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FOLIAR APPLICATION OF AMINO ACIDS TO ALLEVIATE TERMINAL MOISTURE STRESS IN GROUNDNUT (*Arachis hypogia* L)

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ABSTRACT

The Present investigation was carried out at S. V. Agricultural College & RARS, Tirupati to know the effect of amino acids in alleviation of terminal moisture stress in groundnut (*Arachis hypogia*).The results revealed a considerable significant variation in all morphological, physiological and yield parameters. Among the different treatments glutamine 200 ppm followed by arginine 200 ppm recorded significantly highest pod yields (kg ha^{-1}). A significant positive correlation was observed between SCMR and total chlorophyll content. Foliar spray of amino acids caused increased chlorophyll content; high SCMR values and moderate SLA resulted in better crop yield under moisture stress. The role of amino acids in remobilization of resources needs further investigation.

KEY WORDS: Amino acids, Alanine, Arginine, Glutamine, Groundnut, Foliar application, Terminal moisture stress

INTRODUCTION

Groundnut (*Arachis hypogea* L.) is one of the important oil seed crops grown in India. Andhra Pradesh ranks second in the country both in area (13.07 lakh hectares) and production (8.4 lakh tons) of groundnut with an average productivity of 646 kg per hectare (http://www.indianstat.com). Rayalaseema zone of Andhra Pradesh consisting of four districts (Chittoor, Kurnool, Kadapa and Ananatapur) is a predominant groundnut growing region where more than 70 per cent area falls under rain fed condition.

Groundnut in Andhra Pradesh is cultivated in an area of 1.6 m ha during rainy season (*kharif*) and 0.3 m ha in post rainy season (*rabi*). Terminal moisture stress is a common phenomenon under post rainy season which adversely affects the growth and development of the crop (ICRISAT, 2008). Moisture stress if occurs during 50-80 DAS causes severe yield reduction as this period coincides with pod filling and pod maturation in groundnut.

Different approaches were used to reduce the damage caused by drought such as selection of genotypes for higher water use efficiency, use of different growth regulators (GA_3. IAA and Cytokines), seed treatment with osmoprotectants (Muna *et al*., 2013), foliar application of 1 per cent KCl, exogenous application of organic compounds such as amino acids (Ardebili *et al*., 2012) etc.

Amino acids are the building blocks in the synthesis of proteins and are involved in plant growth and development. Amino acids are crucial in stimulation of cell growth, act as a buffer, provide a source of carbon and energy, involved in the synthesis of other organic compounds such as amines, alkaloids, vitamins, enzymes and terpenoids (Abdel Aziz *et al*., 2010). The yield contributing characters and quality of plants could be improved by application of putriscine or glutamine (Amin *et al*., 2011).

Of late a range of products are commercially available in the name of growth promoters. Amino acid formulations, mixtures of nutrients, hydrolyzed proteins, triacontonol, humic acid, sea weed extracts and brassinolides are proposed as commonly used growth promoters (Thomas *et al*., 2009). Foliar application of amino acids for drought alleviation was studied by several workers earlier (Rao *et al*., 2012 and Ali, 2007). Thus the objective of the present study was to know the effect of exogenous application of amino acids for alleviation of terminal moisture stress situation in post rainy season cultivation of groundnut.

MATERIAL AND METHODS

A field experiment was conducted at Department of Crop Physiology, S. V. Agricultural College and RARS, Tirupati during *rabi* 2013-14 (January to April).

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Groundnut variety ‘Dharani’ was selected for the study whose duration was 110 days. The experiment was laid out in a Randomized block design with 13 treatments replicated thrice. To know the effect of amino acids on alleviation of terminal moisture stress in groundnut the following treatments were foliar applied.

