https://doi.org/10.29321/MAJ.10.A04019

Seepage Irrigation to Sugarcane—A new technique for higher efficiency irrigation in summer

by

S. V. PARTHASARATHY, M. Sc.,
Chief Sugarcane Officer, T. A. Sugar Factory, Vadapathimangalam.

Introduction : Sugarcane in Madras and Andhra States is subject to drought in summer and water-logging by North East Monsoon, particularly so when it is cultivated in the wet lands of delta region. The main canals of project areas are closed for annual repairs for varying periods from February to June. The subsoil water level goes low and pumping becomes difficult and costly. The soil and atmosphere go dry and losses due to seepage or evaporation in transmitting pumped water are very high. The crops suffer by severe drought in soil and air with consequent reduction in yield and quality of juice.

Various methods of layout have been adopted in sugarcane cultivation to facilitate irrigation and for economising water. The most popular layout is the furrow system with 3'-6" spacing centre to centre. Irrigation channels are laid across the furrows at intervals of 30 to 60 ft. depending upon soil type and land slope.

Most of the sugarcane growers dig up open wells and sink bore wells to tap subsoil water for irrigation in non-monsoon periods and particularly in summer months. The usual quantity of water used up per irrigation is about 70,000 gallons per acre or roughly 3 acre inches. In many cases, the interval between irrigations is as low as 5 to 7 days, though 12 to 15 days is ideal in many cases. In extreme cases where the subsoil water source is poor, the interval may be as much as 30 days. There are rare instances where the crop receives one or two irrigations only by summer. In the case of project areas, the canals are closed for a period of one month or more and the ryots do not usually provide alternate subsoil sources for this closure period.

In the seepage irrigation described here, the principles of sub irrigation (Renfro 1958) are adopted, by creating artifically through tractor drawn implements, a favourable structure of surface soil for upward capillary movement and through vertical deep cuts for longitudinal movement of water from field channels. It is aimed at raising soil moisture to field capacity at root zone in the maximum

area within limited water and time and also to avoid the ill-effects of flood irrigation, particularly the destruction of soil structure and resulting non-soil aeration and water logging.

The Thiru Arooran Sugar factory owns a 6200 acre farm and it is subject to severe drought from February—June each year when the regular flow in canals is closed for annual repairs. Small quantities of water are made available for a short period in summer and usually this water is insufficient for spread over the entire crop area in summer. Even after adoption of known soil moisture conservation techniques, the crop suffers long periods of drought. Therefore the problem is one of spreading the water to maximum area when the water becomes available in a limited way. Techniques similar to sub irrigation were under trial.

Use of Mole Drain: In the summer of 1960, attempts were made to work the mole drain layer and form mole tunnel at 15" below surface. The implement was attached to a pan breaker worked by D4 Caterpillar. The tractor was worked, making a cut at the centre of two rows and two interspaces could be worked at a time. The plots were irrigated in the normal manner. The irrigation water quickly percolated down to the mole tunnel and it acted as a reservoir. By this method 50% more water was consumed per acre though the moisture was conserved for longer periods. One serious defect in this system was that the water traversed long distances of over 100 or 200 ft. in the tunnel and there was no immediate visible surface effect. The irrigator had no means to judge the extent of inflow and control over irrigation was difficult. Even though the soil moisture by this method was conserved effectively over a long period, the total quanitity of water consumed was greater and the time taken to irrigate a unit area was also longer than under normal system. Quite often symptoms of water logging due to heavy subsoil storage were evident. During the current year a new system was successfully adopted and by this new method we could spread the water over 3 to 5 times the area as compared to normal furrow irrigation. This system is described as "Seepage Irrigation".

Seepage Irrigation: This is a type of sub irrigation developed for regular farm practice. The sub irrigation system is generally adopted in areas where large volume of surface flow raises the level of subsoil water and creates water logging. Usually in the sub irrigation systems adopted in other countries, drainage is a concomitant problem and is adopted at periods when water is in surplus

