2.04	4.75	5.58
9	BAP @ 50 ppm (T_9)	0.186	1.38	1.71	4.23	5.03
10	Ammonium molybdate@ 0.3% + Borox @ 0.5 % + NAA @100 ppm + BAP @ 50 ppm (T_{10})	0.180	1.30	1.38	3.54	4.07
11	Borox@ 0.5 % + NAA @100 ppm+ BAP @ 50 ppm (T_{11})	0.191	1.34	1.47	3.89	4.59
12	Ammonium molybdate @ 0.3% + NAA @100 ppm + BAP @ 50 ppm (T_{12})	0.174	1.24	1.31	3.07	3.53
13	Glutamine @ 1000 ppm + Arginine @ 1000 ppm + Ammonium molybdate @ 0.3% + Borox @ 0.5% + NAA @ 100 ppm+ BAP @ 50 ppm (T_{13})	0.164	1.19	1.24	2.60	3.19
14	Arginine @ 1000 ppm + Ammonium molybdate @ 0.3% + Borox@ 0.5 % + NAA @100 ppm + BAP@ 50 ppm (T_{14})	0.173	1.10	1.12	2.06	2.62
15	Glutamine @1000 ppm + Ammonium molybdate @ 0.3%+ Borax @ 0.5 % + NAA @100 ppm + BAP @ 50 ppm (T_{15})	0.156	1.02	1.04	1.74	2.23
16	Control (water spray) (T_{16})	0.189	1.81	3.82	6.27	7.84
17	Urea spray (2%) (T_{17})	0.202	1.99	4.37	6.66	8.65
	Mean	**0.185**	**1.60**	**2.69**	**4.89**	**6.01**
	C.D	**NS**	**0.35**	**0.45**	**0.70**	**0.81**
	SE (m)	**0.010**	**0.123**	**0.157**	**0.244**	**0.283**
	CV	**9.49**	**13.23**	**10.09**	**8.62**	**8.14**

Table 2. Effect of foliar application of amino acids, growth promoting substances, micronutrients and urea on yield and yield components in Blackgram

S. No.	Treatments	Yield and yield components					
		No. of pods plant $^{-1}$	No. of seeds pods^{-1}	Pod yield (g plant^{-1})	Seed yield (kg ha^{-1})	Test weight (g)	Harvest index
1	Glutamine @ 1000 ppm+ Arginine @ 1000 ppm (T_1)	33.78	8.00	11.96	751.39	5.02	36.05
2	Glutamine @ 1000 ppm (T_2)	28.56	7.66	10.75	709.72	4.96	34.61
3	Arginine @ 1000 ppm (T_3)	30.56	7.69	11.21	679.17	4.94	33.20
4	Ammonium molybdate @ 0.3% + Borax @ 0.5 % (T_4)	27.67	7.67	10.20	587.87	4.76	34.04
5	Ammonium molybdate @ 0.3% (T_5)	21.44	7.63	9.82	610.56	4.6	33.95
6	Borax@ 0.5 % (T_6)	26.22	7.59	9.71	645.00	4.60	35.03
7	NAA @100 ppm + BAP @ 50 ppm (T_7)	24.11	7.70	9.36	572.22	4.46	34.18
8	NAA @100 ppm (T_8)	22.56	7.63	9.09	545.83	4.42	33.68
9	BAP @ 50 ppm (T_9)	24.55	7.58	8.89	526.11	4.41	34.21
10	Ammonium molybdate@ 0.3% + Borox @ 0.5 % + NAA @100 ppm + BAP @ 50 ppm (T_{10})	15.78	7.64	7.78	501.94	4.39	30.79
11	Borox@ 0.5 % + NAA @100 ppm+ BAP @ 50 ppm (T_{11})	20.56	7.59	8.76	506.11	4.40	34.73
12	Ammonium molybdate @ 0.3% + NAA @100 ppm + BAP @ 50 ppm (T_{12})	20.00	7.66	7.75	490.56	4.30	22.22
13	Glutamine @ 1000 ppm + Arginine @ 1000 ppm + Ammonium molybdate @ 0.3% + Borox @ 0.5% + NAA @ 100 ppm+ BAP @ 50 ppm (T_{13})	15.66	7.53	7.60	490.28	4.25	22.45
14	Arginine @ 1000 ppm + Ammonium molybdate @ 0.3% + Borox@ 0.5 % + NAA @100 ppm + BAP@ 50 ppm (T_{14})	13.11	7.67	7.16	480.00	4.25	23.96
15	Glutamine @1000 ppm + Ammonium molybdate @ 0.3%+Borax @ 0.5 % + NAA @100 ppm + BAP @ 50 ppm (T_{15})	13.00	7.69	7.14	467.22	4.22	24.16
16	Control (water spray) (T_{16})	15.00	7.61	10.54	657.50	4.77	34.87
17	Urea spray (2%) (T_{17})	28.22	7.6	10.67	672.50	4.93	33.88
	Mean	**22.40**	**7.65**	**9.32**	**581.99**	**4.57**	**31.53**
	C.D	**4.09**	**N.S.**	**1.10**	**162.80**	**0.53**	**4.55**
	SE (m)	**1.41**	**0.466**	**0.381**	**56.262**	**0.185**	**1.574**
	CV	**10.93**	**7.45**	**7.08**	**16.74**	**7.00**	**8.64**

