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Effect of drip irrigation and fertilizer regimes on fruit yields and water productivity of a pomegranate (*Punica granatum* (L.) cv. Rabab) orchard

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ABSTRACT

We investigated the effect of different irrigation and fertilizer regimes on yield of 9-year old pomegranate trees during 2011 and 2012. The experimental design was a split plot as complete randomized blocks with three replications. The main plots contained five irrigation treatments as irrigating one side of trees with 50% and 75% of ET_C (DI50, DI75); irrigating alternate sides of trees with 50% and 75% of ET_C (PRD50, PRD75) and full irrigation (FI) that received 100% ET_C. The sub-plots were three types of fertilizer including sheep manure; M (50 Mg ha^{-1}), chemical; CF (Urea: 120, diammonium phosphate: 75 and potassium sulfate: 60 kg ha^{-1}) and foliar; FF (Ecoquel Micromix: 1 kg ha^{-1} dissolved in 1000 L water, Defender Calcium and Futop: 2 L mixed in 1000 L water) fertilizer. Results showed that in comparison with the FI treatment, the PRD75 and PRD50 with 25% and 50% less applied water increased the fruit yield by 5.6–8.3% and decreased it by 15.8–17%, respectively. All DI and PRD irrigation treatments had positive effects on water productivity (WP) compared with FI. The PRD strategies showed the superior results in increasing the fruit load, unit weight and diameter of fruit and decreasing the fruit cracking compared to DI strategies. Fertilizers including microelements (M and FF) resulted in higher fruit yield and loading and lower fruit cracking; while, fertilizers, including macroelements (M and CF), were more effective in enhancing the unit weight of fruit. Therefore, the PRD75 strategy in combination with M is highly recommended for pomegranate orchards in semi-arid areas due to the positive impact on fruit yield, loading, WP, unit weight of fruit and fruit cracking. Also, the DI75 strategy could be used for conserving additional water where the extra cost of the PRD strategy in drip irrigation is considerable.

1. Introduction

Agriculture is the largest consumer of freshwater resources in the world, consuming about 70% of extractable water globally and more than 90% in arid countries (WRI, 2005). Typically, 60–80% of water resources are consumed by irrigation (Huffaker and Hamilton, 2007). In many regions, irrigation water availability is decreasing due to excessive consumption and increasing competition among industries, environment and household sectors.

Water-conserving irrigation strategies are used to improve the water productivity (WP) in recent years. Deficit irrigation (DI) and partial root-zone drying irrigation (PRD) are two water-saving irrigation methods that reduce the full irrigation of crops. The amount of irrigation water reduction in PRD is crop-dependent and generally accompanied by no or minor yield loss that increases the WP (Sepaskhah and Ahmadi, 2010). Deficit irrigation is an optimizing strategy under which crops are deliberately allowed to sustain some degree of water stress and yield reduction (Hoffman et al., 1990). Different studies have shown that DI is advantageous when properly applied (Sepaskhah and Ghahraman, 2004; Fereres and Soriano, 2007; Geerts and Raes, 2009; Shabani et al., 2013). Originally, the concept of PRD was first applied by Grimes et al. (1968) in the USA on field cotton in alternate furrow irrigation and then followed by Sepaskhah et al. (1976). The PRD approach is used to alternately irrigate two spatially prescribed parts of the plant root system in order to simultaneously maintain the plant water status at maximum water potential and control the vegetative growth for prescribed parts of the seasonal cycle of plant development (Shahnazari et al., 2007). Therefore, the PRD is a novel irrigation

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