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Research Application Summary

Yield response of different local and hybrid rice varieties to different ponding depths of water

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Abstract

The combined increase in demand for food and scarcity of water worldwide necessitates saving water and increasing its productivity. This study determined varietal performance of four paddy cultivars - TXD306, TXD220, TXD88 and SUPA in terms of yield as influenced by four different ponding levels. The study assessed the yield and water productivity for each ponding depth, the differences in seepage and percolation as a result of differences in hydrostatic pressure. Results showed no significant difference in yield of varieties as a result of ponding treatments. This implies that a lot of water can be saved for other uses if the optimum ponding level, i.e., zero level is adopted.

Key words: Paddy rice, percolation, seepage, water productivity, water scarcity

Résumé

L'augmentation combinée de la demande en nourriture et de la pénurie de l'eau dans le monde entier nécessite d'économiser l'eau et d'augmenter sa productivité. Cette étude a déterminé la performance typique de quatre cultivars de riz non décortiqué - TXD306, TXD220, TXD88 et SUPA en terme de rendement comme influencé par quatre niveaux d'accumulation d'eau différents. L'étude a évalué le rendement et la productivité en eau pour chaque profondeur d'accumulation, les différences dans l'infiltration et la percolation en raison des différences de pression hydrostatique. Les résultats n'ont montré aucune différence significative dans le rendement de variétés en raison des traitements d'accumulation. Ceci implique qu'une grande quantité d'eau peut être économisée pour d'autres usages si le niveau optimal d'accumulation c.-à-d., le niveau zéro est adopté.

Mots clés: Riz non décortiqué, percolation, infiltration, productivité en eau, rareté en eau

Background

Good quality fresh water is increasingly becoming available (Postel, 1997) a situation that is continuously threatening irrigated rice production systems. The high water demand of irrigated lowland rice mainly arises from the practice of keeping a permanent layer of water on the field. A lot of water is lost from this layer through evaporation, seepage and percolation. In Asia, irrigated agriculture accounts for 90% of total diverted freshwater, and more than 50% of this is used to irrigate rice alone. A reduction of 10% in water used in irrigated rice would free 150,000 million m^3 corresponding to about 25% of the total fresh water used globally for non-agricultural purposes. Until recently, this amount of water has been taken for granted, but now the global "water crisis" caused by among other factors climate change threatens the sustainability of irrigated rice production. The available amount of water for irrigation is becoming scarce. The reasons for this are diverse and location specific, but include decreasing quality (chemical pollution, salinization), decreasing resources (e.g., falling groundwater tables, silting of reservoirs), and increased competition from other sectors such as urban and industrial users.

The urban and industrial demands are likely going to receive priority over irrigation.It is therefore essential to develop and adopt strategies and practices that will use water efficiently in irrigation schemes, particularly in parts of Africa, where demand for rice is increasing and water is less abundant than in Asia. Various water-saving technologies exist or are being developed to help farmers cope with water scarcity in irrigated environments (Tuong and Bouman, 2005). These technologies increase the productivity of water (rainfall and irrigation) mainly by reducing unproductive seepage and percolation losses and to a lesser extent by reducing evaporation. Achieving high water productivity in rice irrigated systems will thus provide part of the solution to the limited water availability world over and more so for our sub- region. A study was therefore undertaken to evaluate the yield response of four paddy cultivars to four different ponding levels.

Literature Summary

Numerous studies conducted on the manipulation of ponding depth and interval of irrigation to save water use in rice cultivation have demonstrated that continuous submergence is not essential for obtaining high rice yields. Maintaining a very thin water layer at saturated soil conditions or alternate wetting and drying can reduce water applied to the field by about (40 – 70) percent compared with the traditional practice of continuous shallow submergence as practiced by farmers, without a significant yield loss. Substantial amounts of water can be saved by reducing the depth of ponding in rice fields especially if the required amount of water is provided at critical times. Reducing seepage and percolation flows through reduced hydrostatic pressure can be achieved by changed water management. Instead of keeping the rice-field continuously flooded with 5–10 cm of water, the floodwater depth can be decreased; the soil can be kept around saturation or alternate wetting and drying regimes can be imposed.

