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EFFECT OF FLOODING ON THE GROWTH (ROOT LENGTH, SHOOT LENGTH AND ROOT SHOOT RATIO) OF VIGNA ACONITIFOLIA (JACQ.) MARECHAL AND PORTULACA OLERACEA L

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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 growth (root, shoot length and root to shoot ratio) was studied after every 7 days i. e after 0, 7, 14 and 21 days of treatment. It has been found that the root length of *Vigna aconitifolia* was increased after 7 d of growth under conditions while, it was not much affected under flood conditions. Similarly there was gradual increase in root length of *Portulaca* under control and it was decreased from 14 d in treated plants. The shoot length was increased under control in *Vigna* and slightly decreased from 14 d under flood conditions. The shoot length was increased under both control and treated plants of *Portulaca*. The root to shoot ratio was decreased under both control and flood conditions in both *Vigna* and *Portulaca.*

KEYWORDS: Flooding, Moth bean, Purslane, Root Length, Shoot Length, Root Shoot Ratio.

INTRODUCTION

Day by day frequently global climate is changing. Hence it becomes 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, flooding has become a major problem throughout the world. More than one third of the worlds irrigated area is suffering frequently from flooding. It may be due to heavy rainfall, faulty irrigation, poor drainage etc. In the plants, it induces number of morphological, physiological, biochemical and anatomical changes. 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 growth 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. For the analysis of growth five plants were carefully uprooted, washed thoroughly with water to remove any dirt and dust particles on the plant parts and blotted to dry. These plants, were used for analysis of their growth and development using following various parameters.

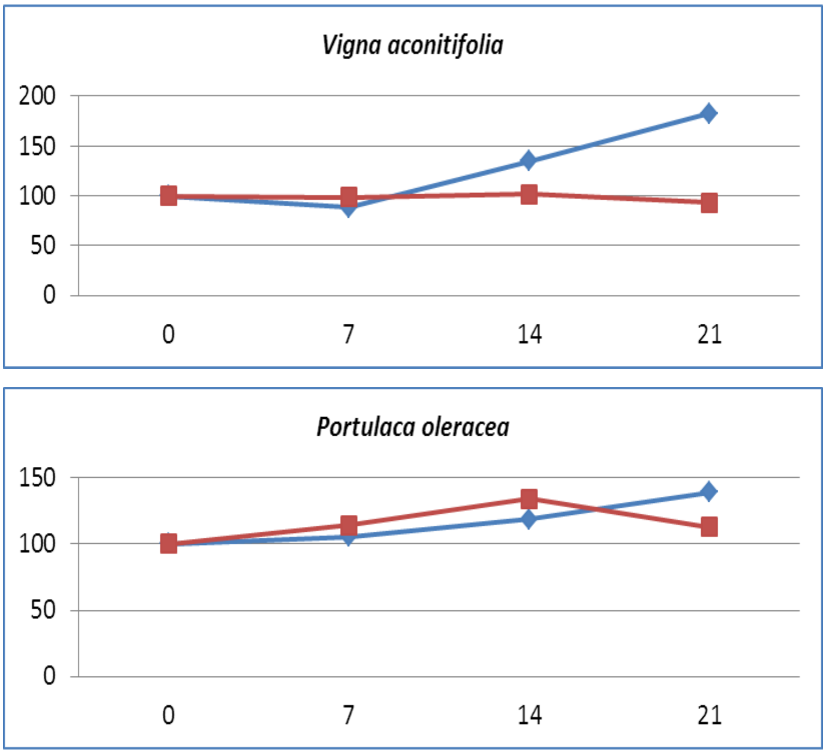
a. Root length
b. Shoot length
c. Root to shoot ratio

The observations were used for statistical analysis.

There was sharp increase in root length after 7d of growth of *Vigna aconitifolia* under control conditions while, there is no much effect on it under flood conditions. The root length of *Portulaca* was found to be increased gradually under control and it was increased up to 14 d and then decreased in the treated plants. The shoot length was increased gradually under control in *Vigna aconitifolia* and it was slightly decreased from 14d under flood conditions. The shoot length of *Portulaca oleracea* was increased under both control and treated plants. However, the length of the shoot was always higher under control than under flooding. The root shoot ratio was decreased under both control and flooding conditions in *Vigna aconitifolia*. Similarly in *Portulaca oleracea* also the ratio was decreased. The root shoot ratio was slightly higher under flood conditions than that in control.

