Advances in Irrigation of Sugarcane in Sri Lanka

By

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The conventional system of irrigating sugarcane (*saccharum officinarum*) in Sri Lanka is furrow irrigation. In this system, water is diverted manually to one or more furrows in turn from unlined field channels that receives water from the main unlined channel.

An evaluation of this system showed that the water conveying efficiency was only 40 to 50% and the water application efficiency range from 30 to 50%. The low water application efficiency was mainly due to non uniform furrow slopes range from 0.5 to 3% and high and non uniform flow rates to the furrows range from 2.8 to 4.2 l/sec.

An experiment was carried out at Sevanagala Sugar Project, Embilipitiya to evaluate and to improve the existing system of irrigation. It was found that, counter furrow system with a gradient range from 0.3 to 0.5 % with a volume flow rate of 2.1l/sec into furrow length range from 45 to 60 meters will give a water distribution efficiency of 70 to 80% for Reddish Brown Soils.

Based on the above results the traditional system practiced was modified to a siphon furrow irrigation system. In this system plastic (PVC) siphon tubes of 50 mm diameter were used in transferring a measured quantity of water from lined field channels into individual furrows of 65 meters having an average slope 0.5 to 0.7. Six to seven siphons were used at a time. The field channel received water from a lined main channel. With the introduction of the cut back, application efficiency of 64% with a distribution uniformity of 80% could be achieved. It was also found that the maximum non erosive furrow stream for Reddish Brown Soil with an average slope range from 0.5 to 0.7 was nearly 3.4 l/sec.

Now this system is practiced by nearly two thousand small holder sugarcane farmers at Sevanagala Sugar Project with satisfactory efficiency. The main problem in maintaining the irrigation efficiency is due to the poor repair and maintenance of the channel system and lack of knowledge on irrigation by farmers. Education and training at all levels are necessary to get the maximum benefit from the system.

Water is becoming a very scarce resource in Sri Lanka and more efficient systems like sprinkler and drip irrigation need to be tried out to optimize this scare resource. However, now the cost of these systems does not justify the benefit from these systems. This is because the cost of irrigation water is small when compared with the other inputs. Eventually inefficient irrigation systems are not only wasting water but also reducing the yield and quality of cane harvested and reducing the land available for sugarcane cultivation by causing ill drain condition. As Such, there is a need to rehabilitate the irrigation system with improved water management methods.

1. INTRODUCTION

The annual domestic demand of sugar in Sri Lanka is nearly 500,000 metric tons at per capita consumption of 25 kg. Only 10 to 12 percent of the annual demand is produced locally from 14,000 hectares of which nearly half the area is under irrigation and rest under rainfed cultivation.

In the dry zone, where the sugarcane is cultivated, receives nearly 1500 mm of rain fall per annum. The annual rainfall distribution exhibits a distinctive seasonality. The rainfall follows a well expressed a bimodal pattern in most of the years as showed below:

- a long rainy season (three months) begins in early October and ends in late December (Maha rains)
- a short dry season (two months) covers the months of January and February
- a long dry season (five months) begins in May and ends in late September
- a short rainy season (two months) lasts for two months of March and April (Yala rains)

Though the rainfall is sufficient to compensate for evaporation in some years, due to poor distribution of monthly and annual rainfall, the crop produced are seldom equal to the crop produced under irrigation. The rainfed yield is nearly half the irrigated yield.

The supplementary irrigation will not only increase the yield but also stabilize the production per unit time and increase the efficiency of land use.

Two methods of irrigation, surface and overhead, are used in Sri Lanka to irrigate sugarcane. However, the overhead system was confined to sugarcane nurseries only due to the capital cost involved in setting up the system. Surface irrigation was the only method practiced in the commercial plantation. Now, the area under surface irrigation is nearly three thousand hectares. Water is conveyed to the field by series of open unlined canals and finally diverted either to a cane furrow or to an inter-row under gravity. There is rarely any device for control or meter how much water applied per unit area. Overall, the frequency varies from 10 to 14 days depending on the water availability and weather conditions. Though it is a furrow irrigation system, the furrows are not open in time and often fields are flooded.

