Research Journal of Chemical Sciences ISSN 2231-606X
Vol. **2(7),** 72-74, July **(2012)** *Res.J.Chem.Sci.*

Short Communication

Effects of Gibberellic Acid on Seedling growth, Chlorophyll content and Carbohydrate Metabolism in Okra (*Abelmoschus Esculentus L.Moench*) Genotypes under Saline Stress

Jasmine Mary S. and John Merina A.
Department of Chemistry, Government College for Women (Autonomous) Kumbakonam, INDIA

Available online at: www.isca.in
Received 30th January 2012, revised 6th April 2012, accepted 27th June 2012

Abstract

The effect of gibberellic acid on the counteracting of the Nacl 50, 100 and 150 mm induced deleterious effects on okra (Abelmoschus esculentus) genotype was studied. Effects of GA_3 on salt tolerance of okra were determined by measuring the growth parameters – shoot and root lengths, shoot and root fresh and dry weights and leaf area. The photosynthetic pigments (chlorophylls a,b and carotenoids) content and sugars level were investigated. In response to the interactive effects of GA_3 and Nacl treatments. Nacl significantly reduced all growth parameters measured, photosynthetic pigments, as well as sugar contents. The effects of Nacl on the previous parameters were increased with Nacl concentrations. Exogenous application of GA_3 counteracted the Nacl deleterious effects on okra genotypes. GA_3 enhanced the okra salt tolerance in terms of improving the measured plant growth criteria. GA_3 appears to stimulate okra salt tolerance by activating the photosynthetic process.

Key words: GA_3, Okra, chlorophyll, polysaccharides

Introduction

Environmental stresses on salinity and drought reduce growth and agricultural productivity more than other factors[1]. Higher salinity levels caused significant reduction in growth parameters like leaf area, leaf length and root and shoot dry weights[2]. Water logging and sea water treatment decrease carotenoids in zeamays seedling and induce reduction in chlorophyll and photosynthetic activity[3]. Okra (Abelmoschus esculentus L.Moench) is a popular vegetable crop belongs to family Malvacea which is widely grown throughout the tropics and also well distributed in the Indian sub continent and East Asia. It's grown from March to June in India and it is very delicious vegetable. The young tender pods used for curries. When ripe the black and white eyed seeds are sometimes roasted and used as substitute for coffee. The stem of plant provides fiber, which is used in paper industry. The crop has high nutritive value. Its production is not adequate to meet the growing demands of the increasing population. One of the constrains in the cultivation of okra is salinity. Salinity is an ever-alarming problem in Indian agriculture. The plant hormone plays an important role in regulating the plant growth under stressful environment. Gibberellic acid is a common plant hormone which is most favourable for promoting and improving plant growth and photosynthetic activity.

The beneficial effect of gibberellic acid on different plant was recorded by Shedeed *et al.* on croton plants, Eraki on Queen Elizabeth rose plants. They concluded that GA_3 is used to regulating plant growth through increasing cell division and cell elongation. There are some reports which indicate that GA_3 enhanced germination and seedling growth in chickpea.

The evidence for hormone involvement comes from correlation of hormone concentration with specific development stages, effects of applied hormones and the relationship of hormones to metabolic activities. The application of gibberellins increase the plant growth by attributing the fact that they increase the amino acid content in embryo and cause release of hydrolytic enzyme required for digestion of endospermic starch when seeds renew growth at germination. GA_3 acts synergistically with auxins, cytokinins and probably with the other hormone. The overall development of plant is regulated by the growth hormones nutrient and environmental factors. They also vary in their germination requirement. It is not know that in which concentrations these hormones will cause a response in the cell under saline stress. This investigation with growth hormones will help in determining that which of hormonal concentration is suitable for plant growth under salinity. In view of the above background the present investigation was undertaken to study the influence GA_3 by different concentration on growth parameters, photosynthetic pigments and sugar levels under saline condition.

Material and Methods

A pot experiment to study the response of okra to foliar GA_3 application during salt stress was carried out at the Department of Chemistry, Government Arts College (Autonomous), Kumbakonam. The experiment was laid down on a completely randomized block design earthen pots (25 cm in diameter), lined with polythene sheets were filled with 7 kg of acid washed sand seeds of Abelmoschus esculents (Arka anamika genotype) were procured from the Mercury seeds Corporation Ltd., Chennai, India Sterilized with 0.01% $Hgcl_2$ solution rinsed using double distilled water, and then sown in the pots. Five plants per pot maintained. Irrigation was carried out using 50% strength Hogland nutrient solution[4]. This continued till germination, after which the salt treatment was initiated concentration of 0, 50, 100,150 mM Nacl were maintained in the Hogland's solution applied daily for 20 days following germination. The GA_3 were sprayed once on the leaves in the early morning when the plants had their fourth leaf completely expanded. A constant volume was sprayed in all cases with a manual pump. All determinations were carried out seven days after Gibbereliic acid treatment and 15 days after salt exposure.

