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Drought and Salinity Stress Response in Flower Crops

M. Kavitha^{1*}, S. Padmapriya² and A. Sankari³

^{1,2}Controllerate of Examinations, TNAU, Coimbatore, Tamil Nadu (641 003), India

³Department of Vegetables Crops, TNAU, Coimbatore, Tamil Nadu (641 003), India

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Corresponding Author

M. Kavitha

e-mail: murugavelkavitha@yahoo.com

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E-mail: bioticapublications@gmail.com

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Abstract

Drought has a greater impact on the productivity of flower crops. Lower water potential, a continuous shortfall in precipitation may be accounted for causing drought stress. As a result of this plants undergo some major physiological changes involving alteration in size and rate of photosynthesis, activity of pigments. Hence, as a result, the yield parameters like size and weight may be observed. This article envisages on effect and impact of salinity and drought on the growth, yield and the quality of flower crops.

Introduction

Drought is an important abiotic stress that limits the plant growth and efficiency of crop production worldwide. A continuous shortfall in precipitation coupled with higher evapotranspiration leads to agricultural drought. Drought impairs normal growth, disturbing the water relations and reduces the water use efficiency in the plants. This will subsequently lead to major reduction in the yield of the plant which will abruptly bring down the productivity of the plant. Salinity turns fertile and productive soil into barren desert land leading to alterations and loss of biodiversity of natural flora. Small changes in salt concentration are sufficient to suppress vegetative growth and plant development thus inducing physiological changes with different direct and indirect effects. Salinity stops growth and, in high concentrations, changes plant morphology and anatomy and has lethal effect on plant organism metabolism.

Effect of Stress

During their life cycle, plants may experience frequent periods of water deficit and drought, which is one of the major abiotic stresses affecting the growth and development. Agricultural drought is the lack of moisture required for normal plant growth and development to complete the life cycle (Manivannan *et al.*, 2008). Some plants show tolerance or resistance to drought. Drought resistance may be defined as the capacity of survival during environmental water stress. There are exclusive responses to drought stress from each and every plant. Plants exploit morphological characteristics of drought adaptation that ensure maximum water absorption during dry conditions. The limitation of plant growth imposed by low water availability is mainly due to reduction of plant carbon balance, which is largely dependent on photosynthesis.

The effect of salinity on *Iris hexagona* flowering phenology was both delayed and persistent, although a significant salinity effect did not appear until the second year of exposure. This observation has particular relevance for coastal populations

that typically experience wide variation in salinity. Fluctuations in salinity can create windows of opportunity for sensitive developmental stages such as seeds but our study suggests that mature plants retain the effects of salinity even during periods of low stress.

Effect on Growth and Development

Drought had a significant effect on leaf area and number of leaves in African Marigold. Reason for decrease in number of leaves with increase in drought might be due to inhibition of growth in association with changes in cell size and division resulting in reduced leaf production and promoting senescence and abscission. The increment in water stress caused the reduction in leaf area, where the leaves became spindle shaped and remained in a stunted state to avoid the excessive transpiration with low stomatal density until they were re watered. Transpiration rate plays a major role in estimating drought tolerance of plants. Varieties which allow less loss of water from leaves through stomata retaining more water are supposed to be more droughts tolerant. It is well documented that drought affects growth and also reduces stomatal conductance which can cause reduction in transpiration under drought stress.

Salinity inhibits plant height in the plants. The relative percentage of growth rate in studied plants was within 85.8% - 91.2% in *Tagetes* and 81.8% - 68.2% in *Ageratum*. The increase of NaCl concentration enhanced the growth inhibition effect. The inhibition effect on bud formation and flowering phases are evident with the higher salinity concentration. Plants treated with high NaCl concentrations manifested a significant delay of bud formation compared to control plants, which was better expressed in *Ageratum* (Zapryanova et al., 2014).

Effect on Photosynthetic Efficiency

It is generally known that photosynthetic efficiency depends on photosynthetic pigments such as chlorophyll a and chlorophyll b which play an important role in photochemical reactions of photosynthesis. Drought stress has capacity to inhibit the photosynthesis of plants by affecting chlorophyll components causing changes in chlorophyll content and damaging the photosynthetic apparatus in plants. Significant reduction in net photosynthetic efficiency and stomatal conductance was observed in two chrysanthemum cultivars subjected to drought. There was also a progressive drop in chlorophyll concentration in both the cultivars over the entire course of drought treatment (Jing Sun et al., 2013). Water stress significantly decreased photosynthetic rate in Jasmine plants thereby affecting the plant growth and yield. Rehydration resulted in yield gradual recovery of net photosynthetic rate in drought induced Jasmine plants.

Metabolic Changes

Proline accumulation, considered a general indicator for drought tolerance. This permits osmotic adjustment, which results in water retention and avoidance of

cell dehydration. During water stress, proline concentration fluctuated in *Chrysanthemum* cultivars, but in the later days proline concentration increased in the cultivars (Jing Sun et al., 2013). Water stress significantly decreased starch content, but increased contents of total soluble sugars and proline in Jasmine plants. Stressed plants always exhibited significant higher proline content in the leaves, confirming that proline is a general marker for drought stress.

Essential Oil

Water stress has a significant effect on the essential oil content of the flowers. The increasing water deficit decreased the percentage of essential oil content in calendula. Though the essential oil content was decreased there were increases in quality of essential oil content.

Effect on Roots

Plants take water and minerals through roots to sustain life and compete for nutrition. When plants are grown under stress i.e. salt or water stress, the competition is more pronounced and roots define the tolerance of plants against stress under the conditions. The overall trend of root length for the cultivars of *Tagetes erecta* was increasing in the beginning and then decreasing as the drought level increased. The root characters exhibiting reduction in the growth of the roots due to the low water supply included are root length, root density and root thickness. Root system that enhances the ability of a plant to capture water is a fundamental adaptation mechanism to drought. The significant correlation between root length and relative water content lends support to the view that increased root length is associated with improved drought stress avoidance in Al-P plants, applied with Alumina buffered Phosphorus (Al-P) nutrition. The roots of marigold plants grown with conventional phosphorus fertilization were distributed primarily near the irrigation drip tube, and not throughout the medium, while plants grown with lower P concentration supplied by Al-P had roots distributed throughout the medium and wilted more slowly during drought.

Conclusion

It is clearly evident that drought inhibits the growth of the plants and their productivity. The flower production is reduced greatly at the stress periods. Hence, a better understanding of the drought tolerant mechanism coupled with development of drought tolerant varieties will pave way to address this universal issue in a better way, in compliance with climate resilient crop production.

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