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RESPONSE OF COTTON CULTIVAR Giza 80 TO Application OF GLYCINE BETAINE UNDER DROUGHT CONDITIONS

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ABSTRACT: *Glycine betaine has been shown to improve the growth and yield of cotton under normal growing conditions. However, it is not clear what the physiological and yield responses of cotton to glycine betaine are under conditions of environmental stress.*

The objective of these studies were to investigate the effect of glycine betaine application on plant growth, dry matter accumulation, leaf photosynthesis, chemical leaves content and yield of cotton subjected to normal and water deficit.

Seeds of Cv. Giza 80 cotton were sown during 2004 and 2005 seasons in pots after complete germination, thinning was carried out leaving one plant per pot. Plants irrigation was carried out regularly at the plant needs using tap water up to the start of flowering stage, then some of plants subjected to drought conditions by preventing water supply till the appearance of sign of wilting and spraying with glycine betaine 600 g/f., Leaving the control plants without treatments. The resulted indicated that, Drought conditions significantly decreased root and shoot length, number of nodes and fruiting branches, leaf area, photosynthetic rate and dry matter accumulation of cotton plants, while the reveres was true for root /shoot ratio. Also, drought conditions reduced chloroplast pigments i.e., chlorophyll A and B and carotein, reducing, non reducing and total soluble sugars, monophenol, poly and total phenols in cotton leaves while, the contrary was obtained in proline content in leaf. Also, the reduction in yield and yield components was observed as results of water stress.

On the other hand, spraying cotton plants with glycine betaine under normal and drought conditions tended to increase physiological processes i.e., stomatal conductance, photosynthetic rate and this tended to a significant increase in growth parameters i.e., number of nodes and fruiting branches, leaf area, dry weight of different organs per plant, root / shoot ratio and some chemical content in cotton leaves i.e., chlorophyll A, B and carotein, reducing, non reducing and total soluble sugars, monophenol, poly and total phenols and proline. Also, the application of glycine betaine tend to a significant increase in number of flowers and bolls per plant, boll setting and lint percentage, boll weight, seed index and seed cotton yield (gm) per plant. On the other hand, no significant effects with the application of glycine betaine on fiber properties.

Key words: *Cotton, glycine betaine, growth, yield, chemical composition.*

INTRODUCTION

Water is generally considered the most limiting factor in higher plants than any other single environmental factor. Exposing cotton plants to water stress especially during the flowering stage, adversely affected plant growth and productivity (Kassem and Alia, 2003 and Meek *et al*., 2003).

Therefore, it seems imperative to work for improving water use efficiency for major crops including cotton which could be approached by searching for means helping in promoting drought tolerance of cotton plants attempt to tolerate or resist stresses due to decreased water availability by making osmotic adjustments to cells through increase in organic ions or organic solutes (Ashraf and Foolad, 2007).

The naturally occurring quaternary ammonium compound and glycine betaine has received attention as a compatible solute that may aid in drought tolerance by allowing maintenance of turgor pressure (Agboma *et al*., 1997 and Meek *et al*., 2003). Glycine betaine also protects physiological processes such as photosynthesis and protein synthesis from the result of water deficit and other stresses (Sulpice *et al*., 2002 and Meek *et al*., 2003). Glycine betaine has been exogenously applied to a variety of crops in an effort to improve stress tolerance and yield. Some of crops include Maize and Sorghum (Agboma *et al*., 1997) and cotton (Gorham and Jokinen, 1998). Results varied, however, and appeared to depend on numerous factors such as type of crop, timing and rate of application and environmental conditions.

In soybeen, exogenous foliar applications of glycine betaine decreased transpiration, increased leaf conductance, improved photosynthetic activity and increased leaf area, but an overall increase in yield between treated and control plants was not observed (Agboma *et al*., 1997). According to Gorham *et al*. 2000, foliar sprays of glycine betaine improved the growth of field-grown cotton in Pakistan when 2.68 lb / acre (3 kg / ha) were applied at time of squaring.

Alia (2003) found that glycine betaine dose and time of application had highly significant effects on chlorophyll, carbohydrate, phenolic compounds, total amino nitrogen in cotton leaves, oil and protein in cotton seeds and significant increased in number of bolls and flowers per plant and seed cotton yield per feddan. On the other hand, fiber properties were insignificantly affected.