T_1 : Water spray

T_2 : Urea solution(1%)

T_3 : Activzyme* (0.1 %)

T_4 : Lihocin** (0.1 %)

T_5 : Arginine 100 ppm

T_6 : Glutamine 100 ppm

T_7 : Alanine 100 ppm

T_8 : Arginine 200 ppm

T_9 : Glutamine 200 ppm

T_{10} : Alanine 200 ppm

T_{11} : (Arginine+ Glutamine+ Alanine) 100 ppm

T_{12} : (Arginine+ Glutamine+ Alanine) 100 ppm + 1% Urea

T_{13} : Control (without any foliar spray)

(* and **Activzyme and Lihocin are commercial products of Modicare Ltd and BASF India ltd respectively)

The experiment was conducted in sandy clay loam soil with a plot size of 2X3 mt following standard package of practices. The spacing adopted was 30X10 cm. Need based irrigations were given, however, the crop was irrigated to field capacity at 45 DAS and then there was no irrigation provided between 50-80 DAS. Treatments were foliar applied on 65th day after sowing i.e 20 days after the last irrigation. By the time the soil reached to its permanent wilting point. The amino acids used for foliar application were procured from Sd Fine chemicals limited (Mumbai, India).

Morphological and physiological observations were recorded 15 days after imposition of the treatments. Destructive sampling of 5 plants from each replication was done. Data on plant height, SCMR (SPAD Chlorophyll meter Reading), SLA (Specific Leaf Area) and number of pegs per plant total drymatter per plant were recorded. Yield attributes *viz*., number of filled pods and unfilled pods, 100 kernel weight (gm), shelling per cent, harvest index and pod yield were recorded at harvest. Chlorophyll content was calculated by the formulae given by Arnon (1949) through DMSO method.

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

a) Growth parameters

There were significant differences observed among different treatments for SCMR, SLA & chlorophyll content. SCMR values were significantly highest in T_9 (Glutamine 200 ppm) (44.8) which was at par with T_2 (Urea solution (1%)) (43.4) followed by T_8 (Arginine 200 ppm), T_1 (water spray), T_7 (Alanine 100 ppm), T_6 (Glutamine 100 ppm), T_5 (Arginine 100 ppm) and T_8 (Lihocin 0.1 %). However, T_3 (Activzyme 0.1 %), T_{10} (Alanine 200 ppm), T_{11} ((Arg + Glu + Ala) 100 ppm) and T12 ((Arg + Glu + Ala) 100 ppm + 1 % Urea) were found to be non significant compared to control (38.0) (Table 1).

SCMR is an indication of leaf nitrogen status. Reddy *et al.* (2003) reported a positive correlation between SCMR and total chlorophyll content as well as SCMR and seed yield in groundnut genotypes. Higher SCMR value was due to high nitrogen content. Higher the nitrogen more is the chlorophyll content per unit leaf area leads to better photosynthetic efficiency and more carbon gain. A significant positive correlation between SCMR and chlorophyll content was also observed in the present study (Fig 1). Limited water supply usually causes a reduction in chlorophyll content. Being positively correlated with yield (Zaharieva *et al.*, 2001) relatively high chlorophyll content may contribute to the plant productivity under stress conditions. Exogenous application of amino acids like Tryptophan, Methonine, Cystein and Proline were reported to increase Chlorophyll –a, chlorophyll-b and total chlorophyll content (Al.Qubaie, 2012).

A clear negative correlation was observed between SCMR and SLA values (Fig 2). Among different treatments T_{11} (Arg + Glu + Ala) (100 ppm) (251.1 cm^2g^{-1}), T_{13} (Control) (249.9 cm^2g^{-1}), T_{10} (Alanine 200 ppm) (238.2 cm^2g^{-1}) recorded significantly higher SLA values. Low SLA values were recorded by T_5 (Arginine 100 ppm) (181.2 cm^2g^{-1}) followed T_9 (Glutamine 200 ppm) (179.3

cm^2g^{-1}), T_1 (water spray) (175.4 cm^2g^{-1}) T_6 (Glutamine 100 ppm) (171.3 cm^2g^{-1}), T_2 (Urea solution (1%)) (170.5 cm^2g^{-1}), T_4 (Lihocin 0.1 %) (168.5 cm^2g^{-1}), T_8 (Arginine 200 ppm) (168.0 cm^2g^{-1}), T_7 (Alanine 100 ppm) (167.8 cm^2g^{-1}) and T_{12} ((Arg + Glu + Ala) 100 ppm + 1% Urea) (165.3 cm^2g^{-1}). According to Renuka Devi *et al.* (2009), the groundnut genotypes under moisture stress condition with lower SLA and high SCMR values recorded higher yields.

