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# Effect of Water Saving Irrigation on Yield and Concentration of Ca and Mg in Malaysian Rice Cultivation

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**Abstract:** Rice production in Asia needs an increase to feed a growing population whereas water for irrigation is getting scarcer. This study was conducted to determine the effect of low flooding on rice yield and nutrient concentration. There were five treatments simulating different flooding depths and durations. SPS200 porous ceramic cup were used to collect sample and Ca and Mg concentration were measured at weekly interval. The results showed that there was no significant effect of low flooding on rice yield and Ca and Mg concentration with time. Overall, rice production could be implement under low flooding water.

**Key words:** Water saving irrigation, concentration of Ca and Mg, rice, Malaysia, yield

## INTRODUCTION

Rice (*Oryza sativa* L.) is the major food crop of the people living in Asia and about 80% of it is grown under irrigated conditions[1]. Demand for rice over the next 30 years may require an additional 50 million ha to be cultivated[2]. For a growing world population, the annual rice production must increase from 518 million tons in 1990 to 760 million tons in 2020[2]. In Malaysia, rice production cannot meet the demand of the increasing population in the country. To meet such demand, rice is to be imported from neighboring countries especially Thailand and Vietnam at a value of about RM500 million per year[3]. Rice produced on submerged soil is a major beneficiary of fresh water resources in Asia. Nearly 90% of fresh water diverted for human use in Asia goes into agriculture and more than 50% of this fresh water is used to irrigate rice[4]. But water is becoming increasingly scarce. The future rice production will therefore depend heavily on developing and adopting strategies and practices through use of efficient resource. Such strategies and practices are essential to produce more rice with less water. The objective of this study was to study the effect of different flooding regimes on rice yield.

## MATERIALS AND METHODS

An experiment was carried out in the field at Universiti Putra Malaysia to evaluate the effect of low water input for rice production. The experiment was laid out in a Completely Randomized Design (CRD) consisting of 5 different water saving irrigation techniques are; W1: continuous flooding at 5 cm, W2: continuous flooding at 1 cm, W3: continuous flooding at 5 cm in the first 3 weeks then 1 cm, W4: continuous flooding at 5 cm in the first 6 weeks then 1 cm and W5: continuous flooding at 5 cm in first 9 weeks then 1 cm with 4 replications. The 90 cm cylindrical culvert with closed bottom was used and soils were filled at 40 cm depth from 20 cm below the brim to facilitate irrigation. Healthy paddy seeds of variety MR 219 were used and a sowing rate of 150 kg ha$^{-1}$. Urea as N (170 kg ha$^{-1}$). $P_2O_5$ (120 kg ha$^{-1}$) as triple super phosphate (TSP) and $K_2O$ (120 kg ha$^{-1}$) as Muriate Of Potash (MOP). A porous ceramic cup was used for collect water extract for an analysis of Ca and Hg. The data was analyzed for analysis of variance (ANOVA). The means were compared using Duncan's Multiple Range Test (DMRT) using the Statistical Analysis System software version 6.12[5].

## RESULTS AND DISCUSSION

**Yield and yield components:** The different flooding levels did not affect tiller numbers, panicle numbers, grain yield (t ha$^{-1}$), straw yield (t ha$^{-1}$), grain per panicle and 1000 seeds weight (g). The tiller numbers and panicle numbers were in the range of 674 to 695 and 636 to 665 per m$^2$, respectively (Table 1). The unfilled and filled grains per panicle were in the range of 19 to 26 and 89 to 101, respectively. The yield of dry filled grain was in the range of 11.72 to 12.39 t ha$^{-1}$. The weight of 1000 seeds was in the range of 27.2 to 27.8 g. The yield was in the range of 11.87 to 12.39 t ha$^{-1}$ higher than MARDI[6] who reported 10.7 t ha$^{-1}$ (Table 1). The results of this study showed