On contrary, Meek *et al*. (2003), reported that endogenous glycine betaine concentrations were significantly higher in water-deficit stressed plants, but were unaffected by foliar application of glycine betaine. It is possible that the high endogenous levels of glycine betaine in cotton are responsible for the lack of effects with foliar applications.

The objective of this study is to evaluate the potential use of glycine betaine to enhance yield and drought tolerance in cotton.

MATERIALS AND METHODS

Two pot experiments were carried out in the Agricultural Experimental Station of A.R.C. at Giza, during 2004 and 2005 seasons to study the response of Giza 80 cotton cultivar to glycine betaine under normal and drought conditions.

Seeds of Cv. Giza 80 were sown in clay loam soils on 4th April in both seasons, plants were thinned leaving one plant per pot, all pots received an adequate amount of fertilizer in order to produce a sound and healthy plants, irrigation was carried out regularly at the plant needs using tap water up to the start of flowering stage, then the pots spilt to two groups. The first group were irrigated using tap water during the whole season, second group were subjected to drought conditions by preventing water supply till the appearance of sing of permanent wilting and spraying with glycine betaine at 600 g/f., leaving the control plants without treatments.

Each treatment consisted of ten pots in which were used for daily flower counting and in recording the following characters at the end of season.

Samples of four plants of all treatments after ten days of applied glycine betaine were used for measuring photosynthesis rate and stomatal conductance by photosynthesis system. C1–310, determined leaf area by AREA meter Model LI-3100 and plants were separated to roots, shoots, leaves and square parts. All of these fractions were oven–dried to determine root / shoot ratio and total dry weight per plant.

For chemical analysis in which leaf samples were obtained from the upper fourth node of the apex. after ten days from the treatment application and the following constituents were determined i.e., chlorophylls (Arnon, 1949), carotenoids (Rolbelen , 1957), total soluble sugars (Cerning, 1975), reducing sugars (A.O.A.C., 1975), poly phenols and total phenols (Simons and Ross, 1971) proline content (Bates *et al.*, 1973).

At harvest, root and shoot length (cm), number of main stem nodes and inter-node length (cm), number of flowers and open bolls per plant, boll setting %, boll weight, lint percentage, seed index and seed cotton yield per plant were measured.

Fiber quality i.e., micronaire reading and Pressley index were measured at the Laboratories of C.R.I. according to A.S.T.M. (1975). The differences between treatments were tested as described by Snedecor and Cochran (1981) using L.S.D. at 5 %.

RESULTS AND DISCUSSION

A. Growth characters:

I. Irrigation:

The results presented in Table (1) reveal that drought conditions exerted a significant influence on all growth characters in both seasons. It is clear from these data that plant subjected to water stress conditions decreased root and

Table (1): Effect of Glycine betaine (GB) on growth characters of cotton in 2004 and 2005 seasons.

Irrigation intervals A	Treatment B	Root length (cm)	Shoot length (cm)	No. of main stem nodes/P	Internode Length (cm)	No. of fruiting branches/P	Dry weight (gm)				Root/Shoot %	Leaf area (cm)
							Root	Shoot	Leaves	Square part		
							2004					
Turgied	Control	30.3	38.3	14.7	2.60	7.2	9.97	12.67	11.63	8.73	0.78	400
	G.B.	30.7	40.7	15.0	2.73	8.8	10.97	12.83	14.43	10.40	0.85	500
	Mean	30.5	39.5	14.9	2.62	8.0	10.47	12.75	13.03	9.57	0.81	450
Wilted	Control	25.3	29.0	11.7	2.47	5.3	7.50	9.11	6.90	4.20	0.82	290
	G.B.	26.3	38.0	13.9	2.73	6.7	8.40	10.00	10.20	6.87	0.84	380
	Mean	25.8	33.5	12.5	2.60	6.0	8.00	9.55	8.55	5.53	0.83	335
Average of	Control	27.8	33.7	13.2	2.53	6.3	8.73	10.90	9.30	6.47	0.80	345
	G.B.	28.5	39.4	14.4	2.73	7.8	9.70	11.41	12.32	8.63	0.84	440
L.S.D.	A	S	S	S	S	S	S	S	S	S	S	S
	B	S	S	S	S	S	S	S	S	S	S	S
	A x B	0.7	0.3	N.S.	N.S.	N.S.	0.93	N.S.	3.2	N.S.	N.S.	N.S.
							2005					
Turgied	Control	29.4	36.0	12.80	2.81	6.2	8.00	11.90	10.70	7.80	0.67	390
	G.B.	30.0	38.7	13.00	2.97	7.9	9.10	12.10	12.90	9.80	0.75	480
	Mean	29.7	37.35	12.90	2.89	7.05	8.55	12.00	11.80	8.80	0.71	435
Wilted	Control	24.9	28.0	10.60	2.64	5.0	6.90	8.30	6.00	4.00	0.83	280
	G.B.	26.3	36.0	12.00	3.00	6.2	8.80	9.90	9.90	5.80	0.88	370
	Mean	25.6	32.0	11.30	2.82	5.6	7.85	9.10	7.95	4.90	0.85	325
Average of	Control	27.15	32.00	11.70	2.73	5.60	7.90	10.10	8.35	5.9	0.75	335
	G.B.	28.15	37.35	12.50	2.98	7.05	8.45	11.50	11.40	7.8	0.81	425
L.S.D.	A	S	S	S	S.	S	S	S	S	S	S	S
	B	S	S	S	S	S	S	S	S	S	S	S
	A x B	0.8	0.5	N.S.	N.S.	N.S.	0.30	N.S.	2.1	N.S.	0.3	N.S.

