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Effect of Drought Stress on some Physiological Traits in Tomato

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Abstract

Among the abiotic stresses, drought is one of the important factors that causes change inphysiological characteristics in tomato, and which further affects the growth and productivity of tomato. Under the present study, effect of drought on relative leaf water content (RLWC%) and SPAD value in two genotypes of tomato. Result revealed that there was significant decrease in these parameters such as RLWC and SPAD value in two genotypes of tomato *i.e,* Kashi Vishesh and WIR-13706 under drought condition. It may be used to select high yielding genotypes that maintain cell turgor and chlorophyll content under water stress environment to give relative high yield.

Key words : *Tomato, RLWC, chlorophyll, drought, SPAD value.*

Introduction

The tomato (*Solanum lycopersicum*) belongs to the Solanaceae family. Tomato is one of the most important plants in the world because it is a most widely consumed vegetable crop. It is also a major vegetable plant and acts as a model system for fruit development because it is easy to grow, often used to explore its characteristics (1). Tomato (*Solanum lycopersicum*) has a diploid genome with a genome size of 950 Mb, distributed over 12 chromosomes and 34,727 protein- coding genes (2). Tomato is a popular and economically important vegetable species worldwide. Tomato consumption as well as production is permanently increasing because of its anti-oxidative and anti-cancerous properties. Tomato is alsoa major source of antioxidants such as beta carotene, vitamin C and vitamin E. Tomato is the second most important vegetable in terms of production worldwide due to its intense breeding programs. Due to its high nutritive value and changing food habits, the consumption of tomato in different form is gaining momentum day by day. China is the largest producer followed by India, Turkey and United States (3). The total production of tomato is 182.3 million tonnes globally and India being the world's second largest producer of tomatoes, produced nearly 18.73 million tonnes, which constituted 10.4 percent of total production. The area under cultivation was 0.79 million hectare with yield (productivity) 25.98 metric ton/hectare. Drought often causes adaptive changes in plant growth and physio-biochemical processes such as changes in plant structure, growth rate, issue osmotic potential and antioxidant defenses (4). Reduction of chlorophyll in tomato under low water condition indicated that drought stress changes the amount of chlorophyll in plant (5,6).

Materials and Methods

In the present study, two tomato genotypes like Kashi Vishesh and WIR-13706 were used for the physiological studies. Experiments were carried out under natural conditions at School of Biotechnology, Sher-e-Kashmir University of Agricultural Sciences and Technology. The plants were subjected to drought stress condition till wilting point and irrigated plants were grown under normal condition for the same period of time. Responses of the genotypes to drought were evaluated using plant relative leaf water content (%) and SPAD value. Observations were recorded on plants of two genotypes in five replications and their mean were worked out for statistical analysis. Relative leaf water content (RLWC) in the leaves was calculated according to the formula: RLWC (%) = [(fresh weight-dry weight) / (Turgid weight – Dry weight) 100]. The leaf dry weight was measured after oven drying at 105°C for 24 hand the turgid weight was measured after incubating the leaves in distilled water for 24h at room temperature. The estimation of chlorophyll content was carried out by SPAD method. Readings offresh leaveswere taken with the help of SPAD. To determine the significant differences between control and drought treatment, Student's t-test (paired) was performed with the help of SPSS-20 software.

Results and Discussion

Water is considered as one of the most important factor for plant growth and development. It is required for different physiological functions the production of new compounds. It is the best source of carrying all the essential metabolites within the plant body. In WIR-13706, the highest and lowest relative leaf water content (RLWC%)

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were 79.27 and 77.84 (under normal) while in drought it were 76.41 and 74.11 respectively. In Kashi Vishesh, the highest and lowest RWC% were 78.91 and 77.13 (under normal) while in drought it were 74.23 and 68.57 respectively. There were significant difference of RLWC% between normal and drought condition (P<0.05, P?<?0.01) in WIR-13706. There is significant difference of RLWC% between normal and drought condition at 5% and non significant at 1% level of significancein Kashi Vishesh. Present results are in agreement with (7). They reported that in controlled environment, the mean value of relative water content was 89.28% while that observed in drought condition was 87.735 which means that about 2% decrease in the average relative water content of the plants has occurred under stress conditions when compared to the controlled situation. The results aresimilar with (8) as they also reported that there were decease in RWC% in drought stress condition. (9) also reported that there was a significant decrease in RWC% due drought condition in tomatoes.

