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Plant Responses To Droughtand Rewatering In Tomato Plant (Solanum Lycopersicum L.)

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Abstract:

The ability of plants to perceive signals of water shortage and to initiate coping strategies in response is referred to as "drought resistance. The specific objectives of the study were-To screen the tomato cultivars for their tolerance against drought stress. To select them tolerant and most sensitive cultivar. To compare the effects of drought stress in drought tolerant and sensitive cultivars of Tomato. The study concludes that NaCl induces more stress than mannitol. Germination of cultivars was subjected to different concentrations of NaCl and mannitol. The germination percentage decreased with increasing concentration of NaCl and mannitol. So, the germination of cultivar was affected by increasing concentration of mannitol and NaCl. Moreover germination percentage in NaCl was much less than that of mannitol. Hence, it was concluded NaCl induced more stress than mannitol.

Keywords: Drought Resistance, Mannitol, Cultivar, Drought Stress, etc.

Introduction:

Plants have evolved in nature to cope with drought stress through a series of morphological, physiological, and biochemical adaptations based on the high diversity of species grown in climatic regions with extreme drought conditions. Plants also have strategies to prevent water loss, balance optimal water supply to critical organs, maintain cellular water content, and survive drought. The ability of plants to perceive signals of water shortage and to initiate coping strategies in response is referred to as "drought resistance". Drought resistance is a complex trait that operates through several mechanisms:

a) Escape (accelerating the plant's reproductive phase before stress impairs its survival),
b) Avoidance (increasing internal water content and preventing tissue damage
c) Tolerance (resisting low internal water content while maintaining growth during drought)
d) Tomato is a member of the Solanaceae family, which includes over 3000 species from both the Old and New Worlds (eggplant in China and India and pepper/potato/tomato in Central and South America).
e) The Solanaceae phylogeny has recently been revised, and the genus *Lycopersicon* has been reintegrated into the genus *Solanum* under the new nomenclature. The cultivated tomato *S. lycopersicum* and 12 additional wild relatives are all members of the*Solanum*section*Lycopersicon*. The only domesticated species is *Solanum lycopersicum*

Tomato production faces a number of challenges worldwide, including high input costs (seeds, fertilizers, pesticides, and irrigation), pests and diseases caused by nematodes, viruses, fungi, and bacteria (that can reduce yield and quality), and post-harvest losses due to inefficient handling, storage, transportation, and processing.

The development of tomato cultivars with enhanced abiotic stress tolerance is one of the most sustainable approaches for its successful production. This study put emphasis on the conservation and valorization of the pool of tomato genotypes, increasing the concept of tomato biodiversity and providing bases to breeding programs for still productive plants in the scenario of climate change. Since tolerance is likely to be allocated to different levels, we chose to assess the importance of three different aspects (genetic, biochemical, and physiological) and their relative contribution to drought tolerance.

Aims and Objectives:

In order to find the answer to the research questions, the following objectives were made. Broad objective of this study was to assess the effect of water stress on various parameters such as shoot length, fresh weight, dry weight, and chlorophyll content, etc. in different tomato cultivars grown in the country.

The specific objectives of the study were:-

I. To screen the tomato cultivars for their tolerance against drought stress.
II. To select the most tolerant and most sensitive cultivar.
III. To compare the effects of drought stress in drought tolerant and sensitive cultivars of Tomato.

Methods:

Collection of seeds of different species of Tomato plant from the 3 cultivars: The seeds of two different cultivars of tomato (Srijana and NCL) were collected from Horticultural Research Division of Nepal Agricultural Research Council (NARC)and three different cultivars of tomato (Dahlia, BL and CL) from the local market.

Selection of osmoticum: Cultivars Srijana was subjected to germination in different concentrations of mannitol and NaCl. 10 gm each of mannitol and NaCl was weighed and dissolved in minimal amount of distilled water.

The mixture was shake well and the final volume was made to 1000 ml. This stock solution was used to prepare the working solutions of 1000 ppm, 2000 ppm, 3000 ppm and 4,000 ppm. Distilled water was used as control solution.