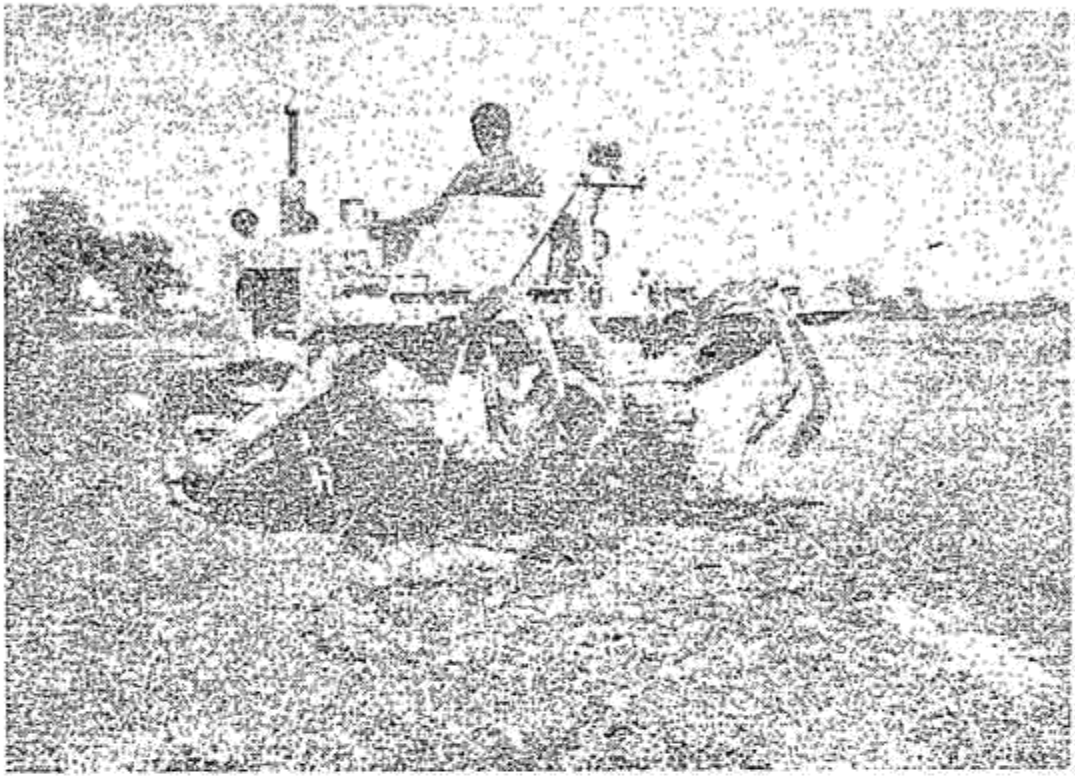

FIG. 1
'Cutter' implement in lifted up position.