This method of irrigation is simple and needs less capital but it is labour intensive requiring nearly four man days per hectare. Now, this irrigation practice is very inefficient having an efficiency of 30 to 50 percent.

2. MATERIALS AND METHODS

An experiment was conducted to evaluate the performance of the surface irrigation system for sugarcane. The purpose of this study was to:

- to determine the efficiency of the system as it is being used.
- to determine how effectively the system can be operated and whether it could be improved
- to obtain information that will assist in designing the other systems
- to provide guidance for the management to continue the existing practices or to improve the system

An experiment was undertaken in a block of one hectare at Sevanagala Sugar Project, Embilipitiya, Sri Lanka. This project is on the left bank channel of the Uda Walawe reservoir in the dry zone of Sri Lanka. The soil type in this area is Reddish Brown Earth (Alfisol), which is the predominant type for the cane production. The soil is sandy clay loam with 25-30% clay, 10-20% silt and dry bulk density are from 1.4 to 1.6 g/cm^3 with a field capacity of 20%.

Ten furrows with a length of 70 meters were selected at random. Levels were taken at every 18 meter interval along each furrow and stations were marked by planting wooden pegs. Average gradients of each furrows were calculated. Three furrows out of ten having approximately equal average gradients were selected as an experimental furrow. Each experimental furrow was provided with two guard rows on either side.

Infiltration measurements were taken just before irrigation by a double ring infiltrometer to find the intake rate of the soil (Figure 1). Tensiometers were installed to find the moisture tension of the soil before and after irrigation. The tensiometer reading at field capacity and 50% depletion level of available soil moisture were recorded (Figure 2). Various combinations of siphons were operated to find the maximum allowable stream size in the experimental furrow, and in the mean time the guard furrows were wetted to field capacity. Tensiometer readings were taken every day after first wetting of the soil and the second irrigation was made at 50% depletion level.

3. RESULTS AND DISCUSSIONS

The maximum non erosive furrow stream was 1.4 l/s with furrows having an average slope between 0.7 and 0.9%. The length of furrows in the sample field was 70 meters. According to Criddle (1956), to achieve high uniformity of wetting the stream front should reach the lower end of the furrow within one-fourth of the total time needed to refill the soil moisture reservoir. One-fourth of the irrigation time calculated under this study was 15 minutes. With this time, even the maximum allowable furrow stream advances only about 40 meters along the tested furrows. Constructing furrows with uniform length is not practicable in the field, so furrows range between 50 and 60 meters are acceptable for practical purposes that will give a satisfactory water distribution uniformity.

To obtain best results, using combinations of siphons with different diameters to get the required volume flow rate is advisable. Though they gave acceptable results, the problem is to use them in the field. Therefore, a siphon with a diameter of 50 mm was selected for the field use.

Cutback system was tried out with two siphons one with 40 mm and the other with 50 mm and then the 50 mm was removed after the water reaches the tail end of the furrow. Though this system increases the efficiency by nearly 10%, now, this is not recommended due to the practical problems associated with the system.

