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Growth and Osmotic Adjustment in Two Almond Rootstocks under Water Stress Conditions

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Abstract

A greenhouse experiment was conducted in 2010 to evaluate the response of seedlings and cuttings of GF677 hybrid (*Prunus persica* and *P. amygdalus*) rootstock and bitter almond seedlings (*P. dulcis*) to water stress. After determination of field capacity (FC) of the soil used for potting, irrigation treatments were imposed by daily irrigation to FC and 2, 4 or 8 day intervals for 96 days. Delaying irrigation had no significant effect on shoot growth and diameter, but decreased leaf production. Root number and length and root to shoot ratio in GF677 seedlings and cuttings increased with increasing frequency of irrigation. In GF677 seedlings and cuttings, delaying irrigation from 0 to 8 days increased leaf sugar, potassium and proline concentrations significantly, and potassium had a significant role in reducing osmotic potential. GF677 seedlings and cuttings had a greater ability to withstand water stress than bitter almond seedlings. It was concluded that conventional bitter almond rootstocks currently considered most tolerant to drought can be replaced by cuttings of GF677 rootstock.

Water shortage is common in the almond growing areas of southern Iran. Fruit trees express various responses to drought stress and develop a wide range of mechanisms to enable them to retain their metabolic activity under low water potential conditions (30). Osmotic adjustment is one of the crucial processes involved in plant adaptation to drought and allows plant to tolerate temporary or prolonged periods of water shortage (6). Higher solute concentration causes lower tissue osmotic potentials, maintains turgor potential, and improves tolerance to low tissue water potentials. Low osmotic potential and the capacity for osmotic adjustment may also serve as useful criteria for selection and breeding of more drought-resistant species and cultivars (33). Plants subjected to water deficits may accumulate or synthesize sugars (35), amino acids such as proline (26, 36), sodium and potassium ions (10) and organic acids (32). Osmotic adjustment through accumulation of compatible solutes has been reported in many fruit and nut trees such as cherry (20), apple (35), jujube (7), grape (17), peach (23), almond (13) and citrange (18). Delaying irrigation sharply increased the proline concentration in almond leaves (36). Accumulation of soluble sugars in almond cultivars reduced the osmotic potential of the leaves (13)

The use of bitter almond seedlings as a rootstock has traditionally been practiced for almond orchard establishment in Iran. Many growers believe that these rootstocks are most tolerant to drought and soil pathogens. The origin of the majority of them is, however, not known and this causes severe orchard problems due to heterogeneity amongst the trees. The GF677 rootstock has recently been introduced to Iranian growers. If this rootstock performs satisfactorily in the arid and semiarid climate of Iran, it can replace the use of bitter almond seedlings as rootstocks.

The difficulty in rooting this hybrid rootstock has stimulated nurserymen to produce seedlings of GF677. Though drought resistance of vegetative GF677 rootstock has been reported by several researchers such as Alarcon et al. (1) and De Salvador (8), there are no reports of a comparison of drought

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