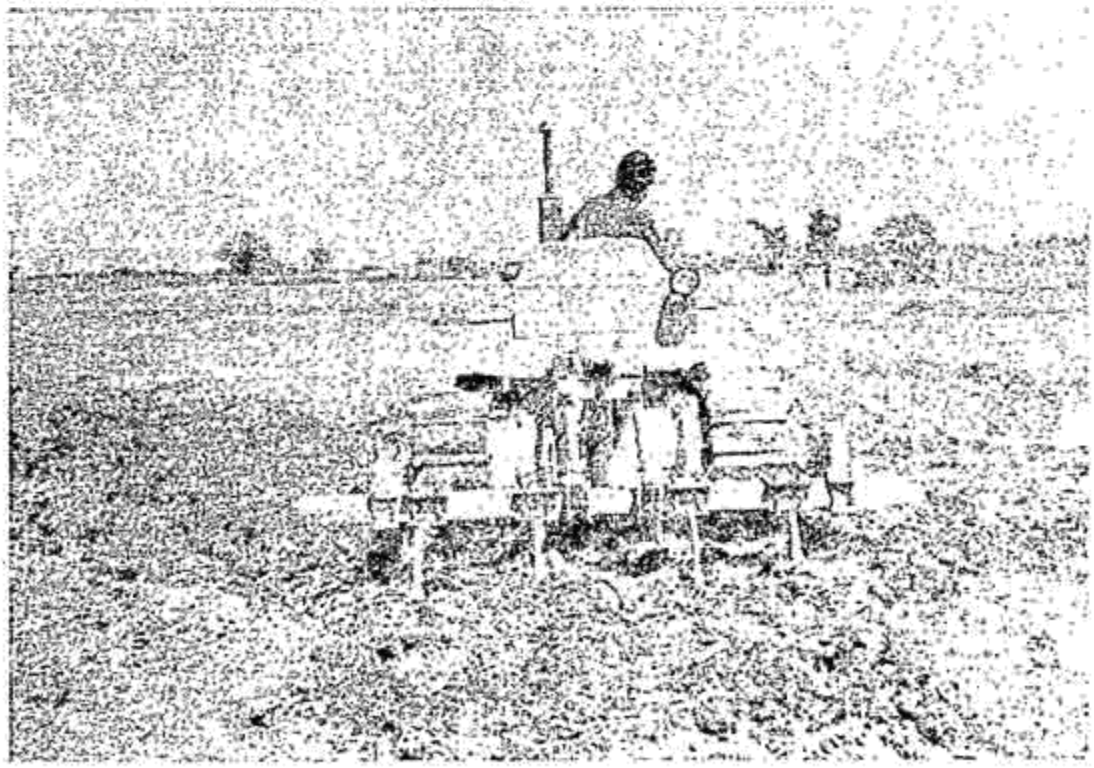

FIG. 2
'Cutter' implement in cutting position.

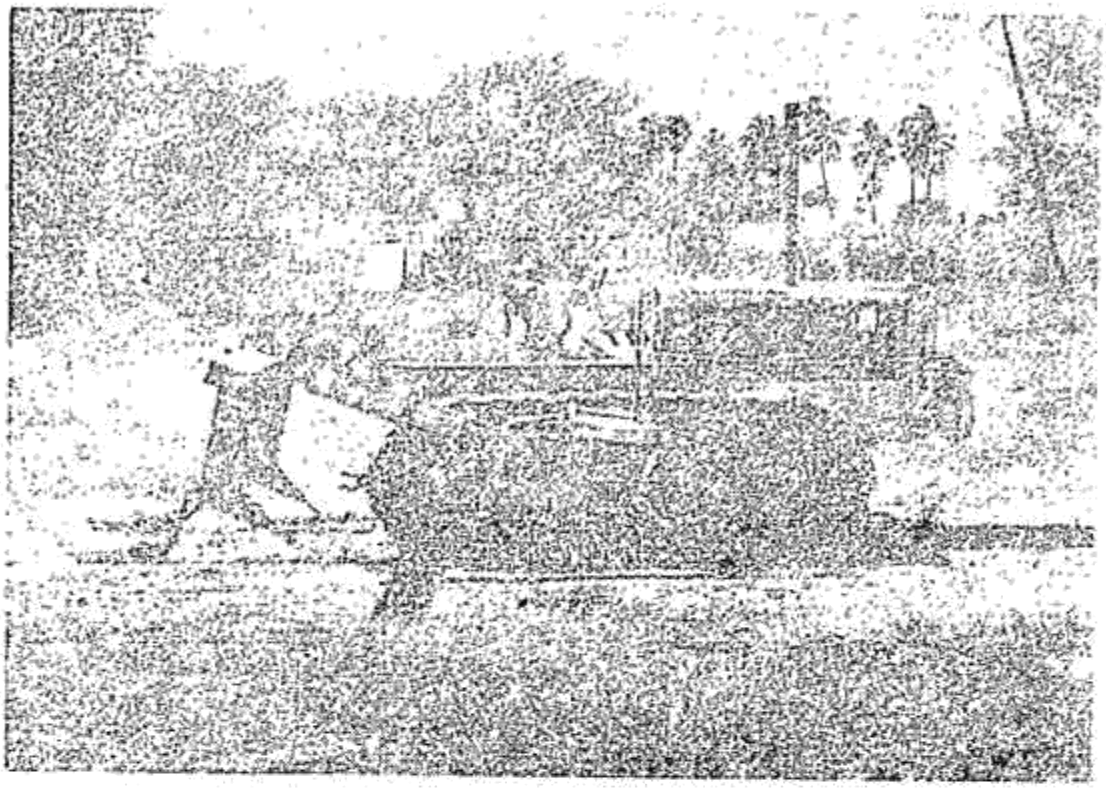

FIG. 3

Pan breaker with mole drain layer in lifted up position.

FIG. 4

Cross-channels with water for seepage.

and not for periods of drought. The sub irrigation may be from natural or artificial sources. The prerequisite conditions for sub irrigation are (a) the texture of soil to permit lateral or upward capillary movement of water, (b) an impervious substratum and (c) good drainage system to draw out the surplus water. The artificial sub irrigation system so far practised even in countries like America proved to be economic failures.

FIG. 5

Vertical cut between cane rows for irrigation water to seep through.

The system described here is a type combining the advantages of surface and sub irrigation systems. The soil is prepared to proper structure by tractor drawn implements and the irrigation water is applied in a manner to permit seepage effects over long distances and raising the soil moisture gradually to field capacity. The details are described hereunder.

