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Retardation of leaf senescence of aquatic plants using ascorbic acid

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Abstract

Potentiality of ascorbic acid on retardation of senescence was analysed using leaves of aquatic plant species namely *Eichhornia crassipes* and *Jussiaea repens*. Changes of some biochemical parameters like chlorophyll, protein as well as activity of catalase enzyme were analysed as reliable senescence indices during leaf senescence of the species under ambient ageing condition. With the progress of ageing duration from zero (0) to 96 hours the levels of chlorophyll and proteins in leaf discs gradually declined in both control and ascorbic acid treated samples. However, in the ascorbic acid treated samples the rate of decline was found to be much slower. The activity of the enzyme catalase was found to decrease progressively during the observation periods (0, 24, 48 and 96 hours) regardless of the treatment. Ascorbic acid partially alleviated the rapid fall of the enzyme activity during the ageing periods. Thus, ascorbic acid seems to be a potent senescence deferral agent for the experimental aquatic plant species

Keywords: Senescence; Ascorbic acid; Protein; Chlotophyll; Catalase; Aquatic plants

1 Introduction

Senescence is a programmed deteriorative phenomenon occurring within cells, tissues, organs and organisms which is culminated in the death of the concerned plant part or the organisms as a whole [1, 2].As the process of senescence takes place at an exceedingly faster rate under detached condition of plant parts, the effect of any chemical having influence on the regulation of senescence can be quickly determined [3].In the present experiment, an attempt was made to ascertain whether ascorbic acid can regulate senescence of aquatic plant species namely *Eichhornia* and *Jussiaea* under detached leaf condition. Regulation of plant senescence by any chemical agent can be expeditiously and almost accurately determined under detached condition of plant parts. In fact, deteriorative processes during senescence of detached leaves simulate grossly with that of attached leaves under natural condition, the main difference being the speed at which the processes run [4].Thus, the principal objective of this investigation was to evaluate the efficiency of ascorbic acid towards possible response on senescence retardation at least in case of the test aquatic plant species.

2 Material and methods

In this investigation the experimental plants used were two aquatic angiosperms like *Eichhornia crassipes* (Family: Araceae) and *Jussiaea repens* (Family: Onagraceae). The plant species were first carefully surface blotted using blotting paper. Uniformly sliced leaf discs, taken from mature leaves of the plants were treated with aqueous solution of ascorbic acid (100 µg ml^{-1}) or distilled water (control) in Petri dishes containing filter paper. The experimental set-up was kept in ambient condition and allowed the leaf discs to experience treatment with ascorbic acid for 96 hours. At an interval of 24 hours the filter papers were remoistened with the test chemical or distilled water and the biochemical data recorded include: chlorophyll and protein, contents as well as activity of the enzyme catalase.

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The chlorophyll content was estimated following Arnon's principle [5]. Extraction and estimation of protein and the enzyme catalase was done as per the method of Lowry *et al*. [6] and Snell and Snell[7] respectively.The assaying of the enzyme was done as per the method of Fick and Qualset[8].

All the data were statistically analysed at the treatment and replication levels and least significant difference (LSD) values were calculated at 95% confidence limits as per Panse and Sukhatme [9].

Table 1 Effect of ascorbic acid (100 µg ml^{-1}) on changes in chlorophyll; CHL and protein; PR (mg/g fr. wt. each) levels in leaf discs of plants analysed during ambient condition.

Plant materials	Treatments (µg ml^{-1})	Hours after leaf ageing							
		0		24		48		96	
		CHL	PR	CHL	PR	CHL	PR	CHL	PR
Eichhornia	Control	1.95	2.54	1.53	1.70	1.30	1.20	0.76	0.64
	Ascorbic acid	1.95	2.54	1.72	2.25	1.61	1.60	1.11	1.05
	LSD(P=0.05)	NC	NC	0.12	0.18	0.10	0.11	0.08	0.07
Jussiaea	Control	1.65	2.65	1.26	1.85	0.80	1.32	0.68	0.78
	Ascorbic acid	1.65	2.65	1.32	2.38	1.05	1.85	0.85	1.60
	LSD(P=0.05)	NC	NC	0.10	0.15	0.07	0.10	0.05	0.07

NC : Not calculated.

Table 2 Effect of ascorbic acid (100 µg ml^{-1}) on the changes in the activity of catalase (ΔOD x Tv / t x v) enzyme in the leaf discs of plants analysed during ambient condition

Plant materials	Treatments (µg ml^{-1})	Hours after leaf ageing			
		0	48	96	144
Eichhornia	Control	75.8	59.0	42.5	29.8
	Ascorbic acid	75.8	66.4	56.7	45.9
	LSD(P=0.05)	NC	1.92	3.88	2.85
Jussiaea	Control	68.8	45.5	28.7	22.9
	Ascorbic acid	68.8	51.8	36.6	28.8
	LSD(P=0.05)	NC	1.50	2.15	1.99

NC: Not calculated

3 Results and discussion

Results showed that both chlorophyll and protein contents started declining rapidly with the advancement of leaf ageing irrespective of the treated and control samples.However, ascorbic acid arrested the rapid loss of both chlorophyll and protein levels (Table 1). The activity of enzyme catalase decreased with the progress of stress-induced ageing duration (Table 2). The chemical treatment of leaves with ascorbic acid alleviated the ageing-induced rapid loss of catalase.