The plants were divided into four groups: i. control (50% Hogland nutrient solution), ii. plants treated with GA_3 (10^{-2} M), iii. plants received Nacl solutions 50, 100 and 150 mM., iv. Plants treated with GA3 (10^{-2} M), with each of the salinity levels.

All treatments were replicated there times. Half of the samples were rapidly dried in an oven at 80°C to constant weight and then ground to fine powder, which was used for determination of dry weight and sugar fractions. The other half was used for growth data and extraction of pigments. Estimation of pigment contents was achieved by application of the method of Metznar *et al.*. 80% acetone extract was calorimetrically assayed at 452, 644 and 655 nm.

The procedure of Naguib was used to determine the sugar fractions. Plant extract plus arseno molybdate solution develops the colour, which was calorimetrically measured at 700 nm. The results presented in the tables are the mean of three replications. The data were statiscally analysed using the least significant differences (LSD) test as described by Snedecor & cochran[5].

Results and Discussion

Applications of the test levels of Nacl to Okra plants adversely influenced their growth pattern (shoot and root length, fresh and dry weights of shoots and roots and leaf area), as compared with control plants (table 1). These results are in agreement with those of Ghoulam *et al*., who showed that Nacl salinity caused a marked reduction in growth parameters. (leaf area, fresh and dry weight of shoots and roots of sugar beet plants). GA_3 treated Okra plants exhibited an increase in tolerance to salt treatment. This increase in salt tolerance was reflected in the measured growth criteria. Fresh and dry and length of shoots and roots as well as leaf area were increased comparing with plants received Nacl only (table 1). Gutierrez *et al.*[6], also reported a similar increase in the growth of shoots and roots of soybean plants in response to Gibberellic acid treatment. Dhaliwal *et al.*[7], and Zhou *et al.*[8], also indicate that GA_3 increases the leaf area in sugarcane plants, which is consistent with out results in okra plants.

Table-1
Growth characteristics of okra seedlings in response to treatment with Nacl in presence and absence of gibberellic acid. Each value is the mean of three replicates. All treatments are significant at 1% level of their controls

Gibberellic Acid (M)	Nacl (mM)	Length (cm)		Fresh Weight (g)		Dry Weight (g)		Leaves Area/Plant (cm^2)
		Shoot	Root	Shoot	Root	Shoot	Root	
0.0	0.0	43.0	13.1	16.28	3.03	2.63	0.40	193
	50	42.5	14.0	15.07	2.80	2.45	0.36	182
	100	37.0	10.1	13.17	2.64	2.09	0.33	168
	150	30.03	6.7	10.09	1.89	1.52	0.25	160
10^{-2}	0.0	47.3	15.8	20.07	6.18	3.35	0.81	215
	50	45.5	16.0	18.74	7.01	3.00	0.90	210
	100	44.7	13.8	17.40	4.75	2.74	0.53	200
	150	38.9	9.2	14.82	3.82	2.28	0.47	194
LSD 1%		1.4	1.3	1.2	0.9	1.3	0.05	2.6

Table-2
Changes on pigments of Okra seedlings in response to treatment with Nacl in presence and absence of gibberellic acid

Gibberellic Acid (M)	Nacl (nM)	Pigments (mg/g Fresh Weight)		
		Chlorophyll a	Chlorophyll b	Carotenoids
0.0	0.0	4.13	1.92	0.97
	50	3.71	1.64	0.71
	100	3.02	1.13	0.48
	150	1.91	0.98	0.30
10^{-2}	0.0	6.04	3.12	2.15
	50	5.12	2.71	1.73
	100	4.51	2.02	1.42
	150	3.90	1.71	1.01
LSD 1%		0.28	0.18	0.12

Table-3
Changes in carbohydrate content of okra seedlings in response to treatments with Nacl in presence and absence of gibberellic acid. Each value is the mean value of three replicates. All treatments are significant at 1% level of their controls

Gibberellic Acid (M)	Nacl (mM)	Carbohydrates (mg/g Dry Weight)		
		Soluble sugars	Polysaccharides	Total
0.0	0.0	77.9	178.6	256.5
	50	83.4	179.3	283.7
	100	90.1	158.9	249.0
	150	98.7	144.7	243.4
10^{-2}	0.0	72.3	195.0	267.3
	50	75.7	188.4	264.1
	100	81.5	179.6	261.1
	150	87.9	158.9	246.8
LSD 1%		2.1	2.5	2.0

Table 2 shows that the pigments (chlorophyll a,b and cartenoids) content of Nacl treated okra plants was significantly decreased below that of the controls. Similarly, Dela-Rosa and Maiti[9] found an inhibition in chlorophyll bio synthesis in sorghum plants because of salt stress.

