ABSTRACT

Reclamation of waste water and its use for crop production

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Key words: Aquatic plants, Coliform bacteria, Irrigation, Napier Grass, Reed, Rice, Soil pollution, Sorghum, Waste water, Water reclamation.

Acute and permanent shortage of fresh water in Jamaica hinder agricultural expansion. Unreliable rainfall, intermittent river flow and greater abstraction of ground water leave no alternative but to consider the use of waste water. Waste water use, however, is not recommended unless it meets the required standards.

Optimization of the factors affecting reclamation of waste water was carried out in concrete tanks. Three species of floating macrophytes (Water Hyacinth, Water Lettuce and Duckweed) at three different hydraulic retention times (12, 24 and 36 hours), with variable plant densities, were used. The quality of the effluents as well as biomass production were monitored.

The use of waste water, after reclamation, was demonstrated by growing two cereal crops, Rice and Sorghum. Growth and production of these crops were compared with two controls: one receiving fresh water and another receiving fresh water plus standard NPK fertilizer. The quality of the effluents from the fields of these crop plants was compared with that of emergent plants; and in addition, the effect of waste water irrigation on soil and the factors causing bacterial die-off in the waste water were examined.

All three floating plant species performed well in reclaiming the secondary-treated sewage effluent. No differences were observed due to the effect of species in removing nutrient elements (N, P, Ca, Mg, Na and Fe) except K, removal of which was highest by Water Lettuce. However, the effect of species was evident on the concentration of TSS and DO which were found lowest in the effluent of Duckweed. Variation in hydraulic retention time (HRT) was effective on all parameters except for DO, Ca and Fe; removal of pollutants and nutrients was generally higher at longer HRT. Increasing plant densities in the tank enhanced the removal process, but also caused depletion of DO. Biomass production, in all the species, was varied with the initial plant densities. Increasing HRT reduced the biomass production in Water Hyacinth and Water Lettuce, but had no effect in Duckweed.

Waste water use for crop production shortened the time to crop maturity. It increased grain production by 145 and 76 percent in Rice and 121 and 37 percent in Sorghum over fresh water and fresh water plus NPK respectively. The grain and straw were not contaminated with toxic metals (Cd, Cr or Pb). The waste water did not cause any accumulation of heavy metals in the crop field except for Zn, which was increased by 10 mg/kg soil over a period of one year. Reduction of pollutants in the effluents was much greater in lands kept under crop/plant cover than when kept fallow. However, fallow land allowed the effluents to gain DO. The two crops performed better than Reed and Napier Grass in reducing N and P.

Coliform bacteria die-off in the waste water was mainly due to the effect of increased pH of water caused by vigorous growth of algae aided by light. Increased oxygen supply, without the presence of algae and consequently unaltered pH, caused the bacteria to linger in the waste water.