WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 6.805
Volume 5, Issue 7, 723-728. Research Article ISSN 2277– 7105

EFFECT OF FLOODING ON THE ANTIOXIDANTS IN THE ROOT AND LEAVES OF *VIGNA ACONITIFOLIA* (JACQ.) MARECHAL AND *PORTULACA OLERACEA* L.

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Article Received on 24 April 2016,
Revised on 15 May 2016,
Accepted on 03 June 2016
DOI: 10.20959/wjpr20167-6453

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ABSTRACT

The present investigation was, undertaken to study the effect of water-logging on growth and metabolism of *Vigna aconitifolia* Jacq (moth bean), and *Portulaca oleracea* L. (common purslane). The seeds of *Vigna aconitifolia* Jacq. (moth bean) and *Portulaca oleracea* L. (purslane) were germinated and plants were established for 25 days under controlled conditions in the soil in plastic pots. The plants were artificially flooded / waterlogged with Hoagland solution (1/10 conc.). The concentration of antioxidants (ascorbic acid and alpha tocopherol) was determined after every 7 days i.e. after 0, 7, 14 and 21 days of treatment. It has been found that under in *Vigna aconitifolia*, the level of ascorbic acid in the roots and leaf was increased under both control and flooded conditions. However, its level was always lower under waterlogged conditions. Its level was found to be higher in the roots as compared to that in the leaves. Similarly, the level of this antioxidant was also increased in the roots and leaves of *Portulaca oleracea* under control conditions. However, its level was considerably decreased under flooded conditions. *Vigna aconitifolia* showed decreased α-tocopherol content of its root and leaves after 7d under both control and waterlogging conditions. In *Portulaca oleracea* roots it was slightly increased under control and waterlogging. However, it was increased in the leaves only under control conditions and that decreased in the leaves under flood conditions.

KEYWORDS: Flooding, ascorbic acid, tocopherol, Moth bean, Purslane.

INTRODUCTION

The global climate is changing day by day. Hence it is essential to understand how different plants respond to different abiotic stresses to improve crop performance. One of the important and major environmental factors is flooding. It severely affects and limits the growth and productivity of the plants. Now a days, it has become a major problem throughout the world. More than one third of the worlds irrigated area is suffering from flooding frequently. The flooding may be due to heavy rainfall, faulty irrigation, poor drainage etc. It induces number of morphological, physiological, biochemical and anatomical changes in the plants. The flooding causes reduction in root-shoot relative growth, formation of lateral adventitious roots and formation of aerenchyma. Continuous flooding results in anoxic condition that reduces oxygen in the soil which restricts the growing root respiration and finally causes death of the roots.

Many plant species have an ability to develop different mechanisms which enable them to grow or tolerate flood conditions.[1] The mechanism of flooding tolerance has not been well understood. Therefore it is necessary to screen number of important crops for their flood tolerance.

To understand the mechanism of flood tolerance it is necessary to fully understand the physiology and biochemistry of plants subjected to water-logging conditions. The flood tolerance has been reported in various plants like wheat, maize, tomato rice etc. but such study in *Vigna aconitifolia* Jacq. and *Portulaca oleracea* is limited. The present investigation was undertaken to study the effect of waterlogging on the antioxidant contents of one of the minor but important crops, *Vigna aconitifolia* Jacq. (moth bean), a C_3 plant and a common weed *Portulaca oleracea* L. (common purslane), a draught resistant and moderately salt tolerant C_4 plant.

MATERIAL AND METHODS

The seeds of *Vigna aconitifolia* Jacq. (moth bean)- MBS 27 collected from Dryland Farming Research Center Mulegaon, Solapur, and *Portulaca oleracea* L. (purslane) collected from local growers were germinated in soil filled in plastic pots. Plants were grown under controlled conditions by watering them regularly to maintain optimal soil moisture. The 25-days-old plantlets were exposed artificially to water-logging with Hoagland solution (1/10 conc.). The water level of one cm height was maintained above the soil level. The plant material harvested after 0, 7, 14 and 21 days of treatment was analyzed for antioxidative compounds – ascorbic acid and tocopherol. The ascorbic acid and α-tocopherol contents were determined by using the methods[2]and[3] respectively.