GA_3 treated plants exhibited higher values of pigment concentration than those of control or salinity treated samples (Table II). In soybean plants treatment with GA3 increased pigments content as well as the rate of photosynthesis[10]. Sinha *et al.*[11] pointed out that chlorophyll and carotenoids contents of maize leaves were increased upon treatment with GA_3 taking together, the results of the previous authors support our findings.

Okra plant submitted to Nacl salinity treatment showed a progressive increase in their soluble sugar content with increasing the salinity level, while an opposite trend was obtained with respect to polysaccharide concentration (table 2).

GA_3 treatment caused a significant decrease in the content of soluble sugars below that of untreated samples (table 3). GA_3 increased, however the control plants (table 3). In this regard soluble sugar content was also increased in tomato plants in relation to salt stress[12]. It is suggested that GA_3 application might activate the metabolic consumption of soluble sugars to form new cell constituents as a mechanism to stimulate the growth of okra plants reported in this study. GA_3 treatment might also be assumed to inhibit polysaccharide. Hydrolyzing enzyme system on one hand and accelerate the incorporation of soluble sugar in to polysaccharide, our assumption could be supported by the result that GA_3 increased polysaccharide level on the sake of soluble sugars. In this connection, Sharma and Lakvir postulated that foliar spray of GA_3 to ray plants resulted in decreasing their soluble sugar level.

Conclusion

In summary it might be concluded that GA_3 treatment of salt stressed okra could stimulate their salt tolerance via accelerating their photosynthetic performance and carbohydrate metabolism.

References

1. Karakas B.P., Ozias-Akins, Stushnoff C., Suefferheld M. and Rieger M., Salinity and drought tolerance of mannitol accumulating transgenic tobacco, *Plant Cell Environ.*, **20,** 609-16 **(1997)**
2. Asharafuzzaman M., Khan M.A.H. and Shahidullah S.M., Vegetative growth of maize (Zea mays) as affected by a range of salinity, *Crop Res.Hisar,* **24,** 286-92 **(2002)**
3. El-Shihaby O.A., Alla M.M.N., Younis M.E. and El-Bastawisy Z.M., Effect of kinetin on photosysnthesic activity and carbohydrate content in waterlogged or sea-water treated *Vigna sinensis* and Zea mays plants, *Plant Biosyst*., **136,** 277-90 **(2002)**
4. Hogland D.R. and Amon D.I., The water culture method for growing plants without soil, *California Agri.Exp.Stat.Circ*., **347**, 32 **(1950)**
5. Snedecor G.W. and Cochran W.G., *Statistical Methods,* 6th Ed.p.275,Iowa State Univ., Press Ames Iowa, USA **(1967)**
6. Gutierrez-Coronado M.A., Trejo-Lopez C. and Largue-Saavedra A., Effects of salicyclic acid and on the growth of roots and shoots in soybean, *Plant Physiol, Biochem*., **36**, 653-65 **(1998)**
7. Dhaliwal R.K., Malik C.P., Gosal S.S. and Dhaliwal L.S., Studies on hardening of micro propagated sugarcane (*Saccharum officinarum*.L) plantnet. II Leaf parameters and biochemical estimations, *Ann.Biol.Ludhiana*, **13,** 15-20 **(1997)**
8. Zhou X.M., Mackeuzie A.F., Madramootoo C.A. and Smith D.L.J., Effects of some injected plant growth regulators, with or without sucrose, on grain production, biomass and photosynthetic activity of field-grown plants, *Agro.Crop.Sci*., **183,** 103-10 **(1999)**
9. Dela-Rosa I.M. and Maiti R.K., Biochemical mechanism in glossy sorghum lines for resistance to salinity stress, *J.Plant Physiol.*,**146**, 515-9 **(1995)**
10. Zhao H.J., Lin X.W., Shi H.Z. and Chang S.M., The regulating effects of phenolic compounds on the physiological characteristis and yield of soybeans, *Acta Agron. Sin*., **21,** 351-5 **(1995)**
11. Sinha S.K., Srinivatsa H.S. and Tripathi R.D., Influence of some growth regulators and cations on inhibition of chlorophyll biosynthesis by lead in Maize, *Bull.Env.Contamin.Toxic.*, **51,** 241-6 **(1993)**
12. Maria E.B., Jose D.A., Maria C.B. and Francisco P.A., carbon partitioning and sucrose metabolism in tomato plants growing under salinity, *Physiol. Plant.*, **110**, 502–11 **(2000)**