Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(4): 2914-2918
Received: 21-05-2018
Accepted: 25-06-2018

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Inflence of foliar nutrition on biochemical parameters in blackgram (*Vigna mungo* (L) Hepper)

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Abstract
A study was conducted at S. V. Agricultural College, Tirupati to know the effect of foliar application of amino acids, growth promoting substances, micronutrients and urea on bio chemical 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 Reducing sugars, non reducing sugars and proteins. However 2 percent urea spray also recorded on par values with control.

Keywords: foliar application - blackgram- amino acids – growth promoting substances – micro nutrients – biochemical 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 (Ministry of agriculture, GOI). 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 physiological, biochemical and inherent 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 the 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) [4]. 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) [1]. When applied together with amino acids the absorption and transportation of micronutrients inside the plant is easier (Ibrahim *et al*., 2010) [3].

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. 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 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. 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. The spacing adopted was 30x10 cm. Black gram variety PU-31 was selected for the study. 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 (arginine & glutamine) described in experimental details was done at vegetative stage, flowering stage and pod formation stage *i.e*. 20 DAS, 40 DAS & 60 DAS respectively. Morphological, physiological and yield observations were recorded 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) [6]. Significance was tested by comparing F-value at 5 % level of probability wherever F- test was significant.

Results and Discussion

I. Bio Chemical Parameters

a) Reducing sugars in leaf (%)

The data indicated that the percent reducing sugars decreased from 30 DAS to 60 DAS irrespective of the treatments imposed. A significant difference among various treatments was observed with regard to per cent reducing sugars both at 30 & 60 DAS.

T_1 recorded a significantly higher per cent of reducing sugars (2.17) followed by T_3 (2.02) and T_2 (2.00). Whereas T_{17} (1.87) and T_4 (1.81) were found to be at par with control (1.530) at 30 DAS.

However, at 60 DAS T_1 (0.66) followed by T_2 (0.610), recorded significantly highest per cent of reducing sugars compared to control (0.54). Further, T_3 (0.58), T_{17} (0.57), T_6 (0.54), T_5 (0.53), T_4 (0.52), T_7 (0.52), T_8 (0.51) and T_9 (0.51) were found to be at par with control (0.54). Whereas T_{15} (0.210) recorded a significantly lowest per cent sugars.

Carbohydrates are the main repository of photosynthetic energy, they comprise structurally polysaccharides of plant, principally cellulose, hemicelluloses and pectin and lignin which consider an important structural compound of plant. Also it's associated with phenolic compounds which play a major role in plant defense (Hahlbrock and Scheel, 1989).

b) Non reducing sugars in leaf (%)

From the results it was observed that the per cent non reducing sugars decreased from 30 DAS to 60 DAS. A significant difference among various treatments was observed for per cent non reducing sugars both at 30 & 60 DAS.

At 30 DAS T_1 (1.58) followed by T_3 (1.23) and T_2 (1.18) recorded significantly highest per cent of non-reducing sugars compared to control (1.11). However, T_{17} (1.16), and T_4 (1.11) were found to be at par with control. In all the remaining treatments per cent non reducing sugars decreased significantly.

Further, at 60 DAS T_1 (0.29) followed by T_2 (0.29), and T_3 (0.27) recorded significantly highest per cent of non-reducing sugars to that of control (0.25). Whereas T_{17} (0.026), T_4 (0.23), T_5 (0.24) and T_6 (0.24) were found to be at par with control. Rest of the treatments, recorded a significantly lowest per cent of non-reducing sugars. The decrease in reducing and non-reducing sugars in leaf at 60 DAS might be due to heavy competition between vegetative and reproductive organs for photosynthates.

c) Leaf Protein content (%)

The results indicated a decrease in per cent of proteins in leaf tissue from 30-60 DAS. A significant difference among the treatments was observed with regard to per cent proteins in leaf material both at 30 & 60 DAS.

At 30 DAS T_1 (24.5) followed by T_3 (23.7), T_2 (23.6) and T_{17} (22.8) were found to record significantly higher per cent of proteins compared to that of control (18.4). Almost a similar trend was observed at 60 DAS.

The overall improvement in plant growth parameters and yield due to application of amino acids may be due to providing readily source of growing substances which form the constitutes of protein in the living tissues.

d) Reducing, Non reducing sugars and Protein content in seeds

The data showed that a significant difference among various treatments with respect to per cent reducing sugars, per cent of non-reducing sugars, per cent and per cent of proteins in blackgram seeds.