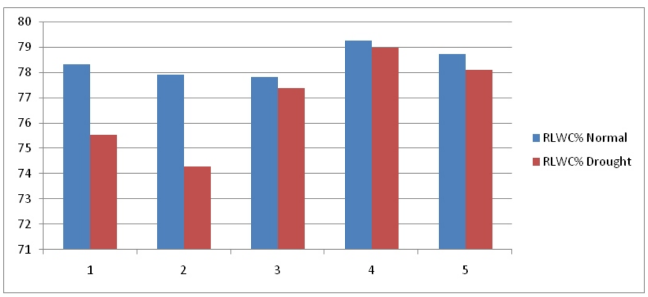

Fig.-1 : RLWC% in WIR-13706 under normal and drought.

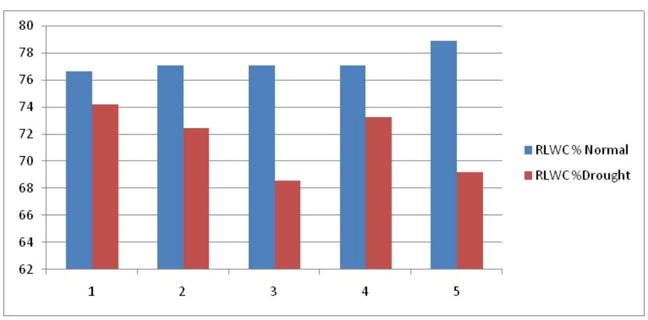

Fig.-2 : RLWC% in Kashi Vishesh under normal and drought.

Highestand lowest SPAD value in WIR-13706 under normal condition was recorded 58.68 and 31.96 respectively. In drought condition, the maximum and minimum SPAD value in WIR-13706 were 53.93 and 25.42 respectively. Whereas in Kashi Vishesh highest and lowest SPAD value were 51.78 and 49.60 with 48.72 and 43.93 in normal and drought condition respectively. There were significant difference of SPAD value between normal and drought condition (P < 0.05, P < 0.01) in WIR-13706. There was significant difference of SPAD value between normal and drought condition (P < 0.05) and non-significant (P < 0.01) in Kashi Vishesh. (10) also reported that there were significant decrease in chlorophyll content in drought conditions as compare to normal condition. (11) examined in different cultivars of tomatoes that under drought stress chlorophyll content was significantly decreased. It wasobserved that the Chl a and Chl b content in 'Arvento' cultivar of tomato significantly increased under drought (9).

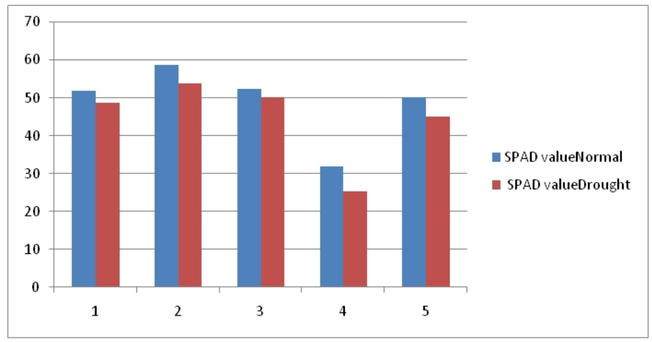

Fig.-3 : SPAD valuein WIR-13706 under normal and drought.

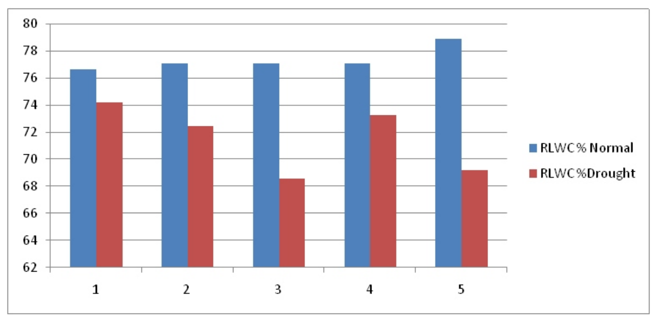

Fig.-4 : SPAD valuein KashiVishesh under normal and drought.

Conclusions

Categorically, there were significant difference between normal and drought condition in these physiological traits,so these may be used for screening of drought tolerance varieties in tomatoes. Relative water content and SPAD valueparameter can be used to select high yielding genotypes of tomato that maintain cell turgor under drought stress to give relatively more yield.

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