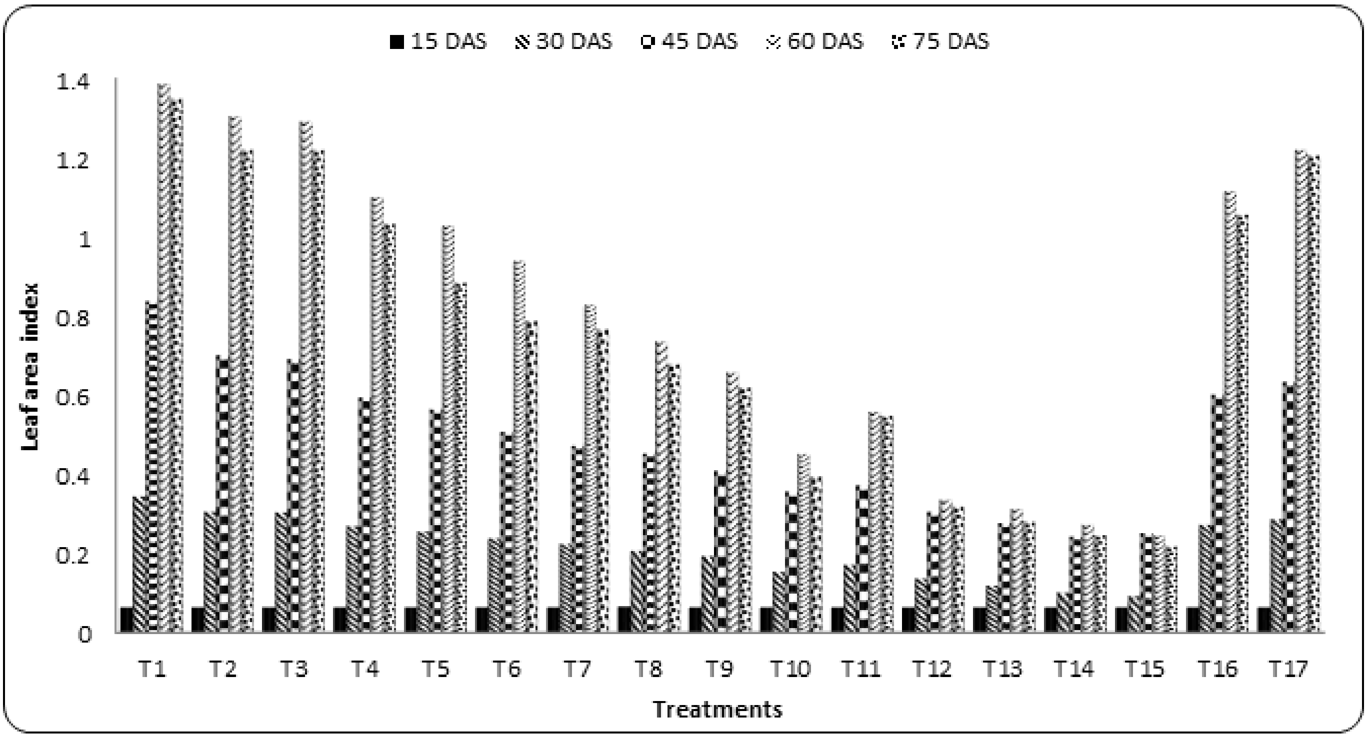

Fig. 1. Effect of foliar application of amino acids, growth promoting substances, micronutrients and urea on leaf area index at different growth stages of Blackgram