Senescence of detached leaves starts immediately after the separation from the plants and occurs at a rapid rate with the progressive increase of catabolic activities and these ultimately result in death and decay of leaves. The precise mechanism of senescence of terrestrial and aquatic plants may be somewhat different but the overall deteriorative changes during senescence are almost similar in both the plant types as well as in attached and detached leaf senescence types. The basic difference is that in case of detached leaf senescence the physiological and biochemical changes occur

at an exceedingly faster rate.[10, 11].Similarly, the reversal effects of the above types of senescence by senescence retardants are more or less same.

Results of this investigation clearly revealed that during the ambient ageing period of zero to 96 hours of the detached leaves of *Eichhornia* and *Jussiaea* the loss of chlorophyll and protein.In ascorbic acid treated leaf samples the same trend of declining was recorded but the magnitude of loss was found to be much less than control sample. Numerous reports exist in the literature that during all types of senescence loss of some vital macromolecules like chlorophyll and protein takes place which is due to their degradation rate of biosynthesis[12,13,14].Any chemical or external agents possessing the property to maintain the chlorophyll and protein levels during senescence are regarded as senescence retardants [15].In this investigation, ascorbic acid-induced partial arrestation of the rapid loss of chlorophyll and protein is indicative of the senescence deferral action of ascorbic acid. Catalase is regarded as a scavenger enzyme and higher activity of this enzyme is the index of plant vigour[16, 17].In this investigation the ascorbic acid-induced retention of catalase activity during detached leaf senescence is indicative of the retardation of senescence.

4 Conclusion

Considering all the biochemical parameters it can be concluded that ascorbic acid is a potent growth promoter for maintenance of membrane integrity as well as arrestration of overall senescence of the detached leaves of the plants analysed. Thus, ascorbic acid can be considered as a potent nonconventional senescence deferral agent at least in case of these two aquatic species analysed in this investigation.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare that they have no conflicts of interest.

References

[1] Leopold AC. Ageing and senescence in plant development. Pages 1-12 in K.V. Thimann, editor, Senescence in plants. CRC Press,Florida, USA,1980.

[2] Pati CK. Seed invigouration, plant potentiation and yield augmentation of two promising pulse crops (Lathurus sativus L. and Vinna mungo (L.) Hepper) by chemical manipulation. Doctoral thesis, Vidyasagar University, West Bengal, India,2007.

[3] SabaterB.Hormonal regulation of senescence. In: Hormonal regulation of plant growthand development, S.S. Purohit (Ed.), Agro Botanical Publ., India,1984;1: 169-217.

[4] Biswas AK, Choudhuri MA. Differential behaviour of the flag leaf of intact rice plant during ageing. Biochem. Physiol. Pflanzen. 1978; 173: 220-228

[5] ArnonDI.Copper enzymes in isolated chloroplasts, Polyphenol oxidase in Beta vulgaris, Plant Physiol. 1949; 24: 1-15.

[6] Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the Folin phenol reagent. J. Biol. Chem. 1951; 193: 265-275.

[7] Snell FD, Snell CT. In: Colorimetric Methods of Analysis. Vol. 4. Van Nostrand Reinhold Co., New York, USA, 1971.

[8] Fick NG, Qualset CO. Genetic control of endosperm amylase activity and gibberellin responses in standard height and short statured wheat. Proceedings of National Academy of Science.USA, 1975; 72: 892-895.

[9] Panse VG, SukhatmePT.Statistical Methods for Agricultural workers. Indian Council of Agricultural Research, New Delhi. 2nd edition, 1967; pp. 150-157.

[10] Biswas AK, Ghosh AK.Regulation of Senescence in Various Plants. Emkay Pub., New Delhi, India, 1999.

[11] Pati CK, Bhattacharjee A. Influence of IAA on the retention of detached leaf senescence of three aquatic plant species. International Journal of Science and Knowledge.2013; 2(1):42-46.

[12] Woolhouse HO. The nature of senescence of plants. Symp. Soc. Exp. Biol.1967; 21: 179-214.

[13] Leopold AC, Kriedemann PE. Plant growth and development, Tata McGraw Hill Publ. Co., New Delhi, India, 1975.

[14] Pati CK. Enhancement of Plant Potential using IAA, International Research Journal of Biological Sciences. 2020; 9(1):25-26.

[15] Pati CK. Retention of seed storage potential using ascorbic acid. American Journal of Life Sciences. 2022; 10(2):28-30.

[16] FridovichI.Oxygen radical, hydrogen peroxide and oxygen toxicity. In : Free radicals in biology, Vol. 1, W.A. Pryer (Ed.), Academic Press, New York,1976; pp.239-277.

[17] Kar M, Mishra D. Catalase, peroxidase, polyphenol-oxidase activities during rice leaf senescence. Plant Physiology. 1976; 57: 315-319