S. : Significant.
N.S. : Not Significant.

shoot length, number of nodes and fruiting branches, inter-node length, dry weight of all plant organs per plant and leaf area.

On the contrary, water stress tended to increase root / shoot ratio. Water stress could restrict inter-node elongation and leaf expansion through inhibiting cell expansion, the process known to be sensitive to water stress. Also, drought could lower biomass accumulation by driving the plants to minimize water loss through transpiration by inducing stomatal closure and since carbon gain can occur only while water is being lost (Radin, 1989), this could decline the photosynthetic rate (Yi *et al.*, 2000) and reduce dry matter accumulation on a whole plant basis. However, since root growth is less sensitive to water stress as compared with vegetative growth especially leaf expansion and root under drought conditions can continue growth deeper in to the profile to exploit a diminishing water supply, root / shoot ratio could be increased under water deficiency stress (Ball *el al.*, 1994). These results are in general agreement with the finding of Ganotisi and Angeles (1990), Kassem and Alia (2003) and Sanaa (2007).

II. Glycine betaine effect:

It is clear from Table (1) that the foliar application of glycine betaine had a significant increase on all studied growth characters as compared with the control in both seasons. The pronounced increase in vegetative growth due to spraying glycine betaine may be a result of a corresponding increase in photosynthesis pigment, photosynthesis rate and carbohydrates content. Glycine betaine as a source of carbon (acetyl Co-A) the availability of carbon in the vicinity of the leaf enhances the photosynthesis rate (Gorham and Jokinen, 1998). These results are in agreement with findings of Meek *et al.* (2003), Yang *et al.* (2003) and Ashraf and Foolad (2007).

III. Interaction:

The interaction between water stress and glycine betaine significantly affected shoot and root length, dry weight of root and leaves in both seasons and root/shot ratio in 2005 season. This may be a mean of osmotic adjustment by which glycine betaine exerted the previously reported improvement in leaf turger pressure and water potential under water stress conditions.

B. Chemical constituents of leaves and photosynthesis rate:

It is obvious from Table (2) that water stress exerted a significant decrease in chloroplast pigments, carbohydrates and phenols content in cotton leaves.

On the contrary, plants subjected to water stress conditions accumulated more proline content in leaves as compared to turgid one.

Concerning the effect of water stress on photosynthesis rate and stomata conductance, figures (1) and (2) showed that water stress also significantly decreased photosynthesis rate and stomata conductance.

Drought conditions tended to reduce chlorophyll A, B and caroteines, this may be due to the reduction of all carbohydrate contents (reducing sugar, non-reducing and total soluble sugars) in leaves. The reduction here may be due to the inhibition of carbohydrate formation by photosynthesis or the degradation as a result of increasing hydrolytic enzymes under drought conditions (Alia, 1997, Kassem and Alia, 2003 and Sanaa, 2007).

These results are in accordance with those of Yi *et al.* (2000), who reported that water stress decreased chlorophyll content in leaves and hence, where it reduced their photosynthetic rate.