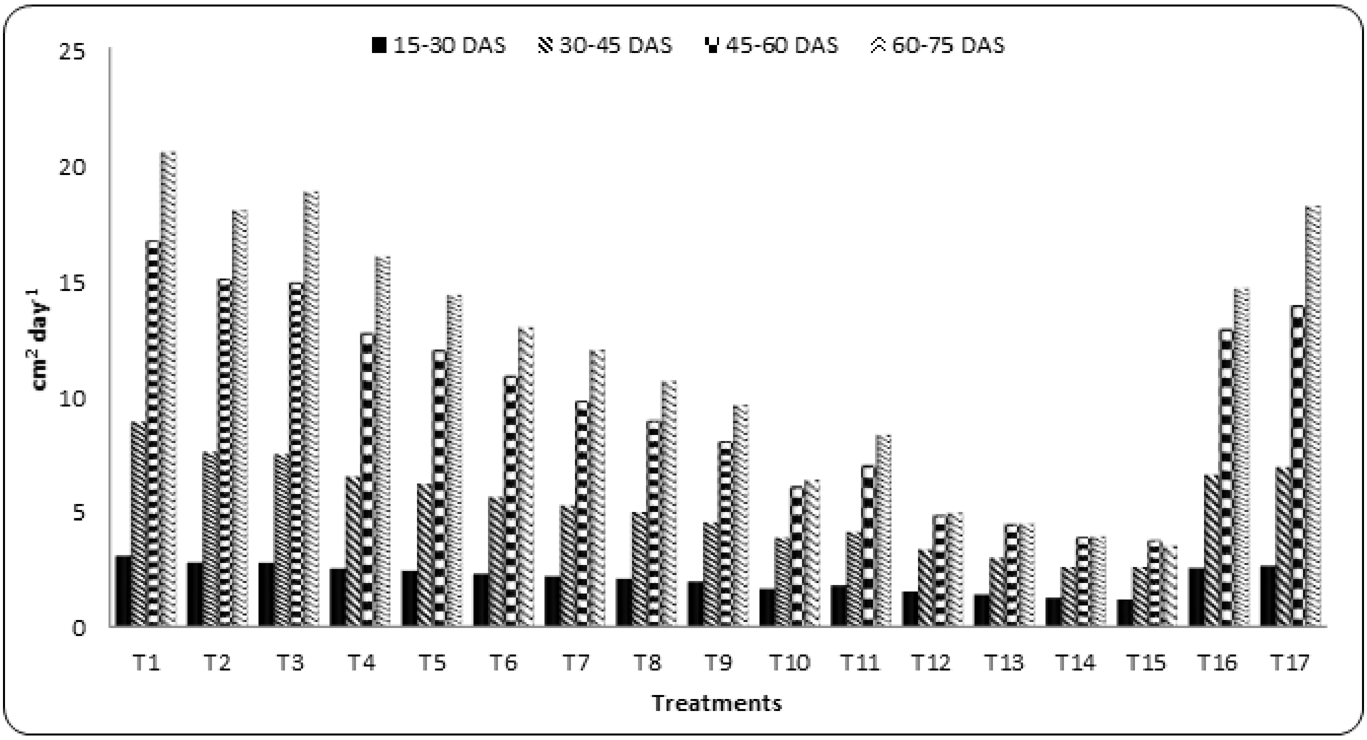

Fig. 2. Effect of foliar application of amino acids, growth promoting substances, micronutrients and urea on leaf area duration ($cm^2 day^{-1}$) at different growth stages of Blackgram

available source of nitrogen to the plants. This readily available nitrogen at all the crop growth stages might help to maintain a good leaf nitrogen content which was reflected from the SPAD chlorophyll meter readings. Increased chlorophyll content helped in increasing the photosynthetic assimilation and for development of early canopy. A good canopy developed in the initial stages of the crop helped to intercept more light and caused a better dry matter production. This was observed from the increased values of both leaf area and leaf area index.

Continuous availability of a ready source of nitrogen in the form of amino acids and urea helped to maintain an effective leaf area, represented as Leaf area duration. A continuous increase in LAI, a prolonged LAD, moderate NAR caused an increased crop growth rate. Which was reflected in higher production of total dry matter. Further, more availability of current photosynthates in these treatments might helped to achieve a better pod yield and seed yield.

REFERENCES

Alcazar, R., Altabella, T., Marco, F., Bortolotti, C., Reymond, M., Koncz, C., Carrasco, P and Tiburcio, A.F. 2010. Polyamines: molecules with regulatory functions in plant abiotic stress tolerance. *Planta.* 231:1237–1249.

Bhattacharya, S.S., Debkanta Mandal, G.N. Chattopadhyay, and K. Majumdar. 2004. Effect of Balanced Fertilization on Pulse Crop Production in Red and Lateritic Soils. *Better Crops*. 88(4):25-27.

Ibrahim, M.E., Bekheta, M.A., El-Moursi A. and Gafar, N.A. 2010. Improvement of growth and seed yield quality of *Vicia faba* L. plants as affected by application of some bioregulators. *Australian journal of Basic and Applied Science*. 1(4): 657-666.

Khalil Zadeh R, Tajbakhsh M, Jalilian J. 2012. Growth characteristics of mung bean (Vigna radiate) affected by foliar application of urea and bio-organic fertilizers. *International Journal of Agriculture and Crop Science*. 4(10):637-642

Li Yunsheng, El-Bassiony, A.M., Fawzy, Z.F and El-Awadi, M.E. 2015. Effect of Foliar Spray of Glutamine on Growth, Yield and Quality of Two Snap Bean Varieties. *Journal of Agricultural Science and Engineering*. 1(1): 39-45

Panse, V.G and Sukhatme, P.V. 1985. *Statistical methods for Agricultural Workers*, ICAR, New Delhi.

Saeed M.R,. Kheir A.M., Al-Sayed A.A. 2005. Suppressive effect of some amino acids against Meloidogyne incognita on Soybeans. *Journal of Agriculture Science- Mansoura University.* 30 (2): 1097 –1103.

Surendar, K.K., Vincent, S., Mallika Vanagamudi and Vijayaraghavan, H. 2013. Physiological Effects of Nitrogen and Growth Regulators on Crop Growth Attributes and Yield of Black Gram (*Vigna mungo* L.). *Bulletin of Environment, Pharmacology and Life Sciences*. 2 (4): 70-76.

www.Indiastat.com Fourth Advance Estimates, 2013-2014.