

A method to evaluate evaporation in olive orchard

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Resumo

O objetivo deste estudo foi controlar a evaporação de solo do pomar de azeitona irrigado de gotejamento em condições de solo secas e molhadas de encontrar uma relação com o conteúdo de água de solo. A evaporação foi medida usando microlysimeters e o modelo do Evett à evaporação potencial.

1. Introduction

Direct evaporation from the soil (E_s) is considered a significant water loss in high-frequency microirrigation systems (Bonachella et al., 2001). At present, the increase of the olive orchards with drip irrigation is concerned in La Rioja (Argentina) because of the limited water resources available. Evaporation from soil at any site is influenced by the interaction of potential evaporation, canopy cover and soil water content. Microlysimeters (MLs) were used to derive empirical relationship between evaporation from soil and soil water content. The study was carried out in ten day periods between May 2006 and January 2007 in an olive orchard in Aimogasta (28E-67S, 800m s/n.m.) La Rioja Province. The experiment was conducted under two conditions: one with an irrigation that represents 40 % of E_{To} (evapotranspiration potential from an automatic station) (T40) and 100 % of E_{To} (T100) with the target to understand the behavior of the evaporation in order to take more suitable decisions. The canopy in the same row is not homogeneous because there is a space between trees, defining as sunny areas and just under the trees as shaded areas.

2. Materials and methods

Evaporation of water from the soil surface beneath olive crop was measured using microlysimeters (ML) containing undisturbed samples of soil made of PVC tubing (0.060 m.i.d. and 0.15 m long). After 24 h they were reweighed to determine the water loss. Five MLs were installed under of the trees in T40 and five MLs in T100. MLs were located in wetted soil by the emitters, between emitters and between the two lines of irrigation. The area wetted by the emitters was measured to obtain the soil evaporation.

The Evett's model (1994) is based on the surface energy balance of dry and drying soil. Data needed include wind speed, the soil surface temperature measurements obtained on a suitably small time interval and a reference dry soil. The model is:

$$\int_{t_1}^{t_2} E_s dt = \varepsilon_s \sigma \int_{t_1}^{t_2} (T_d^4 - T_s^4) dt + \rho C_p \int_{t_1}^{t_2} \frac{(T_d - T_a)}{r_d} dt - \rho C_p \int_{t_1}^{t_2} \frac{(T_s - T_a)}{r_s} dt \quad (1)$$

Where ε_s is the soil emissivity, σ is the Stefan-Boltzman constant; r_s and r_d are the air resistances for sensible heat flux of drying and dry soils. The resistances were derived by Evett et al. (1994) for a soil bare.

The reference dry soil was established using a PVC tubing (0.30 m and 0.50 m long) buried in the soil beneath olive trees for each treatment in the sunny and shaded areas. The dry (T_d) and drying soil (T_s) temperatures were measured using copper-constantan thermocouples and recorded on data logging system every 15 min. These values were obtained in the sunny and shaded areas for both treatments. The air temperature (T_a) and humidity at 10 cm above surface were obtained with psychrometers (Figuerola and Berliner, 2006a) every 15 min for both treatments. Additionally, the soil water content at 10 cm was observed with a EnviroSCAN system each 15 min with three tubes for treatment.

3. Results

The model hypothesis assume uniform soil wetting to avoid the micro-scale advection in olive orchards (Bonachela et al., 2001). Figures 1a and 1b show the means of observed evaporation (E_o) and the estimated evaporation (E_e) from equation (1) for treatment T40 and T100. The estimated evaporation was always lower than the observed evaporation, except in November to the treatment at 40% where a deficit could have occurred. This region corresponds to a No Mediterranean Climate and in spring is common the Zonda wind with highest wind speeds and lowest moist (Figuerola and Berliner, 2006b).