Also, water stress tended to reduce total and poly phenols content as compared to these found in turgid one. Phenolic compounds as well known can be synthesized through three pathways, i.e., acetate, mevalonate and shikimic acid. The main precursors for phenol synthesis in plant tissue are carbohydrates, especially soluble carbohydrate in which lead to the formation of the essential substances required for simple and poly phenols synthesis. Thus, the reduction in phenolic compounds in which was observed may be due to the reduction in soluble carbohydrate under drought conditions (Table 2). These results are in harmony with the results of Ahmed *et al.* (1989), Kassem and Alia (2003) and Sanaa (2007). They concluded that phenolic content of cotton leaves decreased sharply when the cotton plants were subjected to water stress.

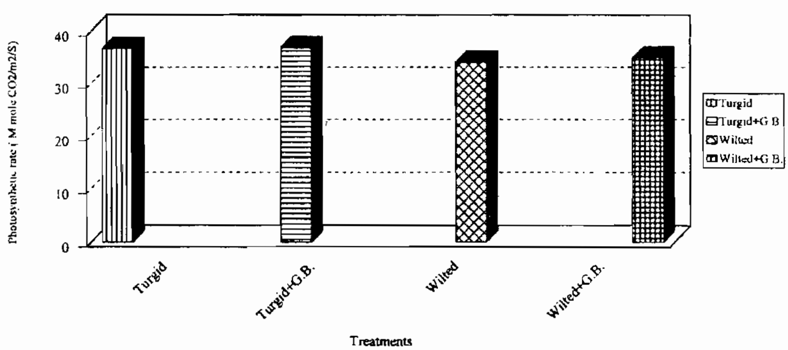

Figure 1: Effect of glycine betaine application on photosynthesis rate under normal and drought conditions.

Table (2): Effect of Glycine betaine (GB) on some chemical constituents of cotton leaves in 2004 and 2005 seasons.

Irrigation intervals A	Treatment B	Chloroplast pigments mg/g			Carotein mg/g dry wt.	Carbohydrate (mg/gm dry wt.)			Phenols (mg/gm dry wt.)			Proline mg/gm f.wt.
		Chl. A	Chl. B	Total chl.		R.S.	Non R.S.	T.S.S.	Mono	Poly	Total	
		2004										
Water irrigation	Control	3.15	2.73	5.88	0.89	6.53	3.03	9.56	2.51	4.19	6.70	3.07
	G.B.	3.85	3.20	7.05	1.17	7.77	3.92	11.69	2.65	4.96	7.61	4.40
	Mean	3.50	2.97	6.47	1.03	7.15	3.48	10.63	2.58	4.58	7.16	3.73
Water stress	Control	1.78	1.50	3.28	0.78	3.57	1.09	4.66	2.25	3.50	5.75	6.07
	G.B.	2.47	2.37	4.84	0.94	6.80	2.12	8.92	2.95	3.61	6.56	7.33
	Mean	2.12	1.94	4.06	0.86	5.19	1.61	6.79	2.60	3.56	6.16	6.70
Average of	Control	2.47	2.13	4.58	0.84	5.05	2.06	7.11	2.38	3.85	6.23	4.57
	G.B.	3.16	2.79	5.95	1.06	7.29	3.02	10.31	2.80	4.29	7.08	5.87
L.S.D.	A	S	S	S	S	S	S	S	S	N.S.	N.S.	S
	B	S	S	S	S	S	S	S	S	S	S	S
	A x B	N.S.	N.S.	N.S.	0.07	1.05	0.80	0.45	0.77	0.77.	1.15	0.31

