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Energy and water saving by using modified closed circuits of drip irrigation system

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ABSTRACT

The aim of this research was determine the en- ergy and water use efficiencies under the modification of closed circuit drip irrigation systems designs. Field experiments carried out on transgenic maize (GDH, LL3), (Zea Mays crop) under two types of closed circuits: a) One manifold for lateral lines or Closed circuits with One Manifold of Drip Irrigation System (CM1DIS); b) Closed circuits with Two Manifolds of Drip Irrigation System (CM2DIS), and c) Traditional Drip Irrigation System (TDIS) as a control. Three lengths of lateral lines were used, 40, 60, and 80 meters. PE tubes lateral lines: 16 mm diameter; 30 cm emitters distance, and GR built-in emitters 4 lph when operating pressure 1 bar under Two levels slope conditions 0% and 2%. Experiments were conducted at the Agric. Res. Fields., Soil and Plant & Agric. System Dept., Agric. Faculty, Southern Illinois University, Car- bondale (SIUC), Illinois, USA. Under 0% level slope when using CM2DIS the increase percent of Energy Use Efficiency (EUE) were 32.27, 33.21, and 34.37% whereas with CM1DIS were 30.84, 28.96, and 27.45% On the other hand when level slope 2% were with CM2DIS 31.57, 33.14, and 34.25 while CM1DIS were 30.15, 28.98, and 27.53 under lateral lengths 40, 60 and 80 m respectively relative to TDIS. Water Use Efficiency (WUE) when level slope 0% under CM2DIS were 1.67, 1.18, and 0.87 kg/m³ compared to 1.65, 1.16, and 0.86 kg/m³ with CM1DIS and 1.35, 1.04, and 0.75 kg/m³ with TDIS whereas with level slope 2% when using CM2DIS were 1.76, 1.29, and 0.84 kg/m³ compared to 1.77, 1.30, and 0.87 kg/m³ with CM1DIS and 1.41, 1.12, and 0.76 kg/m³ (for lateral lengths 40, 60, and 80 meters respectively). Water saving percent varied widely within individual lateral lengths and between circuit types relative to TDIS. Under slope 0% level CM2DIS water saving percent values were 19.26, 12.48, and 14.03%; with CM1DIS they were 18.51, 10.50, and 12.78%; and under slope level 2% with CM2DIS they were 19.93, 13.26, and 10.38% and CM1DIS were 20.49, 13.96, and 13.23% (for lateral lengths 40, 60, 80 meters respectively). The energy use efficiency and water saving were observed under CM2DIS and CM1DIS when using the shortest lateral length 40 meters, then lateral length 60 meters, while the lowest value was observed when using lateral length 80 meters this result depends on the physical and hydraulic characteristics of the emitters, lateral line uniformity, and friction losses. CM2DIS was more energy use efficiency, EUE, water saving, and WUE than either CM1DIS or TDIS.

KEYWORDS

Drip Irrigation; Closed Circuits; Energy Use Efficiency; Water Use Efficiency

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