CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

J1131

Project Title

Development of Blocking Disc Method to Water Plants and Trees Efficiently and to Reduce Water Usage

Abstract

Objectives/Goals

The purpose of my project is to develop a simple low cost technique to reduce evaporation loss of water by blocking with a disc or hemispherical cover. Evaporation loss is expected to reduce since wet soil is not exposed to wind and sunlight.

Methods/Materials

Six pots were filled with potting soil and 80 ml of water was added to each. Plastic discs (3, 5, 7, 9 and 11 cm in diameters) were placed on the soil surface. One sample (control) was not covered. All samples were exposed to wind and sunlight. Inverted hemispherical coffee cup covers with black and Mylar tape and were embedded in to the soil. A central hole allows watering. Radish plants were grown in all samples. Daily weight loss was measured and the exact amount of water lost was added.

Results

In the case of discs, as the diameter increased percentage of evaporation decreased with liner relationship for the first 3 days of exposure to sun and wind. Above 5 cm diameter, the total evaporation loss decreased with a stronger dependence on diameter. Black and Mylar covered hemispherical covers showed 15% and 12% evaporation loss respectively compared to 38% shown by control (no cover) case. When radish plants were grown the control sample lost 71 g of water in a week, while black and reflective hemisphere cases lost 43 and 40 g respectively. Black cover case soil temperature was 4.2C higher compared to that of reflective cover.

Conclusions/Discussion

As the disc diameter increased the amount of wet soil exposed is decreased, and evaporation loss decreased. Water moves laterally due to adhesion. Diameter of this lateral movement depends on soil texture, small for sandy soils and bigger for clay, since large number of pores in fine grain clay increase adhesive forces. Above 5cm diameter, the resistance to lateral movement increases and evaporation loss falls steeply with diameter. For hemispherical cover the wet bulb is not only confined to narrow opening, but it is also lowered. Evaporation is reduced due to resistance to lateral movement of water and upward movement against gravity. Empirical expression was developed for evaporation suppression efficiency given by n =1-[1-(d^2/D^2)]^(5/4), where d is disc diameter and D is total soil diameter, and agrees with experimental data. This implies that soil properties suppress evaporation further more than the amount estimated by pure exposed fraction of area.

Summary Statement

Using a blocking hemispherical or planar cover soil evaporation can be suppressed and more than 30% water can be conserved.

Help Received

I prepared the hemispherical covers/discs and containers with potting soil, measured weight loss and temperature using thermocouple. My dad showed me how to calculate t-ratio of temperature data and helped me with fitting empirical expression to experimental evaporation suppression efficiency.