S. : Significant.
N.S. : Not Significant.

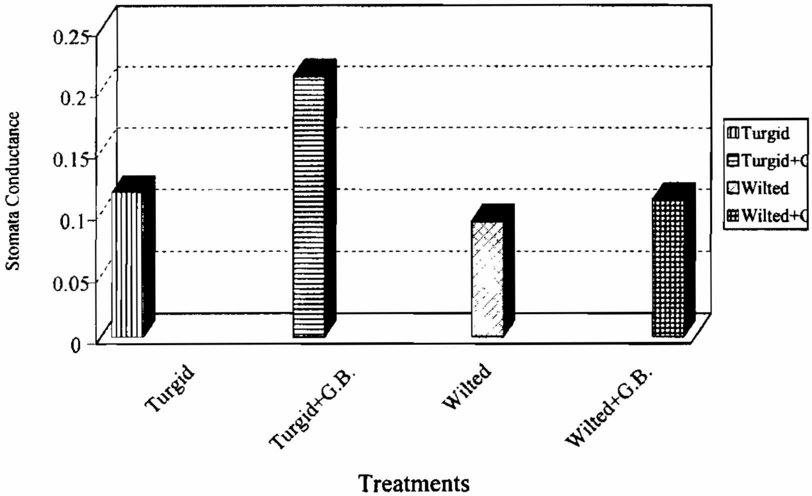

Figure 2: Effect of glycine betaine (GB) application on stomata conductance under normal and drought conditions.

On the contrary, leaves of wilted plants accumulated more proline than those of turgid one and this increase was 49.4 % over turgid one. The increase here may be due to the increase in protein hydrolysis as a result of increasing the activity of hydrolytic enzymes (Nayyer *et al.*, 2003) and / or to increase the synthesis of proline.

Proline would be a good source of energy and N for the plant under drought conditions. These results are agreement with the findings of many investigators, Ahmed *et al.* (1989), Alia (1997), Badran (2006) and Ashraf and Foolad (2007).

II. Glycine betaine effect:

It is clear from Table (2) that the foliar application of glycine betaine had a significant increase in chlorophylls, carbohydrates, phenols and proline contents of leaves. Such increase in chemical contents due to glycine betaine application may be attributed to that (GB) could be a good storage form of nitrogen because of its metabolic proximity and ready conversion to glutamic acid, a key compound in nitrogen metabolism and source of reducing power. Applying (GB) prior to water stress improved photosynthesis by increasing of stomata conductance (Figure 1 and 2).

These results are parallel with the findings of Alia (2003), Nayyar *et al.* (2003) and Meek *et al.* (2003), who reported that (GB) increased chlorophyll, phenols, carbohydrates and proline contents of cotton leaves.

III. Interaction:

The interaction between irrigation intervals and glycine betaine had significant effects on reducing and non-reducing sugars, total soluble sugars, caroteinoid, mono, poly and total phenols and proline contents on cotton leaves but their were in significant effects occurred on the chlorophyll A, B and total chlorophyll. This may be a mean of osmotic adjustment by which (GB) exerted the previously reported improvement in leaf turger pressure and water potential under water stress conditions and increased of stomatal resistant.

C. Yield and its components:

I. Irrigation:

Data presented in Table (3) show that water stress had a significant effect on number of flowers and open bolls per plant, boll setting percentage, boll weight, lint percentage, seed index and seed cotton yield per plant in both seasons. The reduction in yield and yield components as a result to water stress is a logical result of the reduction in vegetative growth in which reflected in lower number of flowers and open bolls as well as lower boll weight (Alia, 1997 ; Gorham *et al.*, 2000 and Sanaa, 2007). It is clear from results mentioned previously that growth and fruiting of cotton plant adversely affected by water stress. Such effects is mainly due to the effects of water stress on certain physiological functions i.e., stomatal conductance, photosynthesis and transpiration. Meek *et al.* (2003), found that water stress decreased stomatal resistance to CO_2 and H_2O and that the major reason that water stress reduced photosynthesis was its effect on the light reaction of the process.

II. Glycine betaine effect:

The data in Table (3) reveal that the foliar application of glycine betaine had a significant increase in yield and yield components. Applying glycine betaine under normal and water stress conditions tended to increase the number of flowers and bolls per plant, boll setting and lint percentage, boll weight and seed cotton yield per plant. This effects are mainly due to the improving effects of glycine betaine on the physiological functions i.e., stomatal conductance and photosynthesis rate (Fig. 1 and 2) as well as increasing in chemical contents of cotton leaves (Table 2).

In addition to, its role as an osmolyte for osmotic adjustment, glycine betaine contributes to stabilizing sub-cellular structures (e.g. membranes and proteins), scavenging free radicals and buffering cellular redox potential under stress conditions, it may also function as a protein-compatible hydrotrope (Srinivas and Balasubramanian, 1995). Many investigations obtained the same results, Meek *et al.* (2003), Alia (2003) and Ashraf and Foolad (2007).

Table (3): Effect of Glycine betaine (GB) on yield and yield components of cotton in 2004 and 2005 seasons.

