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Response of anatomical traits to environmental stresses in the leaves of local orange seedlings (*Citrus sinensis* L)

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This study explores the effects of salinity and drought stress on the anatomical characteristics of local orange seedlings. The research was conducted at the Agricultural Research Station of the College of Agriculture, University of Basra, during the 2022-2023 agricultural season. Salinity stress was imposed using three concentrations of irrigation water (0, 3, and 6 ds.m^{-1}), while drought stress was implemented by varying irrigation frequency (daily, weekly, and monthly). The anatomical traits examined included cuticle layer thickness, epidermal cell thickness, mesophyll cell diameter, vascular bundle diameter, tannin cell diameter, and vascular bundle sheath thickness. A recent study found that salinity stress in irrigation water and drought have a negative impact on the anatomical characteristics of local orange seedlings. Salinity (6 ds/m) and drought (monthly irrigation) led to an increase in the thickness of the cuticle layer (2.50 and 2.03 µm) and the diameter of the tannin cells (7.74 and 6.67 µm). These treatments also caused a decrease in the thickness of the epidermal cells, the diameter of the cells of the mesophyll tissue, the vascular bundle, and the thickness of the sheath of the vascular bundle. The study also found that the interaction between salinity stress and drought led to an even greater decrease in the anatomical characteristics of the seedlings. The interaction between salinity (6 ds/m) and drought (monthly irrigation) caused a decrease in the thickness of the epidermal cells, the diameter of the cells of the mesophyll tissue, the vascular bundle, and the thickness of the sheath of the vascular bundle to 2.57, 5.40, 33.23, and 20.11 µm, respectively.

Keywords: Anatomical characteristics, drought, environmental stresses, orange seedlings, salinity.

INTRODUCTION

Orange plants, scientifically known as *Citrus sinensis* L., belong to the Rutaceae family and are vital in global agriculture due to their production and quality. In Iraq, orange production is relatively low compared to the number of fruit trees, partially due to environmental stresses such as salinity and drought. Salinity and drought are major factors impacting fruit tree cultivation, causing a decline in orange production in Iraq. Salinity, in particular, has been exacerbated by water scarcity and degradation of water quality. This study aims to investigate how these environmental stresses affect the anatomical traits of orange seedlings.

Iraq produces 375 thousand tonnes of oranges, which is low for this number of trees. First in fruit production, oranges produce 66 million tonnes annually (F.A.O, 2005; Agha et al., Baldwin, 1993; 1991).

Most citrus-producing regions endure hot, dry summers with insufficient water and low-quality irrigation water due to high salt regimes. These factors reduce citrus tree output and quality. Climate change worsens salinity and drought stress in citrus-growing regions (Garcia-Sanchez and Syvertsen 2014). The fall in orange output in Iraq is due to salt and drought, which are major variables in fruit tree cultivation and productivity, and a shortage of farmed land (Ahmed *et al.*, 2013). Iraq has the most salinity space in Arab and Asian countries. Lack of water, water resource degradation, poor management, and rising groundwater levels have worsened Iraq's salinity problem in irrigated parts in central and southern Iraq (Taha, 2011). It affects almost 20% of the world's irrigated lands and worldwide agriculture, mainly in arid and semi-arid regions (Munns and Tester, 2008). The average tree production is modest, and the fruit quality has declined in recent years due to its tiny size and lack of juice. Most of Iraq's mineral elements are exposed to many factors that limit their solubility in soil solution and their readiness for the plant due to high salinity and pH and competition and interaction between ions, which decreases the activities of positive and negative ions that the growing plant benefits

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