DEVELOPMENT AND EVALUATION OF MOBILE DRIP IRRIGATION

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ABSTRACT

Replacing the sprinklers on a centre pivot or linear move irrigation machine by using polyethylene “PE” tubes with emitters to convey irrigation water directly to the soil surface converts a normal sprinkler system to a mobile drip irrigation (MDI) system. The idea of the MDI consists of the advantages of stationary drip irrigation (low pressure requirements up to 50 kPa and low evaporation losses) and the advantages of centre pivot or linear irrigation machines (cheaper than drip irrigation) and its success in the irrigation of many crops. The length of drip tubes will depend on water requirements and the distance from pivot point. For the same area, the MDI system needs less than 2 % of the polyethylene tubes that would be needed in a stationary drip irrigation system. Replacing sprinkler with dripper will reduce the energy and water consumption of 70 % and 20 %, respectively, as compared with the centre pivot.

INTRODUCTION

Trickle irrigation is gaining importance in the world, especially in areas with limited and expensive water supplies, since it allows limited resources to be more fully utilized. Replacing the sprinklers on a CP or linear move machine by using polyethylene “PE” tubes with emitters to convey irrigation water directly to the soil surface converts a traditional CP or linear move to a mobile drip irrigation (MDI). In stationary drip irrigation, closed plastic tubes with emitters are used to deliver irrigation water to the plants using low pressure. No water losses due to wind drift and spray evaporation occurs in sprinkler systems specially in CP machines. The idea of MDI is a combination of the advantages of stationary drip irrigation with CP or linear move or the boom trailer irrigation machines. The advantages of the stationary drip irrigation are its low operating pressure, low water losses and high irrigation efficiency. The advantages of the CP machine are its low capital requirements, flexibility and low labour requirements. In addition, soil cultivation under CP machines is easy. The operating pressure of the drip tubes can be much lower than that of sprinkler systems. The operating pressure at the inlet of a traditional CP with sprinklers ranges from 400 to 500 kPa as compared with 175 to 225 kPa at the inlet of the pivot machine with MDI. Thus, pressure reduction in MDI enables energy to be conserved.

The use of drip tubes with a moving irrigation system appears to have been introduced first by Rawlins et al. (1979). One advantage they mentioned was that saline water will not damage the foliage if such a system is used. Newer efforts at commercializing the technology are being made by T-L Irrigation of Hastings, Nebraska, (www.tlirr.com) under the trade name of Precision Mobile Drip Irrigation (PMDI), which utilizes in-line drip hoses

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to distribute water directly to the ground. Many authors have described the MDI, but the classic dripping irrigation materials were never used. In some cases, holes in pipes, similar length of hoses with different types of emitters, similar length of hoses with one type of emitters were used with linear and CP machines. In these cases, the irrigation intensity was very high. At the same time, the classic drip irrigation materials with a CP were never used. Therefore, the application of MDI with CP machines will be important.

MATERIALS AND METHODS

The MDI was developed by replacing the sprinklers on a CP by using irrigation segments containing three polyethylene tubes with emitters to convey irrigation water directly to the soil surface (Fig. 1). A pressure regulator was used to adapt the operating pressure at the inlet of the drop tubes (50 kPa and 100 kPa). The horizontal PE tube is an additional part and was used for the installation of the drop tubes. In this research Hydrogol emitters (7,25 L / h at 50 kpa) were used. The spacing between emitters on the lateral was 15 cm and spacing between drop tubes was about 85 cm. Normal irrigation depth (In) considered in this research was 20 mm.

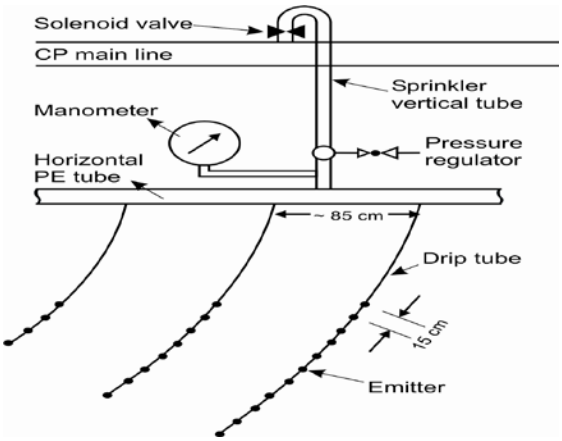

Figure 1. Pressure regulator and manometer used to adapt the operating pressure at the inlet of the MDI drop