Irrigation intervals A	Treatment B	No. of flower per plant	No. of bolls per plant	Boll setting %	Boll weight (gm)	Lint percentage %	Seed index (gm)	Seed cotton yield per plant (gm)	Micronaire reading	Pressley index
						2004				
Turgied	Control	16.50	10.3	62.4	2.10	40.2	10.28	21.43	4.1	9.9
	G.B.	19.2	13.7	71.3	2.40	40.3	10.55	32.86	4.4	9.8
	Mean	17.9	12.0	66.9	2.24	40.3	10.42	27.15	4.2	9.8
Wilted	Control	13.3	8.0	61.5	1.90	37.9	9.99	15.11	4.0	9.2
	G.B.	18.0	11.7	65.0	2.26	40.1	10.30	26.33	4.1	9.5
	Mean	15.7	9.9	63.3	2.08	39.0	10.14	20.72	4.1	9.4
Average of	Control	14.9	9.2	61.9	1.99	39.1	10.13	18.27	4.0	9.6
	G.B.	18.6	12.7	68.2	2.33	40.2	10.42	29.59	4.3	9.6
L.S.D.	A	S	S	S	S	S	S	S	N.S.	N.S.
	B	S	S	S	S	S	S	S	N.S.	N.S.
	A x B	N.S.	N.S.	N.S.	0.32	N.S.	N.S.	N.S.	N.S.	N.S.
						2005				
Turgied	Control	15.0	9.3	62.0	2.44	41.8	.9.17	23.03	4.3	10.1
	G.B.	18.9	12.0	63.4	2.77	42.1	9.82	32.83	4.2	9.8
	Mean	16.9	10.7	62.7	2.61	41.9	9.49	27.93	4.3	9.9
Wilted	Control	9.0	6.7	51.1	1.92	38.9	9.00	12.86	4.1	9.7
	G.B.	11.0	8.6	60.0	2.46	40.3	9.80	20.77	4.3	9.6
	Mean	10.0	7.6	55.6	2.20	39.6	9.40	16.81	4.2	9.6
Average of	Control	12.0	8.0	56.6	2.20	40.4	9.10	17.99	4.2	9.9
	G.B.	14.9	10.3	61.7	2.62	41.2	9.80	26.80	4.3	9.7
L.S.D.	A	S	S	S	S	S	S	S	N.S.	N.S.
	B	S	S	S	S	S	S	S	N.S.	N.S.
	A x B	N.S.	N.S.	N.S.	0.14	1.10	N.S.	N.S.	N.S.	N.S.

S. : Significant.
N.S. : Not Significant.

III. Interaction:

The interaction between water stress and glycine betaine significantly affected only in boll weight in 2004 season and boll weight and lint percentage in 2005 season as the positive effects of glycine betaine in both traits were more pronounced under water stress. This could be due to that glycine betaine promoted some morphological and physiological responses that benefit water stress plants more than well watered, such as increasing leaf area, increasing root / shoot ratio, increasing leaves content of sugars and increasing proline content which all could improve water relations of water-stressed plants (Ashraf and foolad, 2007).

D. Fiber quality:

The results of fiber quality as shown in Table (3), indicate that the two studied factors and their interaction had no significant effects on micronaire reading and Pressley index. (Kassem and Alia, 2003).

CONCLUSION

Finally It could be concluded from this study that the exogenous application of glycine betaine to plants under normal and water stress conditions had positive effects on physiological functions i.e., stomatal resistance and photosynthesis rate as well as chemical contents in cotton leaves which increased plant growth and enhanced the plant fruiting efficiency and yield especially under water stress conditions. Glycine betaine increased seed cotton yield of water stressed plants to be statistically equal to that of well-water control plants. Consequently, it could be concluded that successful application of glycine betaine to improve plant stress tolerance and it is an environmentally friendly beside that glycine betaine had economic applications.

REFERENCES

Agboma, M., M.G.K. Jones, P. Pettonen-Sainio, H. Rita and E. Peha (1997). Exogenous glycine betaine enhances grain yield of maize, sorghum and wheat grown under two supplementary watering regimes. J. Agron. and Crop Sci., 178: 29 – 37.

Ahmed, F.M., M.S. Ismail and Abdel-Al (1989).Effect of drought conditions at bolling stage on some chemical constituents of cotton plant. J. Agron. and Crop Sci, 163: 167 – 173.