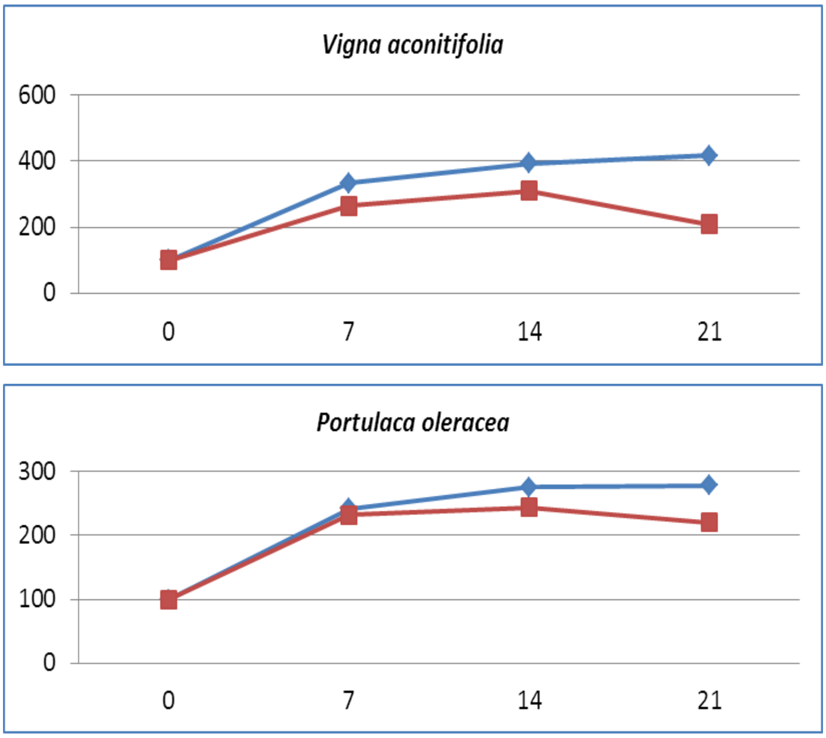
Although all higher plants require access to free water, excess of water in the root environment of land plants can be injurious or even lethal because it blocks the transfer of oxygen and other gases between the soil and the atmosphere.[2] Root growth is frequently more severely suppressed by waterlogging than shoot growth. [3,4] Under flooding, roots of the plant are in a state of hypoxia, their metabolic activities are lowered and ATP production is declined.[5] The decreased ATP production depletes the supply of energy for root growth thereby reducing vegetative growth.[6] In maize, instant effect of flooding and hypoxia on the root physiology is an arrest of root growth.[7] The formation of adventitious roots was strongly enhanced by both flooding and ethylene treatment in *Rumex* plants.[8] Decrease in the root number, root length and the root activity in the poplar and willow seedlings under waterlogging conditions.[9]

In both *Vigna* and *Portulaca* the length of the root is decreased under flooding conditions suggesting that the reduction in root growth is one of the most commonly reported parameters during flooding.[10] Waterlogging significantly reduced shoot length of both KPS1 and CNXP-49 cultivars by about 41 and 58% respectively as compared to that in control in mung bean.[11] The shoot elongation is an obvious and well known effect of submergence on the morphology of the shoot of *Rumex palustris*. [12,13] The enhanced shoot growth is beneficial for restoration of contact between the plant and the atmosphere during total submergence.



Days of treatment

Fig. 1: Effect of flooding on root length (% control) of *Vigna aconitifolia* and *Portulaca oleracea.* [Control -♦-, Flooding -■-].



Days of treatment

Fig. 2: Effect of flooding on shoot length (% control) of *Vigna aconitifolia* and *Portulaca oleracea.* [Control -♦-, Flooding -■-].

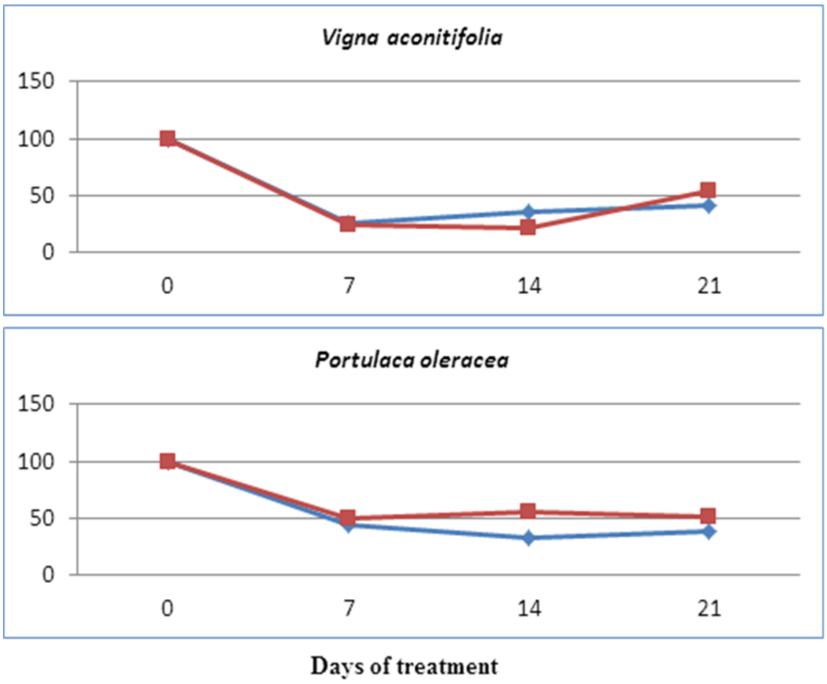


Fig. 3: Effect of flooding on root: shoot ratio (% control) of *Vigna aconitifolia* and *Portulaca oleracea.* [Control -♦-, Flooding -■-].

The plants respond to drought and waterlogging in different ways, such as increasing the root shoot ratio and carbon metabolization, to maintain the water balance in plants.[14] The root to shoot ratio was significantly higher in *Sorghum* plants under waterlogged conditions compared to control.[15] In cotton seedling, waterlogging significantly inhibited the growth of parts above the ground resulting in an increase in root to shoot ratio with stress time extension with respect to temperature.[16] There was progressive increase in root to shoot ratio of *Prosopis juliflora* with increasing levels of saline waterlogged stress by 12.12 to 19.70 % over the control.[17] The change in root to shoot ratio is assumed as an adaptive feature.[18]

CONCLUSION

The present study demonstrated that, the root length, shoot length and root to shoot ratio 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.

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