SLA had a positive correlation with pod yield. Further a negative correlation between SLA and transpiration efficiency was also explained (Wright *et al.*, 1993). In the present study also it was observed that the treatment with high SCMR values, high chlorophyll content, low to moderate SLA showed positive correlation with pod yield. (Table 2).

b) Yield and Yield components

In the present study significantly higher number of filled pods were observed with T_9 (Glutamine 200 ppm) (11.2) followed by T_{10} (Alanine 200 ppm) (10.6), T_{12} ((Arg + Glu + Ala) 100 ppm + 1 % Urea) (10), T_5 (Arginine 100 ppm) (9.8) and T_8 (Arginine 200 ppm) (9.6) (Table 2). Moisture stress decreased the pod yield significantly, primarily due to reduction in number of pods per plant (41.2 %) followed by kernel weight (22.5 %) and number of seeds per pod (20.4) (Reddy *et al.,* 2003). Further, Bootang *et al.* (2010) reported that under moisture stress, reduction in 100 kernel weight though significant were not severe, ranging from 57.9 to 52.9 gm on an average. In the present study it was ranged between 31.9 to 44.4 gm. Among the different treatments T_9 (Glutamine 200 ppm) (44.4 gm), T_2 (Urea solution (1%)) (44.4 gm) and T_8 (Alanine 200 ppm) (42.3 gm) recorded significantly higher test weight (Table 2). The yield decrease in the present study due to moisture stress at the most critical stage of crop growth was around 51 per cent to 84 per cent when it was calculated on the basis of potential yield (35-37q ha^{-1}).

Higher shelling percentage is desirable in groundnut as it denotes high source-sink relationship. Moisture stress at pod development phase decrease the shelling percentage more significantly than other stages (Ramesh Babu *et al.*, 1984). Ramana Rao (1994) reported that shelling percentage in groundnut under simulated drought condition was 62.5 per cent and 66.5 per cent under adequately irrigated condition. Reshma (2014), reported that the shelling percentage of groundnut cultivar 'dharani' under early *kharif* situation was 73 per cent. In the present study shelling percentage was ranged from 72.6 to 82.2 per cent. Among the different treatments significantly higher shelling percentage was observed in T_9 (Glutamine 200 ppm) (82.2) followed by T_7 (Alanine 100 ppm) (82.5) and T_4 (Lihocin (0.1 %) (80.2) (Table 2).

Cultivars with vigorous early growth relatively large biomass accumulation and capacity for remobilization of stored assimilates to reproductive sinks might be adapted to drought stress (Wright and Rao, 1992). In the present study total dry matter at harvest was significantly high in T_8 (Arginine 200 ppm) (21.44) followed by T_9 (Glutamine 200 ppm) (21.39) and T_{10} (Alanine 200 ppm) (19.44). Besides a moderately high HI *viz*. 33.5, 35.5 and 36.4 was also observed with these treatments. It might be due to the increased remobilizing capacity of the assimilates assisted by amino acids.

CONCLUSION

Significantly highest pod yields (kg ha^{-1}) were recorded in T_9 (Glutamine 200 ppm) (1846.3 kg ha^{-1}) followed by T_8 (Arginine 200 ppm) (1643.7 kg ha^{-1}) and T_{12} (Arg + Glu + Ala 100 ppm) (1619.7 kg ha^{-1}) (Table.2). Foliar spray of amino acids caused increased chlorophyll content, high SCMR values and moderate SLA. They further might helped in increased total dry matter. The role of amino acids in remobilization of photosynthetic reserves for increased yields needed a further thorough investigation.

