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Research Paper :

Design of gravity-fed drip irrigation system for tree based farming system

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ABSTRACT

The gravity-fed drip irrigation was fabricated using local and market available materials. The test crops were bottle gourd, bitter gourd and cucumber, grown in specially dugout pits, filled with medium textured soil mixed with manures, fertilizers. The CROPWAT model was used to estimate the ET of various vegetables for scheduling irrigation. Systems hydraulic performance was evaluated by measuring discharge variation among the different emitters, estimating friction head losses in different components. The frictional head loss in the lateral was found to 0.2640 cm cumulatively. Whereas the frictional head loss of emitters was found to be 67.73 cm, the frictional head losses in the fitting were found out to be 6.995 cm. Total head requirement of the system included the head required at the farthest emitter for operation and the frictional losses in the bend, control valve and filter as 2.3 m. Among the vegetable, the bottle gourd resulted in significantly higher average yields as compared to other vegetables. Bottle gourd produced highest yield under drip irrigation (290.9 q ha^{-1}), closely followed by the yield under basin irrigation (229.2q ha^{-1}). In this way the locally fabricated micro drip irrigation system was found significantly superior as compared to the basin irrigation.

Key words : Gravity fed drip irrigation system, Frictional loss, Basin irrigation crop yield.

India has formidable proportion of wastelands being out of cultivation due to various problems *viz.*, water and wind erosion, water logging, salinity, alkalinity and gully formations etc. The country has 144.2 mi.ha area subjected to water and wind erosion, 8.53 Mha area suffering from water logging and 3.97 Mha area under ravines and gullies (SPWD, 2005). These wastelands are now necessary to be put under cultivation due to increased population pressure. In the state of Chhattisgarh also the situation is not different. These waste lands locally called as *Bhata lands* (red lateratic) are basically *Entisols* and are nutrient and water deficient with meagre soil depth. About 20 per cent of the total geographical area of the state is covered under these soils. These soils are deficient in organic matter content with poor water holding capacity. Therefore, utilization of waste lands, through judicious use of water for survival of plantations, is most important. Micro irrigation system is one of the best options for use of limited water and fertilizer under degraded *Bhata* land.

Micro-irrigation systems are advanced method of irrigation through which water is applied directly to root zone around the plant through a pipe network with the help of emitter. Drip irrigation records higher water use efficiency of 52.81 and 26.02 $kgha^{-1}mm^{-1}$ as compared to 10.96 and 11.94 $kgha^{-1}mm^{-1}$ under flood irrigation i.e on an average drip irrigation system had water saving of 41% over flood irrigation (Sharma and Kumar, 2007). Low cost micro-irrigation system, such as gravity-fed drip technique for growing winter vegetables, can save water up to 40 % (Sahu, 1984).

In Chhattisgarh also, gravity fed drip irrigation set was designed, developed and used for growing vegetables in farmer's field (Rao and Sahu, 2002 and Patel and Sahu, 2004) resulted in higher produce (25-30%), savings in water (45-48%), labour (45%) and fertilizer cost (50%). Looking to the success of this technique, the study is proposed to evaluate this technique along with basin irrigation methods for growing vegetables under tree plantation being developed in the *Bhata land.*

METHODOLOGY

The study area was situated at village Uparwara in Abhanpur block of district Raipur, Chhattisgarh. It was about 20 km away from university campus. The study area was located at 210.15' N latitude and 81^0.36' E longitude with an altitude of 300.6 m above the mean sea level. The average annual rainfall in the study area was found about 1422 mm with 64 annual numbers of rainy days. The soils of the study area characterized by a red lateratic soil termed as *Bhata land* (*Entisols*) with water holding capacity was very low (2.12 cm), infiltration rate of this soils was remarkably high (6.24 cm/hr). The field capacity ranged from 12-20 % with bulk density 1.78 kg cm^2. Permanent wilting point was in the range of 6-10 %.