

Effect of N and K fertilizers on nutrient leaching and groundwater quality under mature oil palm in Sabah during the monsoon period.

ABSTRACT

Problem statement: The oil palms are mainly grown in the humid tropics with high rainfall. Soluble Nitrogen (N) and Potassium (K) fertilizers are commonly required by the oil palm plantations to maximize palm productivity due to the highly weathered soils with low fertility. Thus, leaching losses of N and K nutrients may be unavoidable and these nutrients may move further downward and eventually cause groundwater pollution. This study reports the leaching of N and K nutrients in a mature oil palm field as affected by fertilizer rates and soil depths and its effect on groundwater quality during the monsoon period in Tawau, Sabah. **Approach:** The sources of N and K fertilizer were Ammonium Chloride (AC) and Muriate Of Potash (MOP), respectively. Soil water samplers were installed at depths of 30, 60 and 120 cm in four fertilizer treatments, namely, N0P0K0 (Control plot, no N and K), N0P2K1 (K1 = 4.5 kg MOP palm⁻¹ year⁻¹), N1P2K1 (N1 = 3.75 AC kg palm⁻¹ year⁻¹) and N1P2K0. Three replications were used in the experiment. Monitoring wells were installed in the above treatment plots and in another treatment, N2P2K1 (N2 = 7.5 kg AC palm⁻¹ year⁻¹) to investigate the effect of excessive N rate on groundwater quality. Samplings were done at 15 day intervals for duration of 150 days from October 2008-February 2009 to cover the entire monsoon period in North Borneo. Water samples were analyzed for NH₄-N by automated phenate method, NO₃-N + NO₂-N and NO₂-N by automated hydrazine reduction method on Auto Analyzer 3 and K by flame photometric method using flame photometer. **Results:** The mean NH₄-N concentration of N1P2K1 at 33.69 mg L⁻¹ was significantly higher than N1P2K0 at 8.15 mg L⁻¹. In the presence of K, NH₄-N concentrations increased 4.1 fold when N fertilizer was applied and 3.5 times in the absence of N application. The mean NH₄-N concentration was 17.89 mg L⁻¹ at 30 cm depth declining to 12.19 and 6.52 mg L⁻¹ at soil depths of 60 and 120 cm, respectively. The transformation of NH₄-N to NO₃-N was not a major process during the monsoon period. The leaching losses of inorganic N were 1.0 and 1.6% of the applied fertilizer for N1P2K0 and N1P2K1 respectively. For K, the leaching losses were 5.3 and 2.4% for N0P2K1 and N1P2K1 respectively. The concentrations of NH₄-N, NO₃-N and K in groundwater ranged from 0.23-2.7, 0.07-0.25 and 0.63-9.54 mg L⁻¹, respectively. **Conclusion/Recommendations:** N and K concentrations in the soil solution decreased with soil depth and their leaching losses were related to rainfall pattern, fertilizer treatment and nutrient uptake by roots. Groundwater quality was not affected by the applications of N and K fertilizers at the optimum rates for mature oil palms.

Keyword: Fertilizer rates; Groundwater quality; Nutrient leaching; Oil palm plantation.