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Table 1. Effect of amino acids on morphological and physiological parameters of groundnut

S. No	Treatments	Plant Height (cm)	No. of pegs	SCMR	SLA (cm^2/gm)	Chlorophyll content (mg/g)
1	Water spray	27.1	11.6	41.1	175.4	2.34
2	Urea solution (1%)	32.8	10.7	43.4	170.5	2.78
3	Water spray 0.1 %	27.3	13.0	38.3	225.2	1.84
4	Lithocin 0.1 %	37.2	11.9	39.9	168.5	2.15
5	Argenine 100 ppm	31.4	12.2	40.2	181.2	2.31
6	Glutamine 100 ppm	27.9	10.3	40.2	171.3	2.38
7	Alanine 100 ppm	30.8	10.4	41	167.8	2.5
8	Argenine 200 ppm	35.6	15.4	42.1	168	2.55
9	Glutamine 200 ppm	35.1	16.2	44.8	179.3	2.8
10	Alanine 200 ppm	29.2	14.5	38.8	238.2	1.81
11	Arg + Glu + Ala 100 ppm	31.1	14.1	36.8	251.1	1.71
12	Arg + Glu + Ala 100 ppm + 1 % Urea	32.3	14.0	39.4	165.3	2.04
13	Control	35.2	12.9	38	249.9	1.73
	Mean	31.8	12.9	40.3	193.2	2.2
	SEM	1.15	1.0	0.5	6.0	0.11
	CD (5%)	3.36	3.0	1.5	17.5	0.33
	CV (%)	6.3	13.9	2.3	5.4	8.80

Table 2. Effect of amino acids on yield parameters of groundnut

S. No	Treatments	No. of Filled Pods	No. of Unfilled Pods	TDM/pl (g)	100 kernel weight (g)	Shelling (%)	Harvest index (%)	Pod yield (kg ha^{-1})
1	Water spray	8.4	3	13.19	35.6	81.0	36.6	1205.5
2	Water spry + 1 % Urea	7.4	3.9	16.20	44.4	76.1	36.4	1151.7
3	Water spray 0.1 %	8.4	1.4	14.24	31.9	78.6	32.9	615.5
4	Lithocin 0.1 %	6.8	2.6	13.87	33.8	80.2	31.4	627.3
5	Argenin 100 ppm	9.8	2.1	17.95	41.3	78.5	35.8	1292.3
6	Glutamin 100 ppm	7.8	2.8	13.24	38.6	77.7	34.6	957.3
7	Alanine 100 ppm	6.1	1.3	13.54	38.0	82.5	32.8	1198.8
8	Argenin 200 ppm	9.6	2.4	21.44	41.5	81.4	33.5	1643.7
9	Glutamin 200 ppm	11.2	4.3	21.39	44.4	82.2	35.5	1846.3
10	Alanin 200 ppm	10.6	3.9	19.44	42.3	72.6	36.4	1517.9
11	Arg+Glu+Ala 100 ppm	8.3	5.8	15.90	38.5	77.6	33.5	748.0
12	Arg+Glu+Ala 100 ppm + 1 % Urea	10	2.7	15.34	35.9	75.7	37.9	1619.7
13	Control	6.7	3.4	13.70	38.2	76.4	33.4	1050.9
	Mean	8.5	3.0	16.1	38.8	78.5	34.7	1190.4
	SEM	0.55	0.31	1.45	1.3	1.8	1.3	33.8
	CD (5%)	1.6	0.92	4.22	3.9	5.3	1.8	98.7
	CV (%)	11.1	18	15.50	6.0	4.0	6.4	4.9

