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Rice Optimal Water Use in Different Air Temperatures at Flowering, Nitrogen Rates and Plant Populations

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Abstract: Present study was conducted to determine optimal amounts of irrigation water for rice in different nitrogen application rates, flowering stage air temperatures, T_f and plant populations. The results indicated that in water limiting conditions in the study area, the optimum irrigation water was affected by crop management (N application rate and plant population) and climatological factors such as T_f. The optimum amounts of water, w_w decreased at a higher rate (from 1988 to 1226 mm) by increase in nitrogen application rate (from 0 to 150 kg N ha^{-1}) at higher T_f and plant population. These values were 2692 to 2191 mm of water for 0 to 150 kg N ha^{-1} for low value of T_f and plant population. Under unfavorable air temperature condition and low plant population, the w_w decreased by 19% at 150 kg N ha^{-1}, compared with 0 kg N ha^{-1}. However, under favorable air temperature condition and high plant population, this value was 38%. Therefore, under water limiting conditions in the study area, the higher plant population and favorable climatological factor can highly reduce the optimum irrigation water at higher N application rate. Also, N application rate, plant population, P, air temperature at the flowering stage and applied irrigation water affected the net income. The maximum net income was obtained in T_f = 28.2°C (near optimum air temperature during the flowering stage, 30-33°C), P = 25 hills m^{-2}, 120 kg ha^{-1} N application and 2138 mm applied irrigation water. The field management factors such as applied irrigation water, nitrogen application rate and plant population can be controlled by field manager and the optimum amounts may be applied. However, the climatological factors are unpredictable, therefore, these factors should be considered in economic analysis of crop yield production and field management.

Key words: Irrigation water, nitrogen, flowering stage air temperatures, rice

INTRODUCTION

Deficit irrigation is an optimizing strategy under which crops are deliberately allowed to sustain some degree of water deficit and yield reduction. The fundamental goal of deficit irrigation is to increase Water Use Efficiency (WUE) or Water Productivity (WP), either by reducing irrigation adequacy or by eliminating the least productive irrigation. It is widely recognized that when water supplies are limited or water costs are high, the economic optimum level of irrigation will be something less than would be required for maximum yield. Where there are constraints on capital, energy, labor or other essential resources, or when costs of any of these resources are particularly high, deficit irrigation can be used as a strategy to increase profits. This approach can also be used to maximize profits or stabilise regional crop production (Tavakoli and Oweis, 2004). Deficit irrigation is not without controversy, but if the objective is to maximise profits or stabilise food production it is a valid and useful strategy (Sepaskhah *et al*., 2006). This new concept of irrigation scheduling has different names, such as regulated deficit irrigation, pre-planned deficit evapotranspiration and deficit irrigation (English *et al*., 1990).

Optimal allocation of irrigation water and nitrogen fertilizer is very important for agricultural purpose, especially in arid regions or regions where contaminated water is a prime concern in agriculture (Trimmer, 1990; English and Raja, 1996; Godwin and Jones, 1991; Weinhold *et al*., 1995; Zand-Parsa and Sepaskhah, 2001).

Nitrogen is currently the most widely used fertilizer nutrient and the demand for it is likely to grow in future (Godwin and Jones, 1991). Nitrogen is a component of protein and nucleic acid and when nitrogen amount in soil is not optimal, growth is reduced (Weinhold *et al*., 1995). Nitrate-N is highly soluble in water and hence susceptible to leaching, potentially contributing to environmental contamination. Also, fertilizer N can be lost via

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