RESULTS AND DISCUSSION

Vigna aconitifolia showed increased level of ascorbic acid in the roots and leaf under both control and flood conditions. The level of ascorbic acid was higher in the roots as compared to that in the leaves. In *Portulaca oleracea* the level of ascorbic acid was increased in the roots up to 7d and then decreased under control while it was increased up to 14d in the leaves under control. In the root and leaves of the same plant under flood conditions it was found to be decreased.

The α-tocopherol content of *Vigna aconitifolia* root and leaves was decreased after 7d under control and treated plants. *Portulaca oleracea* roots showed slight increase in tocopherol content under both control and waterlogging. However it was found to be increased in the leaves under control and decreased under flood conditions.

A significant increase in the reduced form of ascorbate and glutathione was noticed in the roots of wheat seedlings under hypoxia.[4] There was marked increase in the level of ascorbic acid content of the leaves of *Chlorophytum*.[5] Similar increased level of ascorbic acid was reported only in tolerant genotypes of maize seedlings.[6] However, a slight increase in the concentration of total ascorbic acid and reduced ascorbic acid has been reported in the roots of tomato and egg plants under waterlogged conditions.[7] In the leaves of waterlogging sensitive coriander plants, increased level of ascorbic acid was noticed.[8] Similarly, increased level of ascorbic acid was recorded during waterlogging in *Vigna sinensis*[9] and in Glycine max.[10] In *Prosopis juliflora* leaves the concentration of ascorbic acid was increased under saline waterlogged stress by 7% and in the roots by 14% over the control.[11]

An increased synthesis of antioxidant like α- tocopherol has been correlated with a higher tolerance to drought[12] and other environmental stresses.[13] Waterlogging stress enhances antioxidant defense system by accumulating different non-enzymatic oxidants, α - tocopherol is one of them.[14] A three-fold increase in tocopherol level has been reported in anaerbically germinated rice seedlings.[15] Increased level of α-tocopherol in the anoxia-intolerant wheat and oat seedlings due to anoxia has also been reported.[16] Similar increase in tocopherol concentration in the leaves by 5 to 57% and 4 to 66% in the roots over the control under saline waterlogged stress was reported.[11]