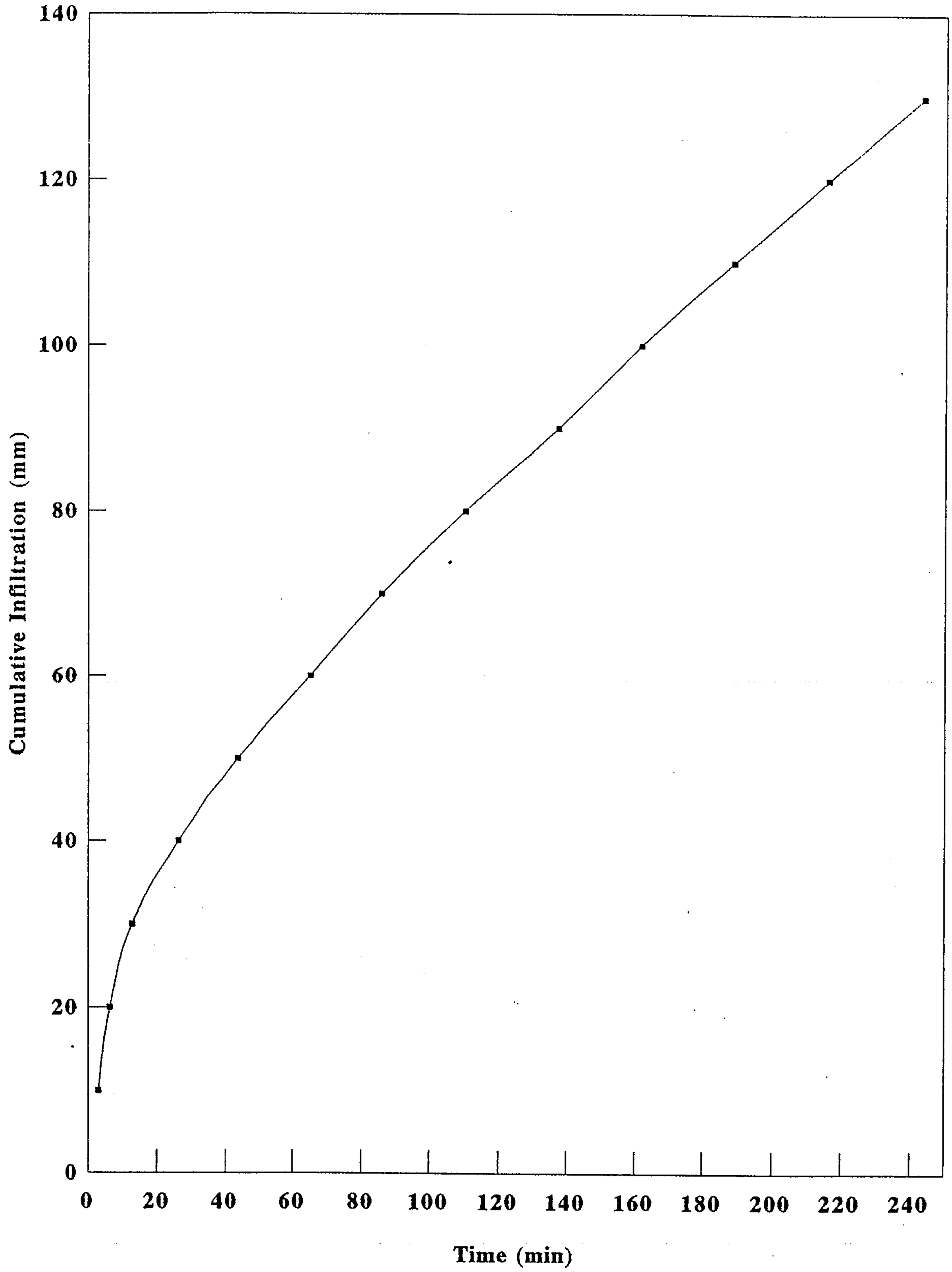

Figure 01. Cumulative infiltration graph for Sevanagala Reddish Brown Earth

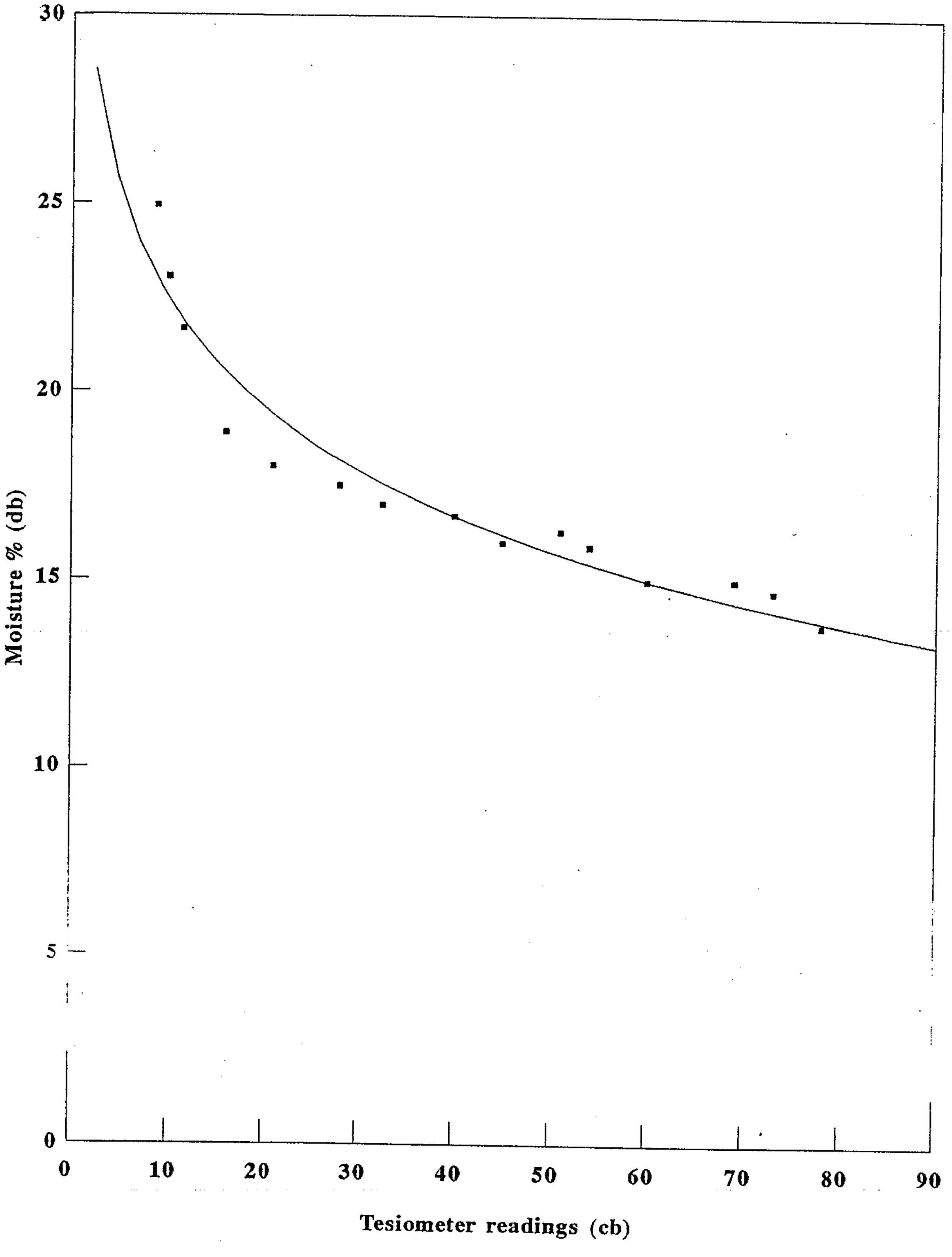

Figure 02. Tensiometer calibration curve for Sevanagala Reddish Brown Earth

To obtain the best results from the study:

Land should be prepared to a pre calculated contour grade to assure uniform slopes as possible. The average slopes of these furrows must be 0.7 to 0.9% but it should not exceed 1%. It was found that more than 1% slopes causes soil erosion.

The following factors were found to contribute to the loss of efficiency

- poor repair and maintenance of the channel system
- vandalism by farmers
- insufficient knowledge on irrigation, drainage and soil conservation by farmers
- soil compaction and gradual reduction of infiltration rate of the soil

Water is becoming a very scarce resource in Sri Lanka and more efficient systems needs to be tried out to optimize this resource. This is more important if water is lifted for irrigation. Now cost of water is low when compared with the other inputs for the production of sugarcane and efficient systems will not justify the cost incurred. However, inefficient irrigation systems are not only wasting water but also reduce the yield and quality of cane harvested. This is causing an ill drained condition and reducing the land availability for sugarcane cultivation.

The following recommendations were given to improve the irrigation efficiency for sugarcane

- direct research activities to invent low cost irrigation equipment with materials available in the local market.
- training should be conducted at all levels from farmers to managers in irrigation, drainage and soil conservation.
- a routine maintenance programme should be done to keep the channel net - work in proper condition
- at national level policy should be formulated to encourage the sugarcane farmers to use efficient profitable system of irrigation by giving subsidy for installing irrigation equipment.

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