Effects of Thinning Density on Soil Water Content of Alfalfa and David Peach Intercropping in the Hilly Loess Plateau, China

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Abstract:

Intercropping alfalfa (*Medicago sativa*) between the four meters inter-row spacing of David peach (*Amygdalus davidiana*) is one of replantation practices at the Longtan catchment in Gansu province of the western Loess Plateau in the early 1980's. However, both alfalfa and David peach are deep-rooted species and their intercropping results in excessive consumption of soil water in the hilly Loess Plateau. To alleviate this, we set up four density/intercrop treatments, which includes: David peach+alfalfa (PA), David peach (P), 60% David peach+alfalfa (60% P+A) and 60% David peach (60% P). TRIME was used to quantify the soil water content in 0 to 180cm soil layers. We found that the deep layer (120-180 cm) soil water content of PA treatment was only 6.9%-8.7% during the growing season, which was close to the permanent withering point (6.5%). The soil water storage of shallow layer (0-60 cm) under P treatment was higher than the other three treatments during the dry season (April-June). Compared with the PA, the soil water storage of deep layer under the 60% P treatment increased by an average of 5.7%. This study concluded that the intercropping of alfalfa and David peach intensified the deep soil water deficit and reducing the vegetation density may be a good measure for the restoration of soil water.

Introduction

Soil water resources affect plant growth and plant distribution. The stability of plantations is mainly affected by soil water. The problem of deep soil desiccation caused by the strong transpiration of plantation affects the growth of vegetation (Jun et al., 2008). Thinning is the main technical measure for artificially promoting plant growth (Bhandari et al., 2021). Reasonable thinning can improve the soil water status of forest land and reduce the competition between plants to maintain the stability of plantations. Therefore, in this study, we chose the David peach (*Amygdalus davidiana*) plantation and alfalfa on the slope of Longtan catchment, Dingxi, the western Chinese Loess Plateau. The plants were used as research objects to monitor the changes of soil water content in plantation and grassland under different structural adjustment measures, aiming at clarifying the effects of removing alfalfa and thinning David peach on the soil water of plantation grassland. This survey is of great significance to the restoration and stability of vegetation in the semi-arid region.

Study Site, Material and Methods

This study was conducted in Longtan watershed (35°43′-35°46′N ,104°27′-104°32′E, ele. 1967-2168 m), Dingxi city, Gansu province China, belongs as the shallow gully Loess Plateau. The annual average temperature is 6.8°C, and the average annual precipitation is 386 mm (Yang et al., 2014). We chose a southeast slope where alfalfa planted between David peach rows over 15 years. Thinning density treatments were as follows: David peach+ alfalfa (PA), 40% David peach was thinned+ alfalfa (60% P+A), all alfalfa were moved only David peach remained (P) and 60% David peach (60% P): 40% David peach was thinned, alfalfa was moved, with four replicates along the slope surface in July 2018. In one treatment, tubes were installed one in *alfalfa* field and two bellow the thinned David peach tree. The soil water content (SWC) was measured at 15 ds interval at layers of up to 180 cm in 20-cm increments below the soil surface using a time-domain reflectometry (TDR) moisture measurement system (TRIME, IMKO Micromodultechnik, Germany).

Results

At the beginning of growing season (May), the SWC under 60% P+A treatment was higher than the other three treatments in 20-60cm soil layers (Fig. 1). In May, August and October, the SWC in 80-160 cm soil layers under 60% P treatment was higher than the other three treatments. The soil water storage of 120-180 cm soil layer under 60% P treatment was higher than the other three treatments (Fig. 2). In the dry season (April-June), the soil water storage in the 0-60 cm soil layer under 60% P+A treatment was higher than the other three treatments.

