ABSTRACT

A computer simulation model Tricad was developed in C language for the design of trickle irrigation subunit using finite element formulation. Formulation was made for designing the trickle subunits with laterals on one side and two sides of the submain. Both the Darcy-Weisbach and Hazen-Williams equations were used for estimation of frictional head loss in the pipelines. Minor losses due to emitter barbs, tees, bends and crosses were also considered in the pressure heads estimation. The proposed model optimizes the lateral length for a given length of submain, row to row and plant to plant spacing satisfying required uniformity, pressure head variation and flow velocity limit in the unit. Life cycle costing (LCC) technique was adopted for determining critical flows between the adjacent pipe diameters.

The developed model was validated with field experimental data on pressure heads and showed excellent agreement with relative error percentage (REP) values of ±. The *Tricad* results were also compared with T-Tape proDesigner software and the results were in very close agreement. *Trisens* program was developed for sensitivity analysis of different design parameters on pressure heads estimation at nodal points in a fixed layout.

The *Tricad* was used for the design of Trickle irrigation layouts for 6 ha banana field. Suitability of various lateral and submain sizes was studied based on emission uniformity limit. The cost of the lateral pipes in the overall cost of the subunits was found to vary from 63.5% to 82.6%. Alternate irrigation plans were proposed for different layouts. The selection of the mainline for the layouts was made using critical flow criteria and velocity limit in the pipeline. Critical flow criteria yielded lowest annual cost of the pipeline. Alternate economical layouts are proposed satisfying both emission uniformity and economic aspects.

Economic analysis of trickle irrigation layouts was made based on crop geometry studies. Field experiments under trickle irrigation were conducted with different planting geometry of banana. Total sixteen crop geometries were tried by altering row to row and plant to plant spacing and planting one, two, three and four plants at a place keeping area under each plant constant to 4 m^2. The effect of length to breadth ratio of the planting on initial investment and annual cost of the trickle equipment was studied.

Keywords: Trickle irrigation, Critical flow, Emission uniformity, *Tricad*, Crop geometry, Economic analysis.