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National Academy of Agricultural Science (NAAS) Rating : 3. 03

Effect of Water Regimes on Biochemical Parameters of Indian Bean (*Lablab purpureus* L.)

Vivek N. Zinzala, Ajay V. Narwade, Nilima Karmakar, S. Sree Ganesh, Akshay N. Kudache and Nitin B. Ahir

Abstract: *An experiment involving the effect of water regimes on biochemical parameters of Indian bean (Lablab Purpureus L.) variety Katargam, GNIB-21, GP-1, Wal-125-36, Guj. Wal-1 and Guj. Wal-2 was conducted at Navsari Agricultural University, Navsari, during 2014-15. Four irrigation treatments viz.,* I_0 *-All irrigation given i.e. 30, 60, 95 DAS (Control),* I_1*-Two irrigation level given i.e. 30, 60 DAS,* I_2*-One irrigation level 30 DAS and* I_3*-Rainfed was given. The various biochemical parameters like chlorophyll content, carotenoids, proline content, protein, glycine betaine content and lipid peroxidation productand yield and yield component were studied at 30 days intervals after stress i.e. 30, 60 and 90 DAS. Studies reported that the application of stress conditions at different growth stages of Indian bean was found to be lowers the different biochemical parameters like chlorophyll content, carotenoids and protein and proline, lipid peroxidation product and glycine betaine content increasing to increase stress.*

Keywords: *Indian bean, Stress, Biochemical parameters*

INTRODUCTION

Indian bean (*Lablab purpureus* L.) Sweet ($2n$ = 22) belonging to family *Fabaceae*, is one of the most ancient among the cultivated crops and is presently grown throughout the tropical regions in Asia, Africa and America. Green pods of Indian bean are used as excellent vegetable as they contain 25% protein. Mature dried seeds are a wholesome, palatable food, either cooked and eaten directly or used in the form of sprouts. Dried seed can be processed to make bean cake and protein concentrates as they contain 20 to 28% protein.

Water stress is a serious problem which affects overall productivity of agricultural system around the world. The retardation in plant growth under water stress is attributed to reduced accumulation of dry biomass due to inhibition of physiological process. Water stress led to improved chlorophyll content, carotenoid, proline, protein, glycine betaine content. Water stress caused mean yield reduction of 64% across population. The lack of water in the soil reduced the ability of the plant to extract essential nutrients from the soil. Water stress clearly affected biomass, dry weight of shoot and chlorophyll content (Banu and James, 2008).

In plants, a better understanding of the biochemical and physiological basis of changes in water stress resistance could be used to select or create new varieties of crops to obtain a better productivity under water stress conditions. The reactions of plants to water stress differ significantly at various organizational levels depending upon intensity and duration of stress as well as plant species and its stage of growth. Understanding plant biochemical responses to drought is of great importance and also a fundamental part for making the crops stress tolerant.

MATERIALS AND METHODS

A field experiment was conducted at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, during rabi season, 2014-2015. There were four treatment consisting of I_0-Control, All irrigation given *i.e.* 30, 60, 95 DAS, I_1-Two irrigation level given *i.e.* 30, 60 DAS, I_2-One irrigation level 30 DAS and I_3-Rainfed. Experiment was laid out in strip plot design with three replications.

Dry sowing of Indian bean variety Katargam, GNIB-21, GP-1, Wal-125-36, Guj. Wal-1 and Guj. Wal-2 was done on raise bed using seed rate of 5-7 kg/ha and maintaining spacing of 60 × 30 cm. The recommended dose of fertilizer was 25 kg Nha^{-1} and 50 kg P_2O_5 ha^{-1}. N and P_2O_5 were applied using urea and single super phosphate, respectively. Plants were harvested after attaining physiological maturity. The data collected from the experiment were subjected to statistical test by following 'Analysis of variance technique' as suggested by Panse and Sukhatme (1985).

RESULT AND DISCUSSION

Chlorophyll, Carotenoid and Protein

There was a significant result observed in the chlorophyll content, carotenoid content and protein among the six indian bean genotypes in the given irrigation condition. The data of the chlorophyll content, carotenoids and protein was recorded at 60 DAS and 90 DAS (Table 1) which reduced significantly in the stress condition. The results were homogenous to the findings of D'souza and Devaraj (2011), Mafakheri *et al*. (2010) and Banu and James (2008). The majority of chlorophyll lost from indian bean leaves subjected to water stress is lost from the mesophyll cells. The reasons for this preferential loss could be attributed to the fact that the mesophyll cells are further removed from the vascular supply of water than the bundle sheath cells, and hence develop greater cellular water deficits which lead to a greater loss of chlorophyll.

Proline

The data presented in (Table 1) indicated that proline content significantly differed among different varieties at different irrigation levels. The proline content significantly increased with the increase in the stress as compared to the irrigation conditions. Higher proline observed in variety Guj. Wal-1. The results were found homologous with Devi and Sujatha (2014), Kumar *et al*., (2011), Mafakheri *et al*., (2010) and Verbruggen and Hermans (2008). Accumulation of proline under stress in many plant species has been correlated with stress tolerance, and its concentration has been shown to be generally higher in stress tolerant than in stress sensitive plants. The accumulation of proline protects the cell under stress by balancing the osmotic strength of cytosol with that of vacuole and the external environment. When the intensity of drought stress increased the level of proline significantly increased in both the cultivars which could be linked to theirability to perform tissue osmotic adjustment to lower the osmotic potential and protect plant from damage of dehydration.