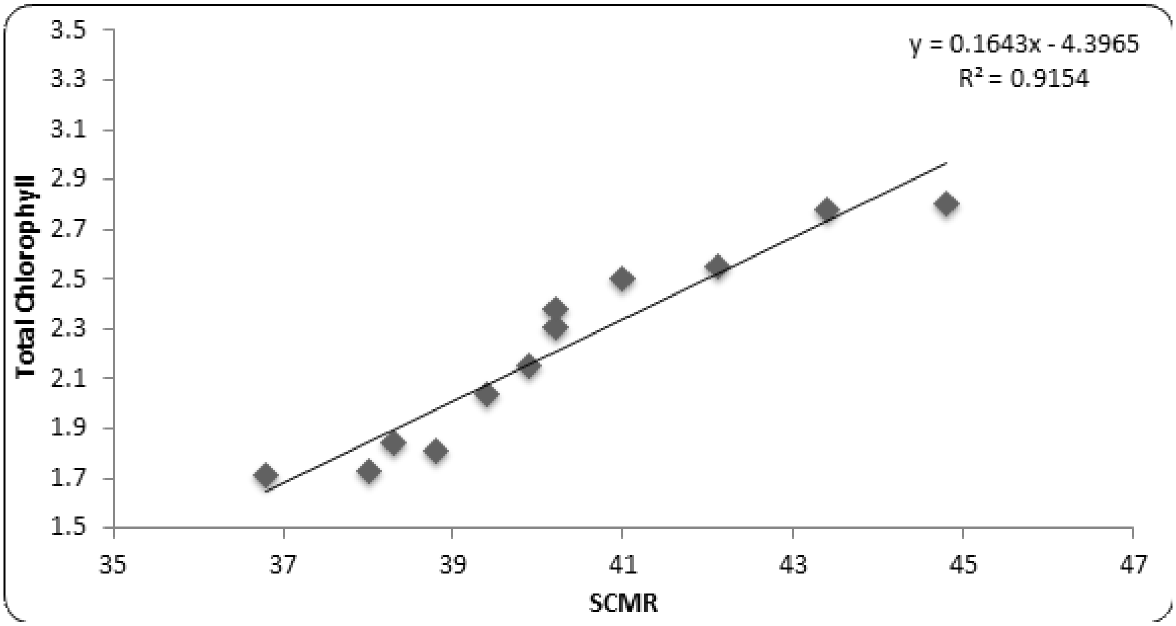

Fig. 1. Correlation between SCMR and total chlorophyll

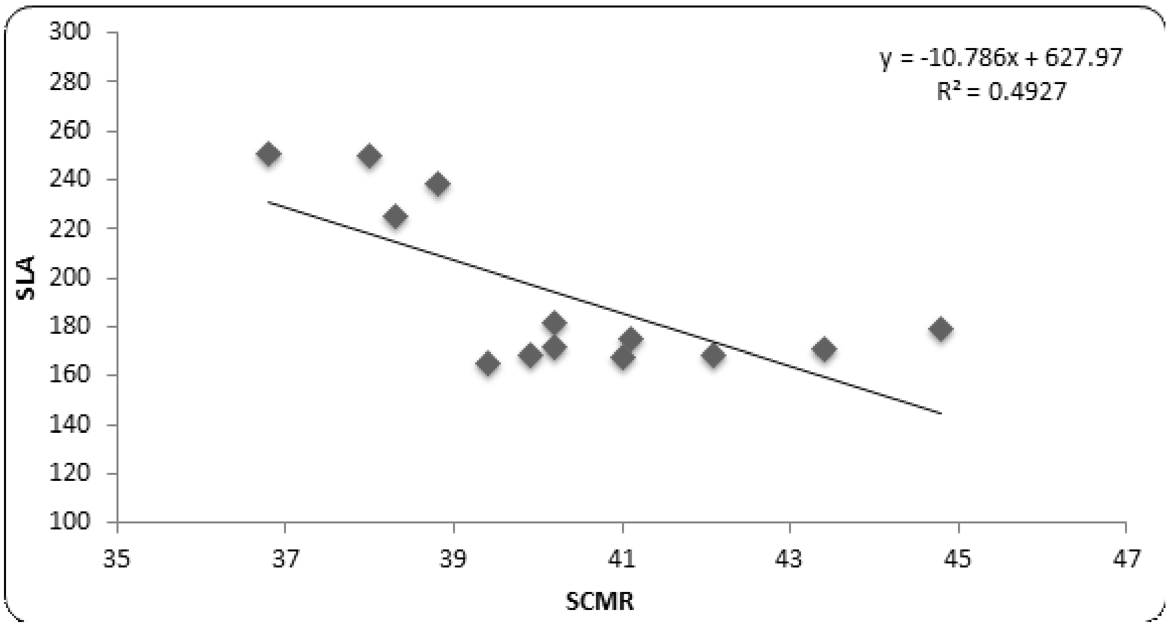

Fig. 2. Correlation between SCMR and SLA

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