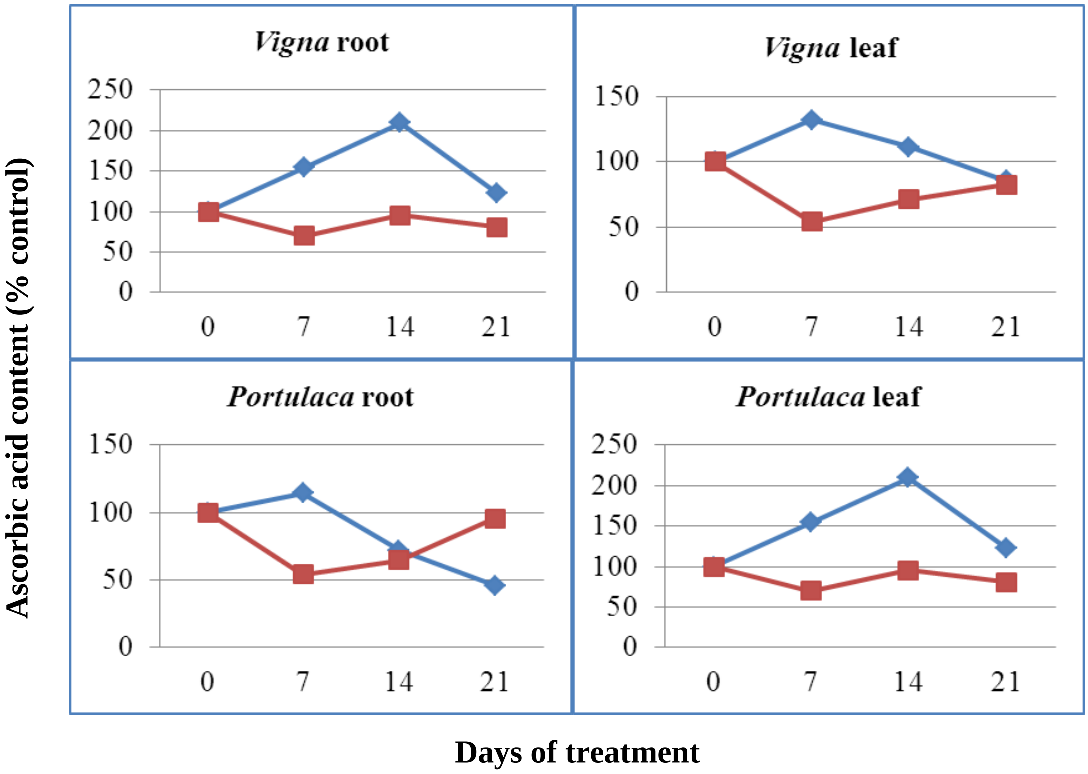

Figure 1. Effect of flooding on ascorbic acid content (g 100^{-1}g fresh tissue) of the roots and leaves of *Vigna aconitifolia* and *Portulaca oleracea*. [Control -♦-, Flooding -■-]

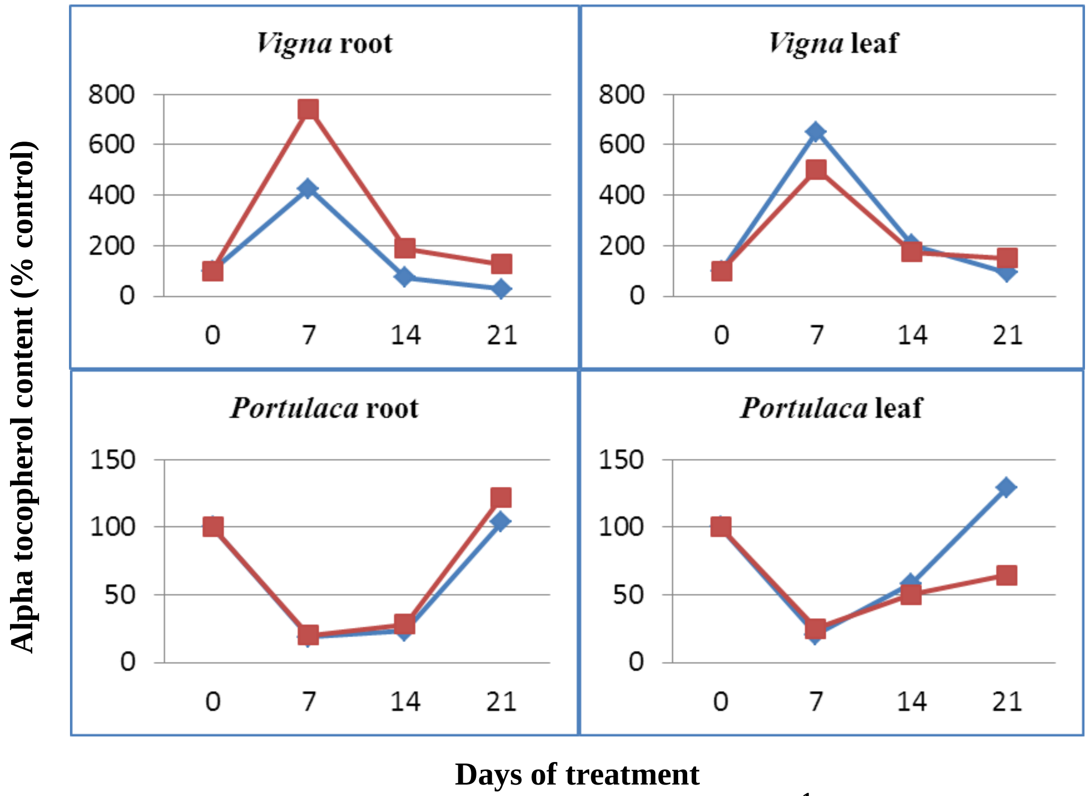

Figure 2. Effect of flooding on α-tocopherol content (g 100^{-1}g fresh tissue) of the roots and leaves of *Vigna aconitifolia* and *Portulaca oleracea*. [Control -♦-, Flooding -■-]

CONCLUSION

The present study demonstrated that, ascorbic acid and tocopherol contents were significantly affected in plants under water logging stress as compared to control plants. The results suggest the sensitive nature of both the plants when grown under waterlogged conditions.

ACKNOWLEDGEMENTS

I am very much thankful to Dr. A. S. Kamble and Mr. B. Y. Buchade for their support and inspiration throughout research work. Similarly, my thanks are due to my colleague Mr. Vishal V. Naik for his help.

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