Glycine Betaine and Lipid Peroxidation Product (MDA)

It was indicated significant differences in glycine betaine content amongst the six indian bean genotypes. The data also indicated that glycine betaine content significantly increased due to stress. The glycine betaine content was recorded at 60 DAS and 90 DAS. The accumulation of the glycine betaine increased with the increase in the stress (Table 1). Higher glycine betaine and MDA observed in variety Guj. Wal-1. The results are homologous to the findings of Kokila *et al*., (2014), Mohammadi *et al*., (2011) and Banu and James (2008). Drought stress has profound effects on the glycine betaine and MDA accumulation in indian bean. The accumulation of glycine betaine and MDA might serve as an intercellular osmoticum of glycine betaine and MDA and could be closely correlation with elevation of osmotic pressure. Glycine betaine and MDA maintains the osmoticum, provided that the basal metabolism of the plant can sustain a high rate of synthesis of these compounds to facilitate osmotic adjustment for tolerance to water stress.

CONCLUSION

The present study on the effect of water stress on biochemical, yield and yield component under rabi season revealed that the stress at 60 DAS and 90 DAS leads to severe loss of yield in the indian bean genotypes by reducing the chlorophyll content, carotenoids and protein.Indian bean genotypes showed greater osmolytes accumulation *viz*., proline, lipid peroxidation product and glycine

Table 1
Effect of irrigation intervals on Chlorophyll content, Carotenoid, Proline, Protein, Glycine betaine content and Lipid peroxidation product of six Indian bean varieties at different irrigation interval

Genotypes	*Chlorophyll content*			*Carotenoid*		*Proline*	*Protein*	*Glycine betaine content*			*Lipid peroxidation product*						
	30 DAS	*60 DAS*	*90 DAS*	*60 DAS*	*90 DAS*		*60 DAS*	*90 DAS*					*60 DAS*	*90 DAS*		*60 DAS*	*90 DAS*	
Katargam	25.01	45.85	61.06	0.88	0.80		1.31	3.21		0.46			1.20	1.82		0.94	1.59	
GNIB-21	16.70	26.55	41.41	0.87	0.83		1.43	3.34		0.58			1.15	1.87		0.96	1.61	
GP-1	28.74	47.54	63.13	0.78	0.72		1.37	3.29		0.46			1.20	1.83		0.92	1.58	
Wal- 125-36	28.95	48.66	63.98	1.10	1.03		1.35	3.26		0.50			1.21	1.89		0.97	1.62	
Guj. Wal- 2	29.51	49.03	64.42	0.99	0.91		1.44	3.35		0.55			1.20	1.87		1.05	1.73	
Guj. Wal- 1	31.27	53.23	68.00	1.11	1.03		1.41	3.32		0.64			1.22	1.89		1.23	1.84	
Irrigation																		
I_0	27.74	47.35	63.10	1.17			0.93	2.13		0.58			0.87	0.97		0.79	1.34	
I_1	27.08	46.15	61.52	1.04			1.24	2.94		0.54			1.06	1.32		0.86	1.49	
I_2	26.46	44.72	59.62	0.89			1.53	3.76		0.51			1.30	2.05		1.11	1.79	
I_3	25.51	42.36	57.11	0.72			1.84	4.35		0.49			1.56	3.10		1.28	2.03	
30 DAS	*I*	*G*	*I × G*							*(Seed)*								
S.E.m+	0.48	0.53	1.10							I	G	I × G						
C.D.@ 5 %	NS	1.67	NS							0.005	0.005	0.029						
C.V. %	7.63	6.90	7.14							0.016	0.016	NS						
60 DAS	*I*	*G*	*I × G*	*I*	*G*	*I × G*	*I*	*G*	*I × G*	*3.760*	*3.330*	*9.420*	*I*	*G*	*I × G*	*I*	*G*	*I × G*
S.E.m+	0.95	0.93	1.73	0.012	0.013	0.037	0.004	0.004	0.005				0.008	0.008	0.017	0.010	0.018	0.037
C.D.@ 5 %	3.28	2.94	NS	0.041	0.042	0.108	0.016	0.011	0.013				0.029	0.026	0.050	0.035	0.055	0.107
C.V. %	8.9	7.15	6.64	5.34	4.88	6.80	1.37	0.89	0.57				3.020	2.420	2.520	4.300	6.020	6.320
90 DAS	*I*	*G*	*I × G*	*I*	*G*	*I × G*	*I*	*G*	*I × G*				*I*	*G*	*I × G*	*I*	*G*	*I × G*
S.E.m+	1.07	1.79	2.66	0.008	0.011	0.027	0.012	0.012	0.013				0.016	0.011	0.026	0.023	0.019	0.056
C.D.@ 5 %	3.70	5.65	NS	0.028	0.036	0.079	0.042	0.039	0.037				0.054	0.033	0.076	0.079	0.063	0.163
C.V. %	7.52	1029	7.65	3.87	4.46	5.36	1.57	1.29	0.67				3.590	1.960	2.440	5.890	4.160	5.900

betaine under stress condition. The osmolytes help plants to tolerate water stress and also to draw soil moisture stress from deeper root zone to maintain turgidity. It can also be used as an evaluating parameter for irrigation scheduling and for screening drought resistant varieties. The findings of the present study would help for evaluating genetic variation for drought tolerance in indian bean genotypes. In future, more emphasis may be laid on biochemical studies, which result in better understanding of the mechanism of plant survival under water stress condition. Increasing crop tolerance to water limitation would be the most economical approach for enhancing productivity and to reduce agricultural use of fresh water resources purposes.

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