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EFFECT OF DROUGHT STRESS ON TOMATO Cv. BAMBINO

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Abstract

Drought stress is one of the most important yield contributing factor. An experiment was conductedat Institute of Biotechnology and Genetic Engineering, The University of Agriculture Peshawar to study the effect of drought stress on Tomato (Lycopersicon esculentum) Cv. Bambino." an experiment was conducted Tomato plants were exposed to two different water conditions (i) Control (normal water availability) and stressed conditions in a green house of 18 x20 meter size. During the course of experiment, data were recorded on relative water content (%), proline content (µmoles) and relative growth rate (gm). It was found that the relative water content of plant body decline during drought due to less water availability. In controlled environment, the mean value of relative water content was 89.28 % while that observed in drought condition was 87.73 %. Proline concentration increased due to continuous decrease in water quantity in cell sap. The value of proline content was 4.4 µmoles g^{-1} fresh weight in controlled condition whereas that the plants in drought condition had 5.8 µmoles g^{-1} fresh weight. In controlled condition the relative growth rate $week^{-1}$ on fresh weight was 1.37gm whereas that of plant in drought condition was 0.57gm.

INTRODUCTION

Tomato (*Lycopersicon esculentum*) belongs to the *solanaceae* (night shade) family. It is native to tropical America where its indigenous name was tomati. From Mexico the tomato was taken to Europe and then to Asia. It plays a vital role in maintaining health andvigor. Tomatoes are very helpful in healing wounds because of the antibiotic properties found in the ripe fruit. It is a good source of vitamins A, B and C. It is widely used in salad as well as for culinary purposes (Malik, 1994).Tomato gain popularity very rapidly and attain the status of widely consumed. Although tomato is a tender perennial crop, which is susceptible to frost as well as high temperature but it is being grown in a variety of climatic conditions (Malik 1994). In Pakistan tomato is grown over an area of 24,144 hectares annually, which produces 275241 tons of tomato. Khyber Pakhtunkhwa is the major producing region where it is grown on an area of 4,230 hectares with a total production of about 51,062 tons annually. In Peshawar valley, quite a sizeable area of 944 acres is put under tomato cultivation with a production of 2.978 thousand tones (Govt of Pakistan 2008). Water plays an important role in plant life. In many localities, it is the limiting factor for agricultural crops and hence increasing yield. Therefore for judicial use of water, attempts should be made to obtain maximum yield with minimum water supply. Under conditions of drought the free energy of water available to the plant is reduced well below that of pure free water. The osmotic adjustment as accumulation of solutes within the cell helps in maintaining turgor at decreasing water potentials (Nahar K. and R. Gretzmacher, 2002). Plant water status controls the physiological processes and conditions which determine the quality and quantity of growth (Kramer,

1969). Since water is essential for plant growth, it is axiomatic that water stress, depending on its severity and duration, will affect plant growth, yield and quality of yield. So in this connection the present research was conducted in order to achieve the following objectives. To study the changes in various physiological and morphological parameters of tomato plant under stress condition, and to observe the suitability of tomato cv. Bambino to drought condition.

MATERIALS AND METHODS

To study the effect of drought stress on tomato cv. Bambino", an experiment was conducted at Institute of Biotechnology and Genetic Engineering during August 2009.Seeds of tomato cv. Bambino were obtained from The University of Agriculture Peshawar. The seeds were grown in green house on 26th August 2009. After three weeks, seedlings were transplanted to large pots where they were maintained and equally watered for healthier growth. As the plants attained a good size (average 23 cm) and health, 10 plants each for controlled and drought condition were selected. The plants in the controlled condition were watered after three days. Withholding water for two weeks imposed drought stress. After that the selected plants were studied for the these parameters, Relative water Content (%), Relative Growth Rate (gms), Proline content (µmoles g^{-1})