Number of emitters installed on drop tubes was calculated based on emitter discharge (qe=7,25 L/hr at 50 kpa), irrigated area covered by drop tubes (distance from the pivot point, r and narrow spacing covered by drop tube, dr), irrigation time (T= 48 hr) and In. Ne was calculated as follows:

$$Ne = 2*3,14*r*dr*(In / T) /qe \quad (1)$$

Where r =distance between drop tube and pivot point and dr = narrow spacing covered by drop tube

The length of drop tubes at any point of the pivot lateral is dependent upon the number of emitters installed on drop tube, the spacing between emitters on the drop tube and spacing between first emitters installed on drop tube and polyethylene segment (in this research 3 m). With due attention to increasing the water application rate and appearing runoff with decreasing the spacing between emitters, also increasing the length of drop tube with increasing the spacing between emitters, an appropriate spacing between emitters should be considered (in this research 15 cm). Thus the length of the drop tubes at any point of the pivot lateral could be calculated as follows:

$$L = 3 + Ne*(0,15) \quad (2)$$

Where Ne is number of emitters installed on drop tube.

RESULTS

Number of Hydrogol emitters installed on drip tubes and length of drip tubes were calculated using Eq. 1and 2 respectively. Number of emitters calculated for the shortest drip tube located at a distance 2 m from pivot point and longest drip tube located at a distance 300 m from pivot point were 1 and 101 respectively. Meanwhile the shortest and longest drip tube had 3,15 and 18,15 m length respectively (Fig. 2). The operating pressure of the drip tubes can be much lower than that of sprinkler systems. Thus our MDI enable to conserve energy through pressure reduction. In this study of MDI with a CP irrigation system, non-filtrated groundwater was used without any problems for both the emitters and water distribution but normally the filtration of water in stationary drip irrigation is necessary to prevent emitter clogging. Also, the process of injecting fertiliser (fertigation) and chemical (chemigation) into irrigation water and applying through this modified CP irrigation system to the crop/field is possible.

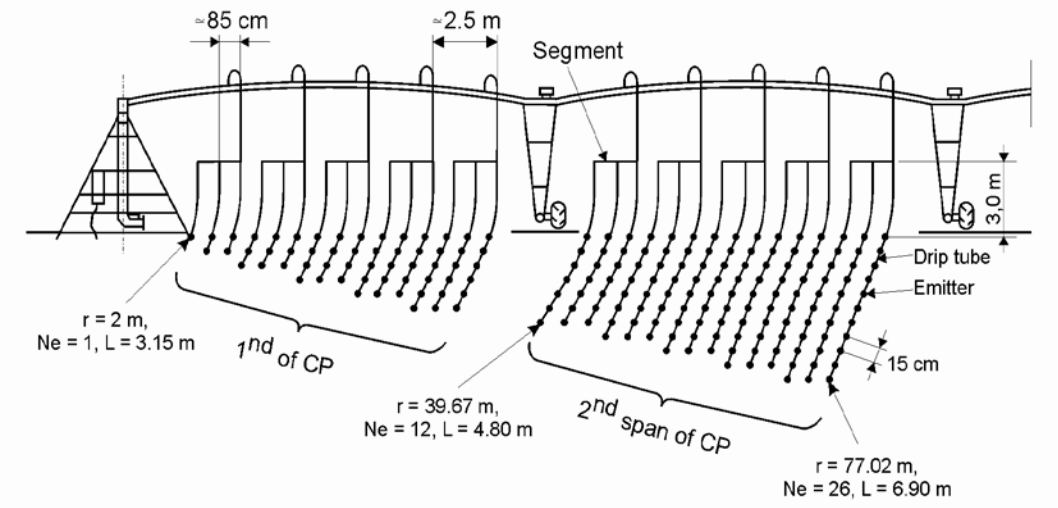

Figure 2. Mobile drip irrigation

REFERENCES

Rawlins, S. L., G. J. H. Hoffman and S. D. Merril. 1979. Traveling trickle system. Proc., Second International Irrigation Congress, San Diego, CA. 184-187.