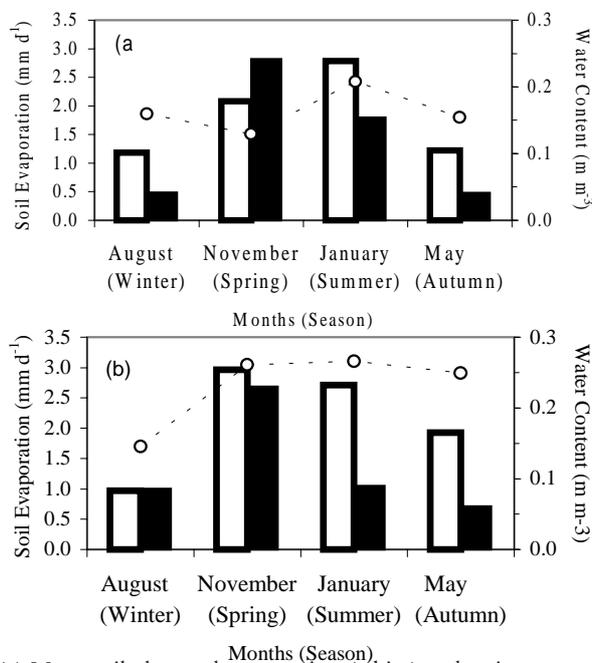


Figure 1. (a) Mean soil observed evaporation (white) and estimate evaporation (black) with the months to the treatment T40, (b) idem to the treatment T100. The line is the water content.

Figures 2a, 2b and 2c present the values of the ration (E_s/E_e) that increase with the water content. The values showed are the first day after the irrigation to assume evaporation potential. Figure 2a is data of winter-autumn. We can observe that $(E_s/E_e) \sim 1$ when the water content lower than 0.15 m m^{-3} . Figure 2b is to spring season: $(E_s/E_e) \sim 1$ with water content as high as 0.25 m m^{-3} ; Figure 2c is to summer: $(E_s/E_e) \sim 1$ with 0.20 m m^{-3} .

4. Conclusion

The evaporation was estimated using the Evett' model to potential evaporation. Knowledge the water content is possible to improve the soil evaporation. The lowest water content is the most advantageous evaporation in winter. The highest water content is required in spring. In summer about 0.2 m m^{-3} water content is necessary. This method treats to avoid the micro-advection effect common in arid regions.

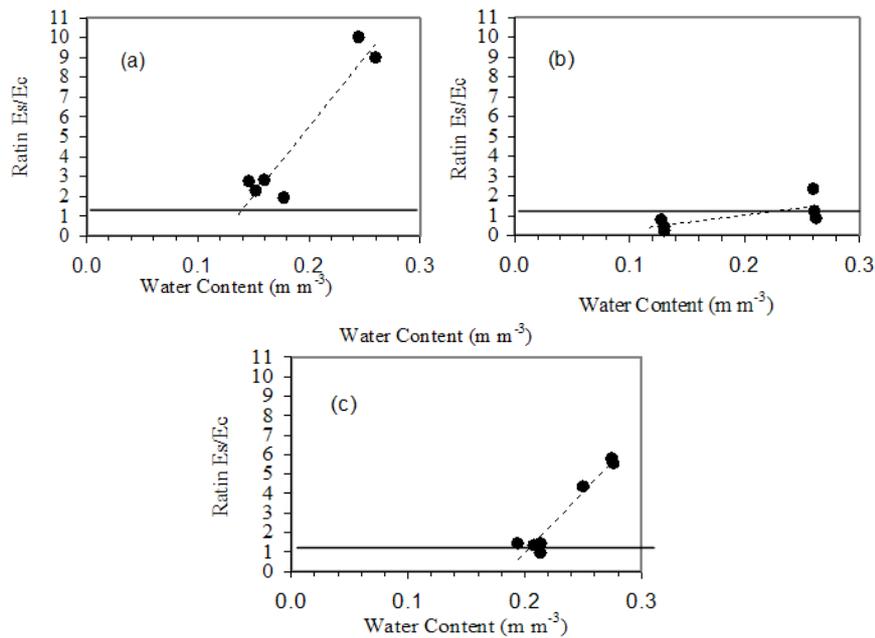


Figure 2. Ration (E_s/E_c) with the water content. (a) winter, (b) spring and (c) summer.

5. References

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