Evaluating the Efficiency of Wicking Bed Irrigation Systems for Small-Scale Urban Agriculture

1) This study explored various irrigation designs with the goal of maximizing water use efficiency when growing tomato plants on a small scale.
2) The two basic irrigation designs under examination were surface irrigation and wicking bed irrigation. The experiment also tested differing soil and wicking bed depths to determine ideal wicking bed design.
3) Quote – A wicking bed is a plant driven system where plans receive water through capillary rise from a self-contained coarse material-filled subsoil reservoir – unquote, as opposed to surface irrigation which is the typical method of pouring water onto the surface of the soil surrounding a plant.
4) The impetus for this this study was the recent expansion in urban food cultivation. As more people return to growing part of their own food supply, the water demand will increase, necessitating more efficient growth practices.
5) Quote – Municipal treated water is the main water supply used to irrigate urban gardens, and in Australia, about 34% of household water consumption is used to irrigate residential gardens – unquote.
6) Equally important is the fact that municipal water supplies in urban environments are typically much more expensive than rural water supplies where most commercial (large-scale) agriculture takes place.
7) This experimental design set out to, quote – focus on water use efficiency, fruit yield, fruit quality, dry matter production, and irrigation labor – unquote.
8) The experiment was performed in a glass house in Adelaide, Australia during the summer of 2014- 2015 and the test subject was a Mighty Red tomato (Solanum lycopersicum).
9) Eight experimental setups were each created in triplicate and labeled T1-T8. Six wicking treatments were tested (T1, T3, T4, T5, and T8) along with a wicking bed with included soil column in T6. T2 and T7 were designed for best practice surface irrigation.
10) Each of the test subjects were placed in an individual pot and were arranged at random in the glass house.
11) After prepping all soil and irrigation setups, a single 4-week old tomato start was planted in the center of each pot.
12) During the growth phase of the trial, numerous characteristics of each sample was measured: plant height, stem diameter, soil moisture at specific depths, soil temperature at specific depths, number of leaves. Watering was performed manually on a subject by subject basis depending on measured soil moisture content.
13) At the end of the growth phase, additional attributes were measured: root mass density, shoot dry matter, fruit weight, fruit diameter, fruit quality, total biomass, and labor requirements.
14) Quote – Overall, the results of this study indicated that wicking beds matched (or exceeded) water use efficiency and yield – unquote when compared to best practice surface irrigation.
15) Specifically, wicking the beds with 150 mm deep reservoir matched to a soil depth of 300mm produced the most effective result.
16) The authors also note that the depth of the reservoir appeared to have little to no effect to overall system efficacy, but soil depth was an important consideration.
17) While the deeper soil depths, 300+mm, was not ideal in this study, the authors acknowledge that certain plant species may a natural affinity for specific soil depths depending on their natural root growth pattern.
18) The results of this study suggest that the use of wicking bed irrigation may be a viable method to improve overall water use, labor use, and produce yield when applied to small scale agriculture.

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