

Research Application Summary

The effectiveness of locally made clay pots as a micro - irrigation equipment

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Abstract

This research established the water balance resulting from the clay irrigation for beans (*Phaseolus vulgaris* L.) and Amaranths (*hypochondriacus*) grown under different plant density per pot and different precedent soil moisture. Results revealed that clay pot irrigation gave good growth for amaranths, under the different conditions, while the same technique did not provide similar results on phaseolus beans.

Key words: *Amaranthus hypochondriacus*, clay pot irrigation, *Phaseolus vulgaris*

Résumé

Cette recherche a établi le bilan hydrique résultant de l'irrigation d'argile pour les haricots (*Phaseolus vulgaris* L.) et amarantes (*hypochondriacus*) cultivées dans la densité des plantes différentes par pot et différentes humidités du sol précédent. Les résultats ont révélé que l'irrigation en pot de terre a donné une bonne croissance des amarantes, dans les conditions différentes, tandis que la même technique n'a pas fourni des résultats similaires sur le haricot.

Mots clés: *hypochondriacus Amaranthus*, l'irrigation de pot de terre, *Phaseolus vulgaris*

Background

The non-reliability of rainfall in Tanzania, in addition to the increased demand of food, calls for increased irrigated agriculture systems. Such systems need the availability of water, which unfortunately is erratic and scarce. Moreover, water use is competed for by other sectors, especially industry and for domestic use. Overall, agriculture consumes 80% of the water resource thus water usage needs to be improved in terms of quantity and efficiency. Techniques such as micro irrigation need to be introduced into farming systems. A simple, cheap and effective micro-irrigation technique such as the pitcher irrigation technique is necessary for small scale farming, which constitute 85% of agriculture in Tanzania.

This study was done to establish the water balance and the performance of the pitcher irrigation technique and its effect

on plant performance. Beans (*Phaseolus vulgaris*) and amaranth (*Amaranthus hypochondriacus*) were used as the test crops.

Literature Summary

In its simplest form, pitcher irrigation entails burying an unglazed, porous clay pot next to a seedling. Water poured into the pot seeps slowly into the soil, feeding the seedling's roots with a steady supply of moisture. It is one of the most efficient and least costly irrigation systems ever devised, ideal for small farmers trying to eke a living out of dry marginal land. It is recorded in Chinese texts dating back more than 2000 years ago (Siyal, 2001).

The success of the pitcher irrigation is based on the pot (Stein, 1998; Abu-Zreig Atoum, 2004) and soil characteristics. Batchelor *et al.* (1996) found that the pitcher irrigation can save water up to 70% when compared to the conventional techniques of irrigation. The average water use efficiency of different crops under pitcher irrigation is 25.2 kg mm^{-1} . This compares with 10.1 kg mm^{-1} when a watering can is used for beans. The pitcher irrigation system saves more water because it eliminates water loss through run off, evaporation and deep percolation. Besides increasing yield owing to adequate soil aeration, soil under this system is always under field capacity (Daka, 1991).

Study Description

This study was conducted at Sokoine University of Agriculture located in Morogoro, Tanzania in a sandy clay loam soil, with a bulk density of 1.411 g cm^{-3} . The pots were molded locally at Magadu village near the university, and were baked at a temperature of 800°C . Beans were used as a test plant. But due to stem blight disease biomass analysis was done on Amaranths. The performance of the irrigation system was determined by using the crop water use efficiency (WUE), a ratio between the yield per unit of surface and the amount of irrigation water applied. The adequacy of the irrigation system was measured by the relative water supply (RWS), a ratio between the amount of the input water to the output water (combination of the plant potential requirement and water loss by deep percolation). The overall application (Ea) (ratio between the crop water requirement) and (the water applied) and the stress level determined by actual evapotranspiration) were also determined.

The set up was a split plot in a randomised block design, having two sub plots: one sub plot had precedent soil moisture at field

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capacity, and the other one had precedent soil moisture started at permanent wilting point. The treatment were the plant density per pot: four plants per pot, six plant per pot, and eight plant per pot that applied only for the beans, while the plant density for the amaranths were 16 plants/pot, 24 plants/pot and 36 plants/pot.

The water balance for each treatment was determined by measuring soil moisture by the means of calibrated tensiometers, and/or gypsum blocks, and the crop evapotranspiration with evaporation pan class A, whereas the amount of irrigation water was measured utilising a beaker. The data were collected on daily basis, whereas the crop parameter: leaf area index (LAI) and plant height were measured on weekly basis on bean plants; plant biomass was determined only on the Amaranths, at the end of the experiment.

Under pitcher irrigation the stress level decreased, with the increase of the plant density, and the lesser the precedent soil moisture the higher was the stress level. During this study the stress level ranged from 0.138 to 0.7015, the higher the indicated value the lesser the level of plant stress. The actual crop evapotranspiration did not meet the potential crop evapotranspiration. That implied that the irrigation water or the water supply was less than the required amount, as confirmed by the relative water supply (RWS), which was between 0.167 to 0.7.

Under the amaranths the IWUE was not affected by the plant density (Table 1).

Table1. Irrigation crop water use efficiency of amaranths under pitcher irrigation IWUE (kg ha⁻¹. mm⁻¹).

Subplot, treatment	16 plants/pot	24 plants/pot	32 pants/pot
At FC	0.267a	0.205a	0.323a
At PWP	0.206a	0.221a	0.196a
LSD(0.05)	0.1836	0.1836	0.1836

Based on the preliminary data use the amaranths performed better than beans under pitcher irrigation. Bainbridge (2001) stated that the the porosity of the pot increase with the temperature of kiln. Hence, it is recommended to bake the

pots at temperature greater than 800°C to increase the seepage rate.

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