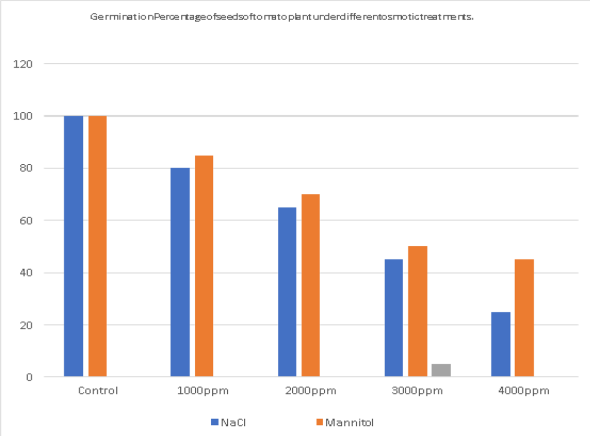
Viable seed selection and surface sterilization: About 75 viable seeds of all the cultivars were selected by observation. The selected seeds were first washed in mild detergent for 2-3 minutes.

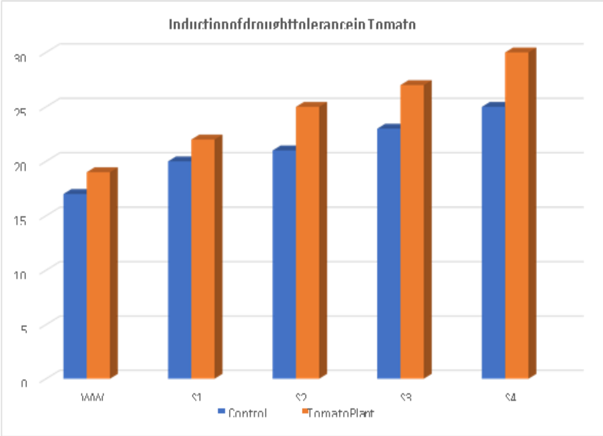
The seeds were then rinsed in tap water. The seeds were transferred in sterile Eppendorf tube containing 0.25% sodium hypochlorite.

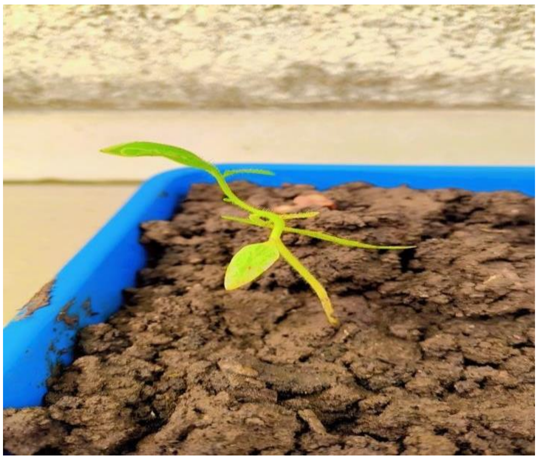
Two drops of tween-20 was added and the tubes were shaken mildly for 15 minute. The seeds were then washed five times with sterile water under aseptic conditions.

2.2:2 Seed germination: First of all sterile petridishes were labelled. Sterile filter paper sheets were placed on the petridishes. Each petridish was then soaked with 2 ml of working solutions (control solution, 1000 ppm, 2000 ppm, 3000 ppm and 4000ppm NaCl and mannitol solutions).

Five sterilized seeds of each cultivar were placed in each petridish. The process was repeated three times.







Observation and Results:

Germination was observed and data was recorded at day 10 after subjected to germination, 2mm radical protrusion was considered as germinated and data was recorded

Drought sensitive and drought tolerant cultivar selection: Cultivar that can grow well under drought stress condition is drought tolerant and the one that cannot grow under stress condition is drought sensitive variety.

Drought sensitive and drought tolerant cultivars were selected by germinating the seeds of different cultivars in different concentrations of NaCl and by measurement of physiological attributes.