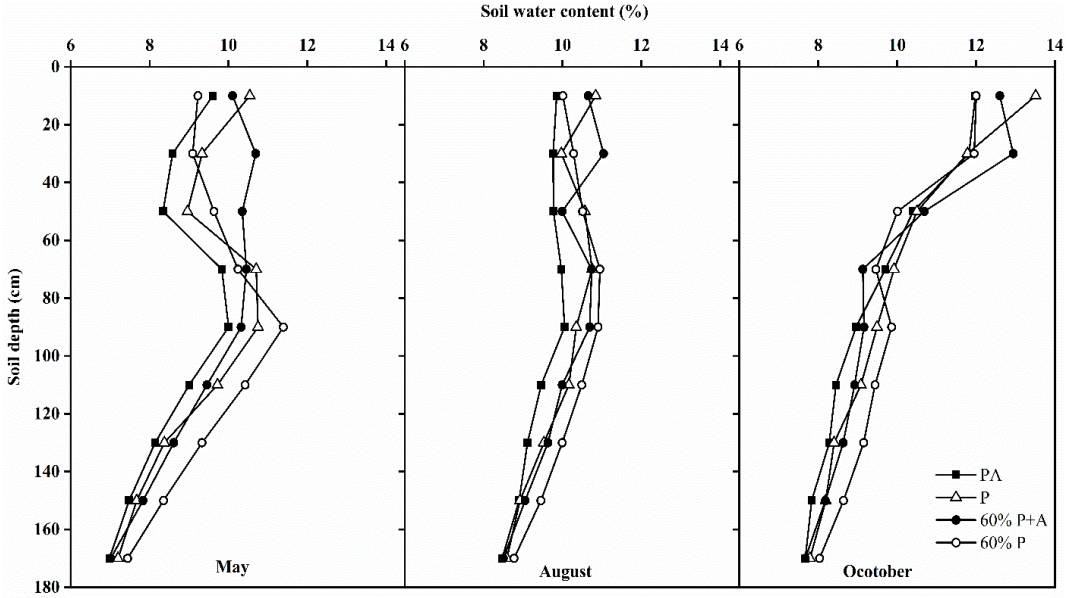

Fig. 1 Profile distribution of soil water content under different treatments in typical periods.

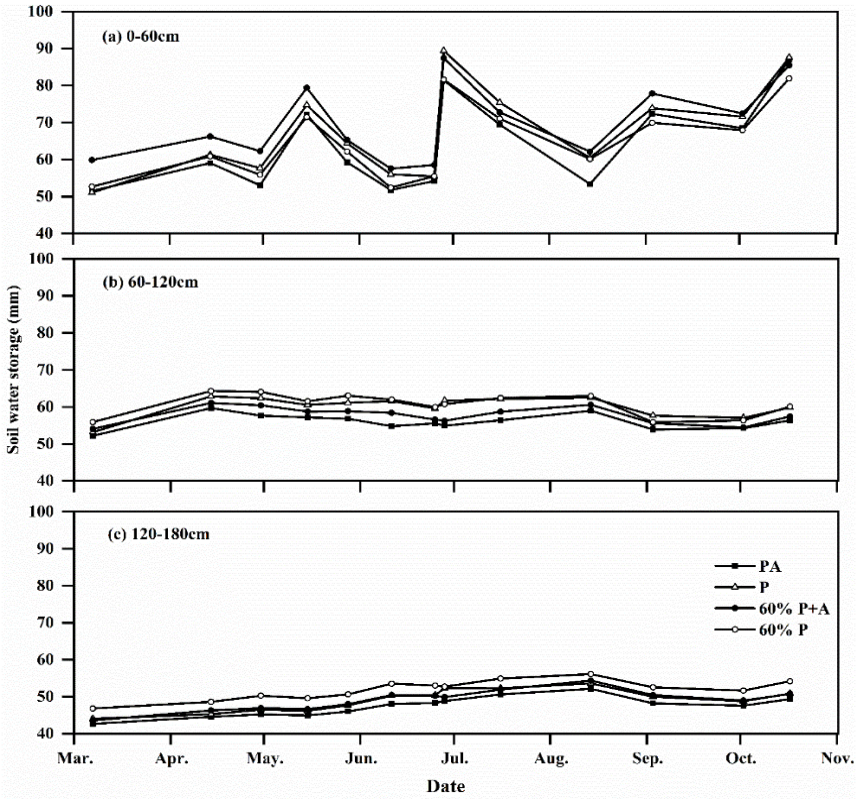

Fig. 2 Dynamics of soil water storage in different soil layers of *Amygdalus davidiana* plantation under different treatments during growing season.

Discussion [Conclusions/Implications]

We found that 60% P+A treatment can restore the surface soil water (0-60cm) of *Amygdalus davidiana*

plantation. And 60% P treatment had a positive effect on the restoration of deep soil water (120-180cm). It is due to that removing alfalfa and/or thinning David peach reduced the consumption of soil water on the slope by reducing vegetation density. Thinning David peach could reduce canopy closure that increased the penetration of rainfall (Zhu et al., 2015). The vegetation will extract a lot of soil water and reduce throughfall, which results in rapid development of soil water deficits. Consequently, measures to reduce vegetation density should be taken to reduce the soil water consumption of vegetation. Bréda et al. (1995) found that excessive density caused vegetation extract a lot of soil water and reduce throughfall, which results in rapid development of soil water deficits. Aiming at resolving the severe water shortage in alfalfa and David peach intercropping land, appropriate water management measures (e.g., thinning) should be taken to reduce excessive consumption of limited water resources. Our study provides valuable information for soil water management of artificial vegetation in the hilly Loess Plateau.

Acknowledgments

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