POTENTIAL GROUNDWATER CONTAMINATION BY NITRATE - NITROGEN AS INFLUENCED BY IRRIGATION AND FERTILIZER APPLICATION RATES

John Kibunei Taragon

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ABSTRACT

Agriculture has become one of the major sources of environmental problems in recent past. Population growth over the last three decades, have compelled communities to intensify agricultural production to meet their food demands. Agricultural intensification has entailed the use of large quantities of fertilizer that are aimed at increasing yields per unit piece of land. Nitrogen fertilizers are of major concern from the environmental point of view. High concentrations of nitrogenous compounds cause eutrophication in surface waters. Nitrates in drinking water have been known to cause health problems. Nitrates are soluble in water and thus very mobile throughout the soil horizons and into groundwater. Of concern is the threat to rural people, who obtain their drinking water from shallow wells, dug in intensively cultivated lands.

However, fertilization application should be aimed at providing the basic minimum nutrients for crop production, which will minimize potential of groundwater contamination without lowering the yields. This study was conducted to determine nitrate nitrogen leaching amounts during the crop growth, to evaluate the optimal nitrogen fertilizer application level to minimize the potential of nitrate nitrogen leaching to groundwater and to evaluate the performance of RZWQ Model in predicting nitrate nitrogen leaching during the crop growth

Hybrid maize, variety DH01 from Kenya Seed Company, was planted in mid November 2004, in experimental field plots that were setup at JKUAT demonstration Farm. Split plot design was chosen (on a CBRD) to cater for two treatments, irrigation water levels on the main plots and nitrogen fertilizer application rates on the subplots. Irrigation had two levels: Normal Irrigation (NI) and Excess Irrigation (EI). Nitrogen fertilizer was applied at five levels. A control treatment with no fertilizer application was also set up. Treatments were replicated thrice.

The amount of nitrate leached over the entire period of maize growing season was measured at intervals of three weeks. For NI at fertilizer rates of 0, 50, 75, 100, 125 and 150 kgN/ha, the cumulative nitrate leaching were 4.8, 9.6, 19.1, 23.9, 38.2 and 47.8 kgN/ha respectively, whereas for EI and the same levels of fertilizer application, the cumulative nitrate leached were 4.8, 9.6, 28.7, 38.2, 43.0 and 66.9 kgN/ha respectively. These results indicated that nitrate leaching increased with fertilizer application rate, for the two levels of irrigation and leaching being highest under EI. Statistical analysis of the two treatments (fertilizer and irrigation) shows that decreasing fertilization rates is substantially more effective in reducing nitrate leaching. Irrigation does not significantly affect the bulk of nitrate leaching although it tends to enhance/influence leaching process, especially at the higher rate of fertilizer application. Under soil and climatic conditions of the study area, optimal grain yields of 7222 kg/ha and lower nitrate leaching amounts (23.9 kgN/ha) may be obtained at fertilizer application rate of 100 kgN/ha.

For the same levels of fertilizer application, the RZWQM predicted nitrate leaching amounts of 0.2, 13.3, 25.1, 38.1, 52.1 and 66.8 kgN/ha under EI whereas for NI, the model predicted values of 0.2, 12.8, 23.3, 34.4, 45.6 and 57.2 kgN/ha. These represent an average percent difference (%D) between observed and predicted values of +2.9% and +20.4% for EI and NI respectively. It is concluded that the model can predict nitrate leaching during crop growth.