A Model for Deficit Irrigation Analysis of Crops

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Scarcity and high cost of water is the most important limiting factor for crop production in irrigated agriculture. Deficit irrigation can be implemented to optimize the use of available water resources and put more land on productive use. A model was developed to determine the savings in water and the economic benefit derived from deficit irrigation. The model was tested using yield-water use data of maize, tomato, okra and cowpea grown under irrigated condition in Nigeria. Cowpea is the main source of plant protein in the local diet and okra one of the major vegetable crops planted in Nigeria. The results indicated that some water reduction is possible without affecting yields. The optimum water reduction is 4, 8, 12 and 18% for maize, tomato, okra and cowpea, respectively. Maximum allowable water reduction increased with increase in the benefit cost ratio of each tested crop. The maximum allowable water reduction is 9, 13, 21 and 32%, with a corresponding increase in cultivated area by 10, 16, 23 and 50% for maize, tomato, okra and cowpea, respectively; at a benefit-cost ratio of 1.5. The model, in most of the years showed that the optimum moisture reduction level increased with increasing seasonal rainfall. Increasing rooting depth or soil water holding capacity also increased the relative maximum yield for water reduction levels up to 40–50%. The developed model would be useful in determining the effect of soil, water, and crop variables on deficit irrigation of crops in different agro-ecological zones with appropriate crop and soil data input, and proper irrigation scheduling.

Keywords: deficit irrigation, economic benefit, optimum water reduction, irrigation scheduling, benefit-cost ratio

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