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Table 1: Yield and yield components of rice plant grown under different flooding regimes

| Treatments | Tiller number/m$^2$ | Panicle number/m$^2$ | Unfilled grain /panicle | Filled grain /panicle | 1000 seeds weight (g) | Straw yield (t ha$^{-1}$) | Yield (t ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| W1 | 691a | 657a | 20a | 93a | 27.7a | 14.28a | 12.39a |
| W2 | 695a | 665a | 26a | 92a | 27.2a | 14.46a | 11.87a |
| W3 | 682a | 647a | 24a | 89a | 27.8a | 13.44a | 12.23a |
| W4 | 679a | 641a | 19a | 93a | 27.4a | 13.15a | 12.27a |
| W5 | 674a | 636a | 23a | 101a | 27.2a | 13.48a | 12.24a |

Means with the same letter are not significantly different in column at P=0.05 by DMRT

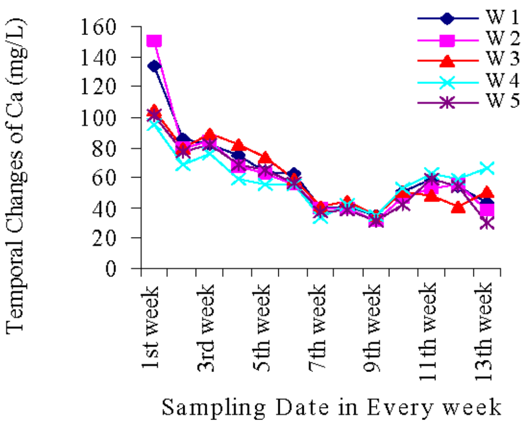


Fig. 1: Changes of Ca concentration in soil

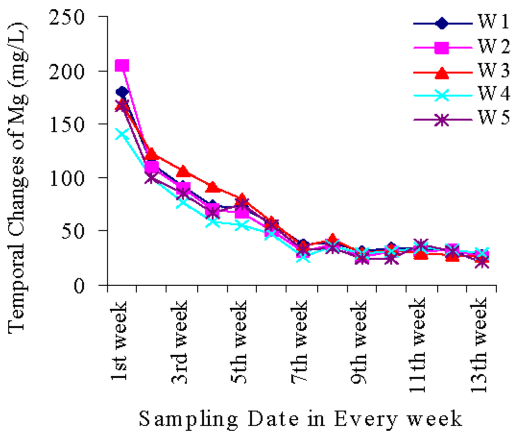


Fig. 2: Changes of Mg concentration in soil

that there was no effect of different flooding levels on yield and yield components.

**Nutrient concentration**

**Changes in calcium concentration:** There was no significant difference under different flooding levels at weekly interval (Fig. 1). The concentration decreased gradually in soil solution from the primary tillering stage to flowering stage with time until application of compound fertilizer. The effect may due to plant uptake. According to Ishizuka[7], the percentage of calcium decreases gradually according to the growth of rice plant and it can increase again from flowering stage. The Ca concentration fairly increased after application of compound fertilizer. The effect probably due to compound fertilizer contained 0.4% of Ca. Thus, compound fertilizer has a positive effect on Ca concentration in soil solution. Ca concentration declined again in soil solution after water was drained.

**Changes in magnesium concentration:** There was no significant different for magnesium concentration under different flooding level in soil solution at weekly interval (Fig. 2). The concentration of Mg decreased gradually until flowering stage with plant grown in soil solution analyzed at weekly interval. It may perhaps due to plant uptakes. Furthermore, Mg concentration was similar in all treatments at different sampling date under different flooding water regimes. The Mg concentration somewhat unchanged during ripening stage after application of compound fertilizer. The 0.6% Mg containing compound fertilizer had applied therefore, it may effects of compound fertilizer on Mg concentration in soil solution with time.

In conclusion, this study clearly shows that it is highly possible to produce rice under low water input, which is capable of saving a lot of fresh water. The study also demonstrated that in addition to saving water, yield is not affected and insignificant on soil nutrient availability. However, this study may not fully reflect a field condition as controlled management system was employed. Therefore, it is suggested that further study should be conducted under natural field condition in order to validate the effects of low water for rice production.

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