Germination test:

Preparation of stock NaCl solutions and working solutions: Stock NaCl solution and working solutions were prepared by the process.

Viable seed selection and surface sterilization: About 30 viable seeds of all the cultivars were selected and surface sterilized by the process.

Seed germination and observation: Seed germination and observation of the selected seeds were done by the process described above in and Measurement of physiological attributes.

Measurement of Physiological Attributes:

Viable seed selection and sterilization: 10 viable seeds of all the cultivars were selected by observation. The selected seeds were first washed in mild detergent for 2- 3 minutes. The seeds were then rinsed in tap water. The seeds were transferred in sterile eppendorf tube containing 0.25% sodium hypochlorite. 2 drops of tween-20 were added. They were shaken mildly for 15 minutes. The seeds were then washed with sterile water for 5 times.

Soil preparation and seed germination: The soil for the seed germination was preparedinplastictraybymixing25%sand,25 %vermin-compostand50%topsoil.

Seedling transplantation: After 10 days of seed germination 3 identical seedlings of each cultivar were transferred to 3 separate plastic bags and were allowed to grow under similar conditions of light temperature and nutrients.

Transfer of seedlings to the plastic bag After 10 days of seed germination in plastic tray, 15 identical seedlings of each variety were transferred to 15 separate plasticbags. The seedlings were then allowed to grow into fully grown plant. The plantswere watered every other day.

Preparation of stock NaCl solution and working solutions 40 gm NaCl was weighed and mixed with 1 litre distilled water to prepare 1M NaCl solution. The mixture was shaken well.

Induction of stress After 30 days of germination, the plants were subjected to stress by treating them with working solutions. Each plant was treated twice with 100 ml of one working solution at a time at an interval of 1 week. So, each plant was treated with 200ml of one working solution. The process was done in triplicate.

Measurement of shoot length: When the plant was 60 days old, the shoot length was measured with the help of measuring tape and noted.

Measurement of fresh weight (shoot) the above ground biomass of each plant was measured. The plants were cut just above the soil level and fresh weight of shoot was measured in the weighing machine and noted.

Measurement of dry weight after the measurement of fresh weight the same plants were then subjected to oven dry at 70°C for 72 hour and dry weight was measured and noted.

Conclusion:

The study concludes that NaCl induces more stress than mannitol. Germination of cultivars was subjected to different concentrations of NaCl and mannitol. The germination percentage decreased with increasing concentration of NaCl and mannitol. So, the germination of cultivar was affected by increasing concentration of mannitol and NaCl. Moreover germination percentage in NaCl was much less than that of mannitol. Hence, it was concluded NaCl induced more stress than mannitol. Five different cultivars were subjected to germination in mannitol and NaCl.

Of all the cultivars, NCL possess highest percentage of germination followed by Dahlia. The lowest germination percentage was that of BL. Moreover, ELWR and RWC of NCL were also greater than other cultivars and BL had lowest percentage of ELWR and RWC. So it can be concluded that NCL is drought tolerant and BL is drought sensitive. Drought stress had had severe effect on different aspects of growth and development of tomato.

Shoot length, fresh weight and dry weight were higher in BL than other cultivars. Under increasing concentration of stress, shoot length, fresh weight and dry weight decreased. The decrease was found to be more profound in BL than NCL. Unlike shoot length, fresh weight and dry weight, chlorophyll content was higher in NCL.

Chlorophyll content was also found to decrease on increasing the concentration of stress. This study led to conclude that drought stress had effects on different aspects of tomato. As the impact of drought was more intense in BL, the yield of tomato may be low. Moreover, the chlorophyll pigments in NCL was higher than BL. This may lead to the conclusion that yield of tomato should be higher in NCL than BL.

Biodiversity is thought to be an important genetic resource for numerous aspects of plant physiology and development, although the extent of its impact remains uncertain. It is believed to play a critical role in maintaining ecosystem balance and potentially provides various ecosystem services, such as air and water purification, nutrient recycling, and climate regulation.

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