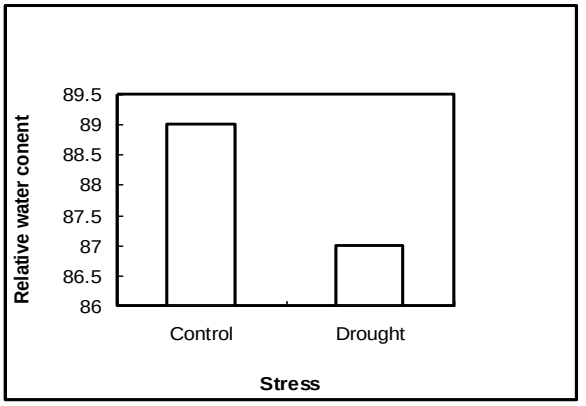
RESULTS AND DISCUSSION

Relative water Content (%): Water is the most important factor responsible for different plant functions. Figure 1 showed that relative water content was lower in pots exposed to water stress conditions as compared to normal (control pots) plants where no water stress was induced. Overall, water stress conditions reduced relative water content of tomato by 2%. By this way the cells tend to loose their turgidity due to loss of water. The results are in agreement with Nayyar *et al* (2005) who obtained a decrease amount of relative water content in tomato plants upon stress implementation.

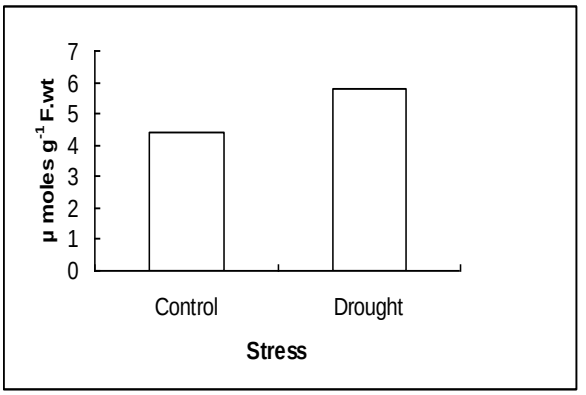
Proline Content (µ moles g $^{-1}$): Proline is an α-amino acid that is used in the biosynthesis of proteins. Figure 2 showed that Proline Content (µ moles g $^{-1}$) was increases from normal ratio in pots exposed to water stress conditions as compared to normal (control pots) plants where no water stress was induced. The value of proline content is 4.4 µmoles g^{-1} fresh weight in controlled condition whereas that of plants in drought condition is 5.8 µmoles g^{-1} fresh weight. Due to decrease in water content (stress condition) the proline content in cell sap increases resulting in high concentration of proline in cell solution. The proline-water ratio was found normal in plants grown in controlled condition (Rose,1988). A similar experiment was conducted by Doan and Maurel (2004) who found the proline content increases according to the shortage in water availability

Relative growth rate on plant height basis: Figure3 showed that average plant height was decreased when the plants were subjected to drought conditions as compared to normal (control pots) plants where no water stress was induced. Before stress the average plants height was recorded as 23cm. After withholding water for two weeks the average plants height recorded was 27.5cm, while in controlled environment the average plants height was 30.5cm. In control condition, the Relative growth rate week^{-1} was 1.14cm and that in drought condition was 0.43cm. Due to the sessile life cycle, plants have evolved mechanisms to respond and adapt to adverse environmental stresses during their development and growth. Plant growth is impaired by severe drought stress due to a decrease in stomatal opening, which limits CO_2 uptake and hence reduces photosynthetic activity (Yuriko *et al*, 2014).