T_1 (0.124) followed by T_2 (0.029) and T_3 (0.029) recorded a significantly higher per cent of reducing sugars compared to control (0.011). Whereas T_4 (0.026), T_5 (0.026), T_6 (0.026) and T_7 (0.025) were found to be at par with control. Significantly lowest per cent of reducing sugars were observed in rest of the treatments.

A similar results was observed with regard to per cent non reducing sugars where T_1 (0.089), followed by T_2 (0.086), T_3 (0.083) and T_4 (0.068) recorded the significantly high values compare to control (0.065). Remaining treatments recorded significantly lowest per cent of non-reducing sugars compare to control.

Among the various treatments per cent seed protein values were recorded significantly highest in T_1 (21.4) followed by T_2 (24.6), T_9 (24.5) and T_{12} (24.1). However, T_{11} recorded significantly lowest per cent of seed proteins (18.6).

The increase in protein content might be due to increased availability of nitrogen with amino acids, ammonium molybdate, borax, NAA alone or in combination with BAP. These chemicals might help in improved translocation and mobilization of metabolites towards developing seeds.

III. Yield components
a) Seed yield Kg ha^{-1}
The results indicated a significant difference among various treatments with respect to seed yield Kg ha^{-1}. The highest seed yield was observed in T_1 (751.3), followed by T_2 (709.7), T_3 (697.1), T_{17} (672.5), T_6 (645.0), T_5 (610.5), T_4 (587.8), T_7 (572.2), T_8 (545.8), T_9 (526.1) T_{10} (501.9) and T_{11} (506.1). However they are at par with control (672.5).
Significantly the lowest seed yield was recorded in T_{15} (467.2) followed by T_{14} (480.0), T_{12} (490.56) and T_{13} (490.2).

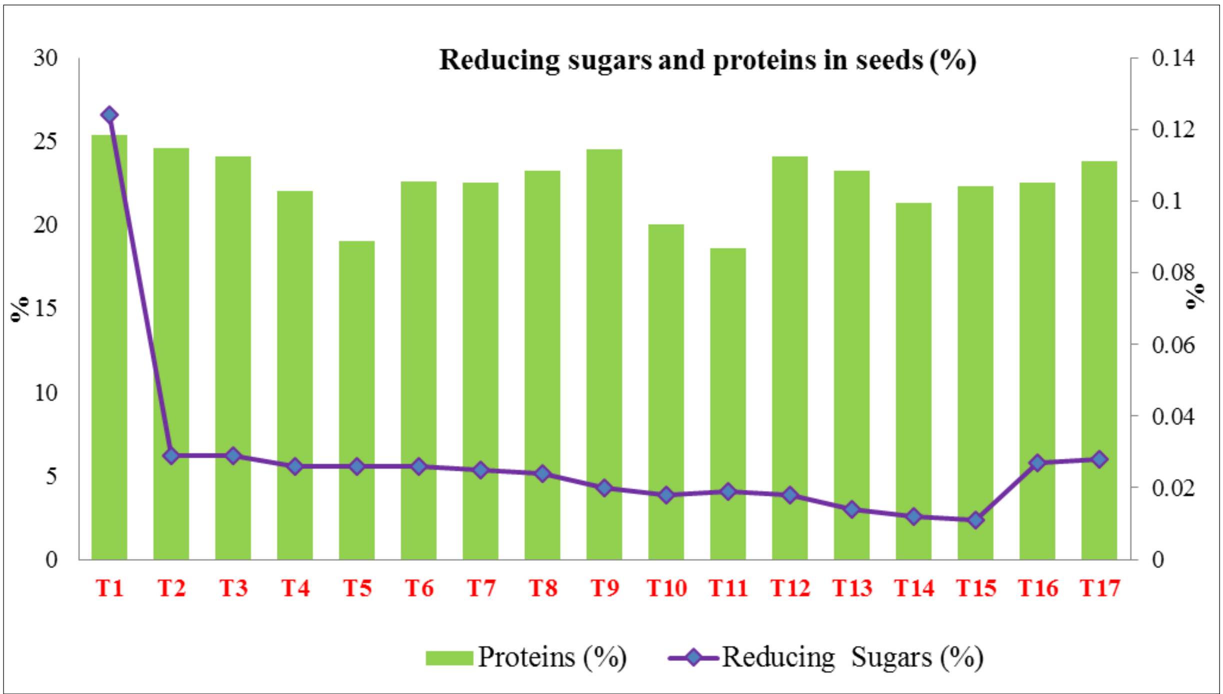

Fig 4.16: Effect of foliar application of amino acids, growth promoting substances, micronutrients and urea on protein and reducing sugars content in seeds of Blackgram

