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Design, construction and evaluation of an affordable continuous-flow drip irrigation system

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Abstract

An affordable continuous-flow drip irrigation system was designed, and evaluated in Bauchi state, Nigeria with tomato as test crop. The system was designed to deliver the peak daily crop water requirement on a continuous basis throughout the day. The calculated continuous-flow rate was 9 drops of water per minute. The hydraulic design was based on a step wise use of the energy equation. The system was constructed exclusively from cheap and locally available materials, incorporating a modified form of the medical infusion set as emitter. Results of the system's evaluation revealed high Application Efficiencies in the order of 95, 96, 96, and 98% under continuous discharges of 9, 13, 17, and 21 drops/min respectively. The corresponding Irrigation Efficiencies were 94.0, 90.1, 91.0, and 88%. Measured Distribution Uniformity for the four treatments were 90.0, 91.4, 93, and 97% while the Adequacy of Irrigation were 92.0, 93.1, 94.0, and 98% for the four treatments in same order. Such high values of measured performance parameters indicate an excellent exploit of the continuous-flow system. Emitter clogging which is a common menace with drip systems was controlled fairly well by two improvised low-cost primary and secondary filters, and a weekly addition of sodium hypochloride solution. The drip system has an initial cost of N 11,280 to N 48,480 (US $80 to 350) depending on materials used, and can irrigate 288 vegetable crop stands continuously for ten days without refill. This research therefore recommends a new dimension in affordable micro-irrigation technology that could assist developing countries to increase their food production several folds in a sustainable manner. The continuous-flow drip system also provides potential to accelerate poverty alleviation within rural communities of developing countries.

Keywords: Affordable drip irrigation system, gravity irrigation, continuous-flow, infusion set