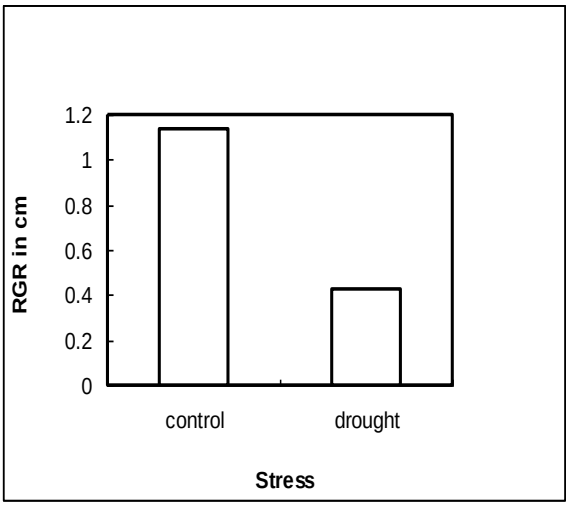
Relative growth rate on fresh weight and dry weight bases: Figure 4 and 5 showed that relative growth rate was decreased when the plants were subjected to drought conditions as compared to normal (control pots) plants where no water stress was induced. In controlled condition the relative growth rate week^{-1} on fresh weight bases is 1.37gm whereas that of plants in drought condition is 0.57gm. The relative growth rate week^{-1} on dry weight basis was 0.17gm in controlled condition while in drought condition 0.12gm. Similar results were obtained by Mirakhori*et al* (2009) in which significant decrease in growth was observed in an experiment conducted on tomato plants exposed to different drought stress conditions.



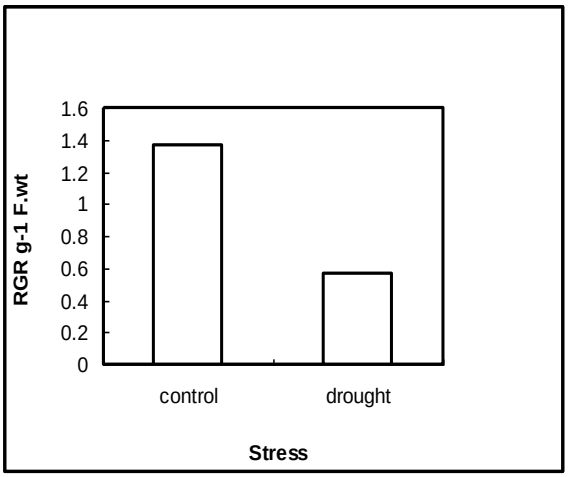
Graph-1. The Effect of drought stress on relative water content (%) of tomato plant.



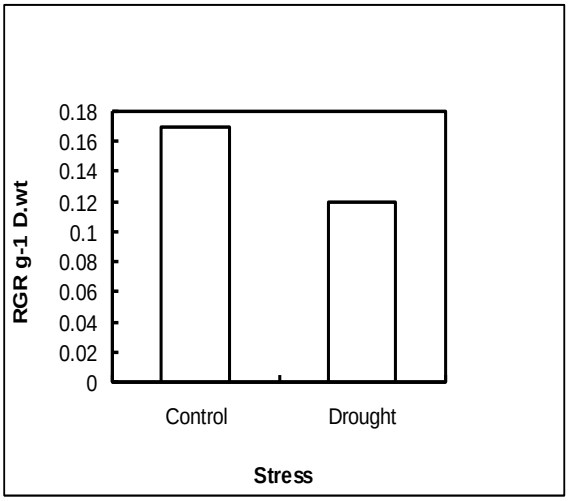
Graph-2. The Effect of drought stress on proline (μ moles) of tomato plant.



Graph-3. The Effect of drought stress on height (cm) of tomato plant.



Graph-4. The Effect of drought stress on fresh weight (gms) of tomato plant.



Graph-5. The Effect of drought stress on dry weight (gms) of tomato plant.

CONCLUSIONS AND RECOMMENDATIONS

It was found that drought stress reduced relative water content as compared to normal water conditions. Moreover, proline concertation increased in plants exposed to drought stress over normal plants. Therefore, it is concluded that we need to evaluate new varieties of tomatoes which are tolerant to drought stress, because as the result shows, Bambino variety is highly susceptible to drought condition.

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