

Research Application Summary

**Evaluation of water productivity for maize under drip irrigation**

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**Abstract**

A drip system operating under deficit irrigation was used to evaluate water productivity (WP) of TMV-1 maize variety in Morogoro, Tanzania. A block was divided into four sub-blocks; and each randomly assigned with deficit treatment (T1, T2, T3 and T4 as 60%, 40%, 20% and 0% irrigation water deficits, respectively). Three replications were used producing randomized block design. Each sub block biomass, grain yield and harvest index were determined. Biomass development and grain yield were significantly ( $0.1 \leq P \leq 0.05$ ) influenced by water deficit. Both increased with increasing irrigation water to full irrigation. WP were different ( $P=0.1$ ), with T2 having the highest value ( $2.2 \text{ kg/m}^3$ ).

Key words: Biomass production, deficit irrigation, grain yield, harvest index

**Résumé**

Un système d'égouttement fonctionnant sous l'irrigation de déficit a été employé pour évaluer la productivité de l'eau (WP) de la variété de maïs TMV-1 à Morogoro, en Tanzanie. Un bloc a été divisé en quatre sous-blocs et chacun aléatoirement assigné avec le traitement de déficit (T1, T2, T3 et T4 en tant que déficits de l'eau d'irrigation de 60%, de 40%, de 20% et de 0%, respectivement). Trois répliques ont été employées en produisant la conception randomisée de bloc. Chaque biomasse d'un sous-bloc, le rendement de grain et l'index de moisson ont été déterminés. Le développement de biomasse et le rendement de grain ont été sensiblement ( $0.1 < P < 0.05$ ) influencés par le déficit de l'eau. Tous les deux ont augmenté avec l'augmentation de l'eau d'irrigation à la pleine irrigation. Les productivités de l'eau étaient différentes ( $P=0.1$ ), avec le traitement T2 ayant la valeur la plus élevée ( $2.2 \text{ kg/m}^3$ ).

Mots clés: production de la biomasse, irrigation de deficit, rendement de grain, index de moisson

## Background

Improving crop water use and productivity (WP) has become a concern of many countries in the world due to the increasing water scarcity. The problem of poor WP is more serious in developing countries than in developed countries due to lack of simple and straight forward techniques of managing irrigation water. Several measures have been suggested to tackle the problem of poor WP. One is deficit irrigation which can provide a significance increase in water productivity up to 50% of the normal irrigation practices. The use of efficient irrigation systems especially drip systems increases WP. There is inadequate information that links these possibilities of improving WP in developing countries. Field experiment aimed at evaluating the effectiveness of the drip irrigation systems and regulated deficit irrigation in improving maize WP was conducted in Morogoro district in Tanzania.

## Literature Summary

The need to improve crop WP is unquestionable (Molden *et al.*, 2003; Yenesew and Tilahun, 2009). The use of efficient irrigation systems especially drip systems have been reported as one of the best way to increase WP (Yenesew and Tilahun, 2009). Applying regulated deficit irrigation can play a useful role in developing practical recommendations for optimizing crop WP under conditions of scarce water supply (Cavero *et al.*, 2000; Ismail and Dewpeg, 2005; Schahbazian *et al.*, 2007).

## Study Description

The experiments were conducted at the crop museum of Sokoine University of Agriculture (SUA) in Morogoro region. The average elevation for the area is about 526m above sea level, while average rainfall is about 1000mm per year with erratic distribution. The short rains occur between November and January followed by long rains in March to June. A dry spell is experienced in February. Soils at the site are heavy textured dominated by more than 45% clay.

The effects of four different water deficit levels (T1, T2, T3 and T4 as 60%, 40%, 20% and 0% water deficits, respectively) on WP of maize under drip irrigation were compared. A block of land was selected from the experimental site and divided into four sub blocks. The sub blocks were randomly assigned to receive one of the four treatments. This process was replicated three times producing a Randomized Block (RB) design. In each sub-block, a diviner tube was installed for volumetric soil measurement. The drip system for irrigating maize was installed in the block.

The planting and emergence date (of TMV1 maize variety) was recorded; biomass development was monitored at 45 and 75 days after planting (DAP). From each sub-block plant within a 1m<sup>2</sup> area were cut on each sampling day. Wet and oven dried biomass (in kg) were taken for the samples. At harvest grain yield was measured. Data were analysed using Genstat computer package.

### **Research Application**

The mean biomass production between treatments were significant at 45 and 75 DAP. At 45 DAP mean biomass production for T1, T2, T3 and T4 were 0.512, 0.604, 0.92 and 1.248 kg/m<sup>2</sup>, respectively, while at 75 DAP mean biomass production for T1, T2, T3 and T4 were 0.684, 0.728, 1.049, 1.378 kg/m<sup>2</sup>, respectively. The mean grain yield was significantly affected by water deficit (P=0.1 and 0.05). The measured mean grain yields increased with increasing water use, resulting into 2.67, 3.62, 3.89, and 4.7 tons/ha for T1, T2, T3, and T4 respectively. Water deficit level did not significantly (P>0.05) influence average WP. The highest value of 2.2 kg/m<sup>3</sup> was observed at T2 which received 40% deficit of crop water requirement. Other values were 1.67, 1.78, 1.72 kg/m<sup>3</sup> for T1, T3 and T4, respectively. Harvest index values were proportional to water used and were significantly (P≤0.05) influenced by water deficit levels. Harvest indices were 0.33, 0.43, 0.44 and 0.45 for T1, T2, T3 and T4, respectively.

### **Recommendation**

Forty percent (40%) water deficit (T2) is recommended for adoption in water scarce areas as the optimum maize irrigation requirement since it gives the highest value of WP. In areas where water scarcity is not a problem, supplying full irrigation can lead to high grain yield although it does not give the highest value of WP.

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