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Comparison of emitters of ceramic tube and polyvinyl formal under negative pressure irrigation on soil water use efficiency and nutrient uptake of crown daisy

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ABSTRACT

This study compared water-use efficiency (WUE) and nutrient absorption of *Glebionis coronaria* L. through emitters of ceramic tube (CT) and polyvinyl formal (PF) under negative pressure irrigation. Three (↓4 kPa, ↓8 kPa, ↓12 kPa) water-supply treatments and artificial watering (CK) with pot experiments were investigated. The results showed that soil water content ranged from 18.1 to 27.2% with CT and 18.5–27.6% with PF, respectively. A decrease of water supply pressure resulted in a gradual decrease of water supply, water consumption, and nitrogen content of *Glebionis coronaria* L., whereas the contents of phosphorus and potassium gradually increased. The soil water content, plant height, yield, nutrient uptake, and WUE of plants irrigated with the PF emitter were superior to those irrigated with the CT emitter. The best water supply model was a water supply pressure of ↓4 kPa during the early growth stage and ↓8 kPa in the middle and late stages. Thus, water supply pressure has significant effects on the growth and development, yield, WUE, and nutrient absorption of Crown Daisy.

1. Introduction

Negative pressure irrigation (NPI) has been applied to a variety of crops in greenhouses in recent years (Lei et al., 2005; Li et al., 2010; Rodriguez-Sinobas and Rodriguez, 2012; Li et al., 2017a, 2017b). Soil water content can be kept in an unsaturated state and controlled accurately according to crop requirements under NPI (Bian et al., 2018). The plant height, yield, and water-use efficiency (WUE) of tomato with NPI were found to be higher than with drip irrigation (Li et al., 2017a, 2017b). The growth and yield of red pepper saved 35% more water using NPI, than using normal irrigation (Nalliah and Ranjan, 2010). Although many studies have shown that NPI could improve the yield, quality, and WUE of a variety of crops (tomatoes, peppers, cabbage, tobacco, and cucumber) (Agrawal et al., 2018; Camp et al., 2000; Bozkurt et al., 2006), little has been reported on crown daisy.

Crown Daisy (*Glebionis coronaria* L.) is a typical leafy vegetable, which has been cultivated for approximately 900 years in China. *Glebionis coronaria* L. is a water-intensive vegetable that consumes nearly 260 mm of water during the growth period of less than two months (Yan et al., 2017).

The suction is the key of the negative pressure irrigation device. At present, traditional intermittent is most commonly used in ceramic tube (CT), which might crackly and is not an efficient irrigation method for crops, resulting in low water-use efficiency (WUE), yield, and quality, causing many environmental problems (Ren et al., 2010; Zhao et al., 2017). Polyvinyl formal (PF) could more readily meet the crop water requirement than a ceramic tube (CT) in the water supply pressure range of ↓10 to ↓5 kPa, which is suitable for common crop growth (Cong et al., 2017).

The objectives of this study were to investigate the effects of different water supply pressures and different emitters on the growth and nutrient absorption of crown daisy, and to determine the optimum water supply pressure and emitter type for negative pressure irrigation.

2. Material and methods

2.1. Site description and NPI

The experiment was carried out in the rain shelter house of Chinese Academy of Agricultural Sciences (CAAS) in Beijing (39.9 °N, 116.3 °E)

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