Alia, A. M. Namich (1997). Biochemical studies on cotton plant. Ph. D. Thesis, Fac. Agric., Cairo Univ.

Alia, A. M. Namich (2003). Effect of glycine betaine on growth, yield, yield components and some chemical constituents of cotton plant of Giza 80. Egypt. J. Appl. Sci., 18 (1): 91 – 101.

Arnon, D. I. (1949). Copper enzymes in isolated chloroplast. Plant physiol., 24: 1 – 15.

Ashraf, M. and M.R. Foolad (2007). Roles of glycine betaine and proline in improving plant a biotic stress resistance. Environmental and Experimental Botany 59 (2): 206 – 216.

A.O.A.C. (1975). Official Methods of analysis of Official Agricultural chemists 12th ed. Washington D.C.

A.S.T.M. (1975). American society for testing and Materials. Standard on textile Muterials (D 1448-59 and D 1445-67). The Society, Washington, Philadelphia, U.S.A.

Badran A. E. (2006). Bio-Metrical and Bio-Technological aspects to evaluate some Egyptian genotypes under stress conditions. Ph. D. Thesis, Agric., Cairo Univ.

Ball, R. A., D.M. Oosterhuis and A. Mauromoustakos (1994). Growth dynamics of the cotton plant during-deficit stress. Agron. J., 86: 788 - 795.

Bates, L. S., R. P. Waldren and I. D. Teare (1973). Rapid determination of free proline for water stress. Plant and Soil, 39: 205 – 207.

Cerning, B. J. (1975). A note on sugar determination by the enthrone method. Cereal Chem., 52: 857.

Ganotisi, N. D. and H. L. Angeles (1990). Irrigation strategies for cotton under Limited water supply. Cotton Conf., 1: 46 – 49.

Gorham, J. (1996). Centre for Arid Zone Studies, School of Biological Sciences, University of Wales, Bangor LL 57 2 UW, Wales, UK. Phytochemistry, 1996, 43 (2): 367 – 369.

Gorham, J., J. Bridges, M. N. Malik and I. A. Khan (2000). Physiological response of cotton to water deficit in Pakistan. Pages 587 – 590.World Cotton conference.

Gorham, J. and Jokinen (1998). Glycine betaine treatment improves cotton yield in field trials in Pakistan. P. 329. World cotton conference II, Athens, Greece, in press.

Kassem, M.M.A. and Alia A.A. Namich (2003). Response of cotton cultivar Giza 83 to Mepiquat chloride (Pix) under two levels of irrigation intervals. Egypt. J. Appl. Sci., 18 (5): 105 – 121.

Meek, C., D. Oosterhis and J. Gorham (2003). Does foliar applied glycine betaine effect endogenous betaine levels and yield in cotton on line. Crop Management doi. 10 – 1904 / CM –2003–0804–02– RS.

Nayyar H. and D.P. Walia (2003). Water stress induced proline accumulation in contrasting wheat genotypes as affected by calcium and abscisic acid. Biol. Plant. 46 (2003), PP 275 – 279.

Radin J.W. (1989). When is stomatal control of water loss consistent with the thermal kinetic window concept. Proc. Beltwide c otton Conf., 1: 46 – 49.

Rolbelen, G. (1957). Untersuchungen on strohlenin duzieten blat arbumutonten von arbidopoid thalianal (L.). Verbungsic.

Saanaa, G. Gebaly (2007). Effect of foliar application of methanol under two levels of irrigation regime on cotton productivity. Egypt. J. Agric. Res., 85 (2): 615 – 628.

Simons, T. J. and A. F. Ross (1971). Change in phenol metabolism associated with enclosed systemic resistance to tobacco mosaic Virus Samson N. tobacco. Phytopathology, 61 : 1261 – 1265.

Sirnivas, V. and D. Balasubramanian (1995). Proline is protein-compatible hydrotrope, Langmuir 11 : 2830 – 2833.

Snedecor, G. W. and W. G. Cochran (1981). Statistical Method. 7th ed. Iowa State Univ., Press. Ames, U.S.A., 305 PP.

Sulpice, R., Y. Gibon, G. Cornic and F.R. Larher (2002). Interaction between exogenous proline content and photo-respiratory pathway in canola leaf discs, Physiol. Plant. 116 (200), PP. 460 – 467.