Study Description

The study was conducted at Mkindo farmer managed irrigation scheme located in Mvomero rural District in Tanzania. It is located at latitude 6 ^{0} 16’ and 6^0 18’ South and longitude 37^0 32’and 37^0 36’east and its altitude ranges between 345 to 365 metres above sea level about 85km from Morogoro (JICA,1996).The average annual temperature is 24.4^o C with a minimum of 15.1 ^{o} C in July and a maximum of 32.1 ^{o} C in February. The mean relative humidity is 67.5% while the mean annual sunshine hours are 7.0 per day. The soils are sandy clay loam. The experiment was designed as a 4 x 4 factorial in complete randomized blocks with three replications. Main-plots were the four different water ponding treatments. Subplot treatments were four different rice cultivars in 2 m^2 subplots. All the four rice varieties were first sown in nursery beds and managed for one month before transplanting. Other than the ponding treatment, the agronomical practices were the same in all plots. Four ponding levels were administered ETc, Zero, 3 cm and 5cm. ETc treatment refers to water application based on climatic weather conditions for a particular day and was the control treatment for the study.

Research Application

The effect of ponding on the yield of the four varieties was not significant. There was also no interaction effect between the ponding treatment and variety. Variety TXD88 gave the highest yield at all ponding levels and consequently the highest water productivity while Supa variety had the lowest yield at all ponding levels. There was a 78.1% yield difference between the highest (TXD88) and the lowest yieding variety (Supa), while for TXD306 and TXD220 it was 20.7% and 20.3%, respectively. Further, the results showed that of the four ponding levels, the optimum was the zero ponding treatment. It resulted into the least amount of seepage and percolation. A plot of consumptive use versus seepage and percolation showed that the optimum seepage and percolation loss was 37% of the water applied based on hydrological and water management practices on site.

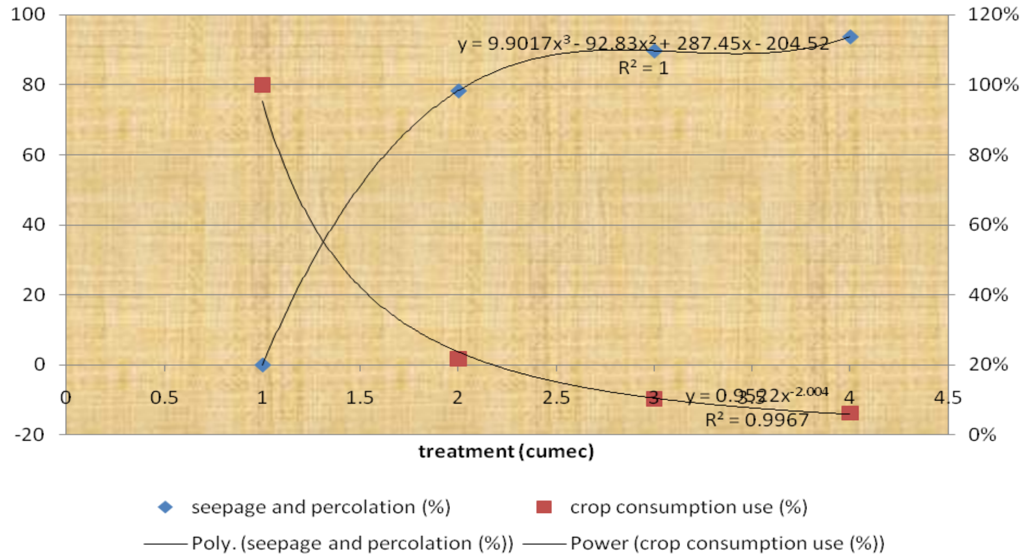

Figure1. Graph for consumptive use versus seepage and percolation.

Recommendation

Significant amounts of water can be saved by adopting water saving technologies at field scale by farmers. Our study has not investigated the interaction between irrigation and groundwater table depths. This needs to be established before making wide-scale recommendations.

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