

Efficiency and profitability of water saving technologies on irrigated rice in South-Kivu province, DR Congo

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Abstract

Water scarcity is reducing both irrigated areas and irrigated rice yield in the South-Kivu province, DR Congo, leading to increased poverty and food insecurity, at both provincial and national level. This situation is likely to be worsened by climate change and population growth. A study was conducted with the major aim of assessing the effect of water saving technologies (WST) on rice yield. A split plot experiment 5 varieties (3 imported and 2 local) was set up with 3 WST, namely alternating wetting and drying and saturated soil without flooding and the permanent flooding. The experiment was conducted in both lowland (Luberizi) and highland (Kavumu) of South-Kivu. Results showed that WST did not affect significantly the biomass both in sites ($p>0.05$). Varieties, however, impacted significantly the biomass, but only in Lowlands ($p=0.001$). In Lowlands, WST affected significantly rice yield ($p=0.05$) but it did not in Highlands ($p>0.05$). Rice yield varied significantly from one variety to another both in Lowlands ($p<0.001$) and in Highlands ($p<0.001$).

Key words: Efficiency, profitability, water management, water saving technologies

Résumé

La rareté de l'eau réduit à la fois l'étendue des superficies irriguées et le rendement du riz dans la Province du Sud-Kivu, en RD Congo, accroissant la pauvreté et l'insécurité alimentaire. Cela pourrait être empiré avec le changement climatique et la croissance démographique. Une étude visant à évaluer l'impact des technologies d'économie d'eau (TEE) à la fois sur la production du riz a été réalisée. Une expérimentation ayant 5 variétés (3 importées et 2 locales) avec 3 technologies d'économie d'eau (TEE): l'alternance entre l'irrigation et la coupure d'eau, le maintien du sol en état de saturation sans l'inonder, comparées à l'irrigation permanente a été conduite. Les résultats ont montré que les TEE n'ont pas affecté significativement la biomasse ($p>0.05$). Les variétés, par contre, ont affecté significativement la biomasse, mais seulement en basse altitude ($p=0.001$). En basse altitude, les TEE ont affecté le rendement ($p=0.05$) mais pas en haute altitude ($p>0.05$). Les rendements ont varié significativement d'une variété à l'autre à la fois en basse altitude ($p<0.001$) et en haute altitude ($p<0.001$).

Mots clés: Efficience, rentabilité, gestion de l'eau, technologies d'économie d'eau

Problem statement

South-Kivu has a high potential for rice production (de Failly, 2000; IFDC-catalyst, 2011) but water scarcity is reducing irrigated areas and irrigated rice yield in South-Kivu province, DR Congo. This is because DR Congo despite not being listed as a water scarcity affected country, some parts of the country (e.g. the Ruzizi valley) seriously affected by water scarcity. Climate change has been noted to be one of the factors that may exacerbate this water scarcity, especially by modifying the rainfall pattern (IPCC, 2007), whereby the total rainfall amount may remain the same, but there may be more rainfall in a short period and a longer period without rainfall. This will ultimately reduce yields and cropped areas, thus increasing food insecurity and poverty in the future.

Democratic Republic of Congo has a high prevalence of undernourishment of over 50% (FAO, 2009) and poverty rate of 70% (PAM and INS, 2008). It also has one of the highest population growth rates in the world (12 million inhabitants in 1950, 48M in 2000 and 152M in 2050, according to the projections of the UN (2004)). This increases food demand and exacerbate food scarcity and water demand for both agriculture and human use. It should be noted that however much yields might increase with research, catering for the population needs in terms of food in the near or far future, is almost out of reach. This therefore, makes research in agriculture both crucial and challenging. This study aimed at determining the effect of variety and WST on rice yield.

Methodology

This study was done in the Eastern part of DR Congo, precisely the South-Kivu Province. Two study sites were selected based on their landform, namely Luberizi for the lowland and Kavumu for the highland. In each of these sites a field experiment and a survey were conducted. A split plot design with 3 blocks and WST was used. The three WST included alternating wetting and drying (AWD), saturating the soil without flooding (SWF) and permanent flooding as control (PF). Five varieties of rice were planted three were imported: Kyabukoli (V1), Angerica (V2) and Nerica 4 (V3) for Lowlands; and Nerica 19 (V1), K5 (V2) and Nerica 4 (V3) for Highlands. Two local varieties, namely Iron (V4) and V046 (V5) were also used for both sites. Each treatment was replicated three times. For growth parameters (resumption rate, crops height, leaf area index, biomass and crop yield) and yield parameter (number of spikelets, number grain per spikelet, abortion rate, weight of 1000 grains and total yield) were measured in both sites. To measure resumption rate, the number of crop that resumed after transplantation was counted and compared to the total number transplanted. For crop height and leaf area index, a ruler was used at one and two months after transplantation on 5 random crops of each plot. For biomass, and weight of 1000 grain a weight machine with a precision of $\pm 0.1\text{g}$ was used. These parameters were taken respectively at 50% heading and harvest time. For yield parameter they were all counted at harvest time. Data were entered and analysed using ANOVA in Genstat.