Yang, W.J., P.J. Rich, J.D. Axtell, K.V. Wood, C. C. Bonham, G. Ejeta, M.V. Mickelbart and D. Rhodes (2003). Genotypic variation for glycine betaine in sorghum. Crop Sci. 43: 162 - 169.

Yi, LH, Y.Q. Zhou and T.M. Hua (2000). The effect of soil moisture on the chlorophyll content and photosynthetic rate of different cotton cultivars. China Cottons, 27 (2): 21 – 22.

أستجابة صنف القطن جيزة ٨٠ للمعاملة بالجليسين بتايين تحت ظروف التعطيش

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للجليسين بتايين دور واضح فى تحسين النمو والمحصول لنباتات القطن النامية تحت ظروف الرى العادى. ولم يتضح دوره بعد على العمليات الفسيولوجية وكذلك محصول نبات القطن تحت ظروف الجفاف. وتهدف هذه الدراسة إلى معرفة تأثير المعاملة بالجليسين بتايين على معدل البناء الضوئى والنمو والوزن الجاف ومحتوى الأوراق من المكونات الكيميائية والمحصول وذلك تحت ظروف الرى العادية والتعطيش.

زرعت بذور صنف جيزة ٨٠ خلال موسمى ٢٠٠٤ و ٢٠٠٥ فى أصص قطرها ٤٠ سم ، بعد تمام الأنبات تم خف النباتات إلى نبات واحد فى كل أصيص. رويت التباتات بأنتظام بأستخدام مياه الصنبور حتى بداية التزهير ، ثم تعرض بعض النباتات إلى التعطيش لحين ظهور علامات الجفاف على النباتات ثم ترش النباتات بالجليسين بتايين بتركيز ٦٠٠ جم/فدان مع ترك جزء بدون معاملة (كنترول).

وكانت النتائج المتحصل عليها كالتالى:

١. أدى التعطيش إلى نقص معنوى فى طول الساق والجذر وعدد العقد والأفرع الثمرية ومساحة الأوراق ومعدل البناء الضوئى والوزن الجاف للجذور بالنسبة للمجموع الخضرى. أيضاً يؤدى التعطيش إلى نقص فى محتوى الأوراق من الصبغات النباتية مثل كلورفيل أ ، ب والكاروتين والسكريات المختزلة والغير مختزلة والذائبة الكلية والفينولات الأحادية والعديدة والكلية فى أوراق القطن ، بينما حدث العكس بالنسبة لمحتوى الأوراق من البرولين. لذلك حدث نقص فى المحصول ومكوناته كنتيجة منطقية للتعطيش الذى يؤدى إلى نقص فى كل العوامل السابقة.

٢. أدى رش نباتات القطن بالجليسين بتايين تحت ظروف الرى العادية والتعطيش إلى الزيادة فى العمليات الفسيولوجية مثل كفاءة الثغور ومعدل البناء الضوئى وأدى هذا إلى زيادة معنوية فى معدل النمو مثل عدد العقد والأفرع الثمرية على النباتات ، ومساحة الورقة والوزن الجاف للأعضاء النباتية المختلفة للنبات ، وكذلك نسبة الوزن الجاف للجذور بالنسبة للمجموع الخضرى ، وبعض المكونات الكيميائية فى الورقة مثل كلورفيل أ ، ب والكاروتين والسكريات المختزلة والغير مختزلة والكلية الذائبة ، والفينولا ت الأحادية والعديدة والكلية ، والبرولين.

٣. أدى المعاملة بالجليسين بتايين إلى زيادة معنوية فى عدد الأزهار واللوز بالنسبة للنبات، والنسبة المئوية للوز العاقد والألياف ، ووزن اللوزة ووزن ١٠٠ بذرة ، وكذلك محصول القطن الزهر للنبات بالجرام. ومن ناحية أخرى لم يكن للمعاملة بالجليسين بتايين تأثير معنوى على الصفات التكنولوجية للألياف.

* يمكن أن نستخلص من هذه الدراسة أن الرش بالجليسين بتايين أدى إلى بعض التحورات المورفولوجية والفسيولوجية والبيوكيميائية بالنبات والتى تحسن من صفات النبات تحت الظروف العادية والعطش مما يعنى إمكانية أستخدام الجليسين بتايين فى زيادة مقاومة القطن للعطش.