Table 4.22: Effect of foliar application of amino acids, growth promoting substances, micronutrients and urea on reducing sugars (%) and non reducing Sugars (%)in leaf at different growth stages of Blackgram.

		Reducing Sugars (%)		Non reducing Sugars (%)	
S.NO	Treatments	30 DAS	60 DAS	30 DAS	60 DAS
1	Glutamine @ 1000 ppm+ Arginine @ 1000 ppm (T_1)	2.170	0.660	1.580	0.290
2	Glutamine @ 1000 ppm (T_2)	2.000	0.610	1.180	0.290
3	Arginine @ 1000 ppm (T_3)	2.020	0.580	1.230	0.270
4	Ammonium molybdate @ 0.3% + Borax @ 0.5 % (T_4)	1.810	0.520	1.110	0.250
5	Ammonium molybdate @ 0.3% (T_5)	1.780	0.530	0.990	0.240
6	Borax@ 0.5 % (T_6)	1.770	0.540	0.980	0.240
7	NAA @100 ppm + BAP @ 50 ppm (T_7)	1.770	0.520	0.970	0.220
8	NAA @100 ppm (T_8)	1.690	0.510	0.960	0.210
9	BAP @ 50 ppm (T_9)	1.730	0.510	0.950	0.200
10	Ammonium molybdate@ 0.3% + Borox @ 0.5 % + NAA @100 ppm + BAP @ 50 ppm (T_{10})	1.670	0.480	0.830	0.150
11	Borox@ 0.5 % + NAA @100 ppm+ BAP @ 50 ppm (T_{11})	1.670	0.490	0.940	0.160
12	Ammonium molybdate @ 0.3% + NAA @100 ppm + BAP @ 50 ppm (T_{12})	1.650	0.480	0.800	0.120
13	Glutamine @ 1000 ppm + Arginine @ 1000 ppm + Ammonium molybdate @ 0.3% + Borox @ 0.5% + NAA @ 100 ppm+ BAP @ 50 ppm (T_{13})	1.630	0.450	0.750	0.110
14	Arginine @ 1000 ppm + Ammonium molybdate @ 0.3% + Borox@ 0.5 % + NAA @100 ppm + BAP@ 50 ppm (T_{14})	1.630	0.400	0.640	0.100
15	Glutamine @1000 ppm + Ammonium molybdate @ 0.3%+Borax @ 0.5 % + NAA @100 ppm + BAP @ 50 ppm (T_{15})	1.530	0.210	0.590	0.080
16	Control (water spray) (T_{16})	1.840	0.540	1.110	0.250
17	Urea spray (2%) (T_{17})	1.870	0.570	1.160	0.260
	Mean	1.778	0.506	0.9865	0.2024
	C.D	0.048	0.047	0.056	0.019
	SE (m)	0.017	0.016	0.02	0.007
	CV	1.621	5.518	3.428	5.571

Table 4.24 Effect of foliar application of amino acids, growth promoting substances, micronutrients and urea on leaf protein content (%) at different growth stages of Blackgram