Results

Water saving technologies did not affect significantly the biomass both in sites ($p>0.05$). Varieties, however, impacted significantly the biomass, but only in Lowlands. Three homogenous groups were found: Iron > K5 e" V046 and Nerica 19 e" Nerica 4 (Fig. 1). Both variety had significant effect on rice yield ($p<0.05$) in both sites, but WST affected rice yield only in Lowlands.

In Lowlands, WST affected significantly rice yield ($p=0.05$). The rice yield followed the order AWD > PF > SWF (Fig. 2). Rice yield varied significantly from one variety to another ($p<0.001$). The rice yield followed the order Iron > Nerica 19 > V046 > Nerica (Fig. 3). In highlands, only varieties affected significantly the yield ($p<0.001$). Two homogenous groups were found: V046 and Iron (a) and Angerica, Kyabukoli and Nerica 4 (b) (Fig. 4).

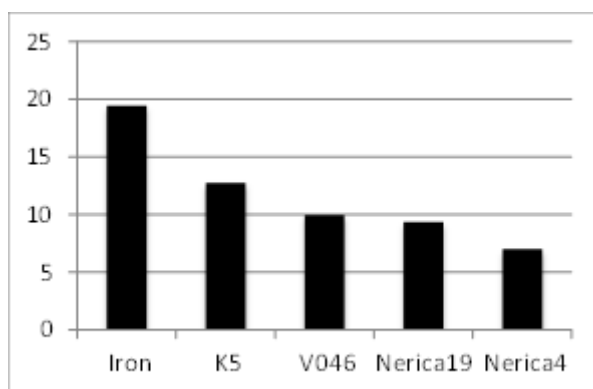


Figure 1. Effect of variety on rice biomass (t ha⁻¹) in the lowlands.

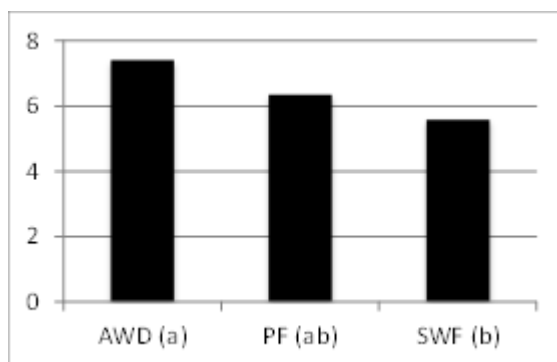


Figure 2. Effect of WST on rice yield (t ha⁻¹) in the lowlands.

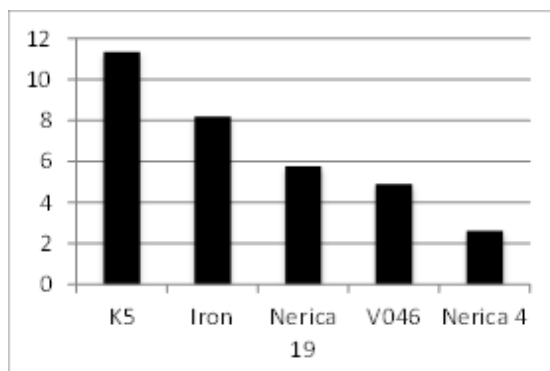


Figure 3. Effect of varieties on rice yield (t ha⁻¹) in the lowlands

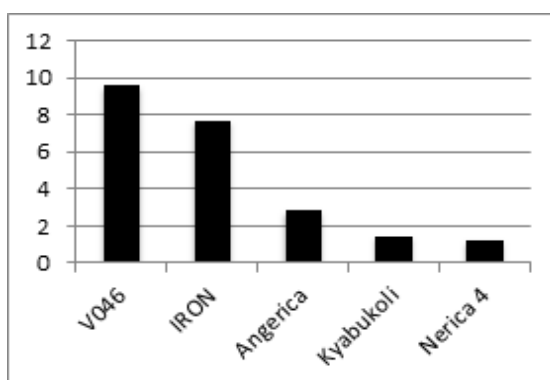


Figure 4. Effect of varieties on rice yield (t ha⁻¹) in

Recommendations

Based on the above results, it is recommended that water saving technologies are introduced to reduce water scarcity under the changing climate and that more varieties are introduced to increase rice yield.

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