S.NO	Treatments	Proteins (%) 30 DAS	60 DAS
1	Glutamine @ 1000 ppm+ Arginine @ 1000 ppm (T_1)	24.5	21.5
2	Glutamine @ 1000 ppm (T_2)	23.6	20.7
3	Arginine @ 1000 ppm (T_3)	23.7	20.4
4	Ammonium molybdate @ 0.3% + Borax @ 0.5 % (T_4)	19.0	17.6
5	Ammonium molybdate @ 0.3% (T_5)	18.8	17.4
6	Borax@ 0.5 % (T_6)	18.8	18.5
7	NAA @100 ppm + BAP @ 50 ppm (T_7)	19.8	18.1
8	NAA @100 ppm (T_8)	19.4	16.4
9	BAP @ 50 ppm (T_9)	20.7	19.3
10	Ammonium molybdate@ 0.3% + Borox @ 0.5 % + NAA @100 ppm + BAP @ 50 ppm (T_{10})	19.9	18.9
11	Borox@ 0.5 % + NAA @100 ppm+ BAP @ 50 ppm (T_{11})	17.9	15.5
12	Ammonium molybdate @ 0.3% + NAA @100 ppm + BAP @ 50 ppm (T_{12})	19.0	16.4
13	Glutamine @ 1000 ppm + Arginine @ 1000 ppm + Ammonium molybdate @ 0.3% + Borox @ 0.5% + NAA @ 100 ppm+ BAP @ 50 ppm (T_{13})	17.9	16.6
14	Arginine @ 1000 ppm + Ammonium molybdate @ 0.3% + Borox@ 0.5 % + NAA @100 ppm + BAP@ 50 ppm (T_{14})	19.5	17.5
15	Glutamine @1000 ppm + Ammonium molybdate @ 0.3%+Borax @ 0.5 % + NAA @100 ppm + BAP @ 50 ppm (T_{15})	21.3	18.5
16	Control (water spray) (T_{16})	18.4	16.5
17	Urea spray (2%) (T_{17})	22.8	19.9
	Mean	20.3	18.2
	C.D	1.325	0.662
	SE (m)	0.458	0.229
	CV	3.909	2.174

Table 4.25 Effect of foliar application of amino acids, growth promoting substances, micronutrients and urea on protein and sugars content in seeds of Blackgram

S.NO	Treatments	Reducing Sugars (%)	Non reducing sugars (%)	Proteins (%)
1	Glutamine @ 1000 ppm+ Arginine @ 1000 ppm (T_1)	0.124	0.089	25.4
2	Glutamine @ 1000 ppm (T_2)	0.029	0.086	24.6
3	Arginine @ 1000 ppm (T_3)	0.029	0.083	24.1
4	Ammonium molybdate @ 0.3% + Borax @ 0.5 % (T_4)	0.026	0.068	22.0
5	Ammonium molybdate @ 0.3% (T_5)	0.026	0.062	19.0
6	Borax@ 0.5 % (T_6)	0.026	0.057	22.6
7	NAA @100 ppm + BAP @ 50 ppm (T_7)	0.025	0.051	22.5
8	NAA @100 ppm (T_8)	0.024	0.048	23.2
9	BAP @ 50 ppm (T_9)	0.02	0.043	24.5
10	Ammonium molybdate@ 0.3% + Borox @ 0.5 % + NAA @100 ppm + BAP @ 50 ppm (T_{10})	0.018	0.038	20.0
11	Borox@ 0.5 % + NAA @100 ppm+ BAP @ 50 ppm (T_{11})	0.019	0.029	18.6
12	Ammonium molybdate @ 0.3% + NAA @100 ppm + BAP @ 50 ppm (T_{12})	0.018	0.024	24.1
13	Glutamine @ 1000 ppm + Arginine @ 1000 ppm + Ammonium molybdate @ 0.3% + Borox @ 0.5% + NAA @ 100 ppm+ BAP @ 50 ppm (T_{13})	0.014	0.024	23.2
14	Arginine @ 1000 ppm + Ammonium molybdate @ 0.3% + Borox@ 0.5 % + NAA @100 ppm + BAP@ 50 ppm (T_{14})	0.012	0.016	21.3
15	Glutamine @1000 ppm + Ammonium molybdate @ 0.3%+Borax @ 0.5 % + NAA @100 ppm + BAP @ 50 ppm (T_{15})	0.011	0.013	22.3
16	Control (water spray) (T_{16})	0.027	0.065	22.5
17	Urea spray (2%) (T_{17})	0.028	0.067	23.8
	Mean	0.028	0.051	22.6
	C.D	0.002	0.002	1.504
	SE (m)	0.001	0.001	0.52
	CV	3.868	2.208	3.986

Conclusion

The impact of different amino acids, micronutrients, plant growth promoting substances and urea on various physiological, biochemical and yield parameters was studied to understand the scientific basis for manipulation of source sink relationship of blackgarm. Besides a significant increase in reducing, non-reducing sugars and per cent protein content in leaf and seeds of blackgram was also observed. Almost a similar result was also recorded with 2 percent urea spray (T_{17}).

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