Tractor operation : The sugarcane setts are planted in fields prepared in ridges and furrows during the months December to April. The crop needs frequent irrigation for good sprouting, vigorous tillering and growth. In Madras and other South Indian States, the crop is irrigated at intervals of 5 to 10 days depending upon availability of water. In order to conserve soil moisture, the surface soil is tilled periodically to shallow depths, alternate with each irrigation.

In TAS cane farm, the soil is heavy clay upto great depths. Under ordinary conditions vertical percolation of water is very poor. In the factory's own farm, the usual implement adopted for preparation or for interculture are the 'cutters' i. e. a heavy type of tynes that rip open the soil vertically to depth of 12" to 15". Pan breaker. of standard type serve the same purpose.

In 1961 summer, the young crop was worked up with cutters or pan breakers between rows (Figs. 1, 2, 3). This stirs up the soil to 12" – 15" depth. Three types of interculture were tried (a) single cut between rows, (b) double cut between rows and (c) single cut with pan breaker with mole drain layer. These three operations on soil were compared with normal soil in respect of irrigation by furrow method.

In seepage irrigation after working up the soil, field irrigation channels were laid out at intervals of 35', both parallel to the row and across the row. The channels were $1\frac{1}{2}$' broad by $\frac{3}{4}$' deep (Fig. 4). Water was taken through the parallel-to-the-row channel and at intervals it was blocked to fill up to the brim. By stages, all parallel and cross channels were filled up. In this method, the water is not allowed in each furrow as is done in normal irrigation practice. After 6 to 12 hours, the water in the channel seeps through laterally along the vertical openings cut by tractor implement (Fig 5). The water first travels through the cut ends opened up by the tractor implement (cutter or pan breaker) and then starts spreading both laterally and vertically by capillary action. The soil reaches its maximum water holding capacity in 6 to 12 hours. The quantity of water required under the different implement treatments is given below :

	Qty. of water per acre in gallons	Time taken per acre in number
(a) Single cut between rows.	22,400	90
(b) Double cut between rows.	26,826	108
(c) Pan breaking with mole drain— single cut between rows.	17,920	72
(d) Normal.	62,776	248

This seepage irrigation was effectively practised in 1961 and under field conditions the spread of water was 3 to 5 times with corresponding economy in water.

Special Advantages : This irrigation technique can be practised only in such cases where the crop is young and the soil can be ripped to fine tilth to a depth of atleast one foot. Double cut between rows or pan breaking with mole drain layer is found ideal. This irrigation necessitates keeping the soil in fine condition of tilth. A single tractor operation is helpful over two consecutive irrigations. Since the water does not flow over the surface of soil, the fine tilth and open crumb structure of soil are well maintained even after irrigation. The soil pore space to a depth of 9" to 12" is remaining undisturbed. The quantity of available water could be spread over 3—5 times the area. It is interesting to note that the quantity of water required per acre is less than what is required under sprinkler type. The advantage over sprinkler type is that one needs no special equipment like special pumps or sprinkler pipe lines and nozzles. Since very little water can seep down to lower layers in heavy soil condition, the plant nutrients rise towards surface with capillary action and become more easily available at the active feeding root zone. This system may lead to concentration of salts in surface layers. Since normal irrigation is feasible in these areas from June onwards such concentration of salts may be easily flushed out by June and this will lead to permanent removal of soluble salts. Further, in this cane farm, the rise of salts to the surface is mitigated by the system of trash mulching adopted extensively in all cane fields. It is also interesting to note that the soil moisture is maintained at higher level in subsoil in seepage irrigation than under normal irrigation. This reversal of soil moisture status as compared to surface irrigation leads to development of deeper roots and training the crop to resist drought.

Conclusion : Seepage irrigation is a technique that combines the advantages of the two well known methods of surface and sub irrigation. It could be adopted to all young crops of sugarcane. It helps to maximise the use of costly irrigation water in summer months and also trains the plant for drought conditions by encouraging deep rooting. The available water is spread over 3—5 times the area to raise the soil moisture to field capacity in the root zone of the young crop.

The young crop is intercultivated using D4 Caterpillar with cutters or pan breakers. This operation vertically cuts the soil to 12" — 15" depth. Field irrigation channels 1' wide by 9" deep, are then laid 35 ft. apart in criss-cross direction along and across the row. Irrigation water is let into the field channels by stages and filled to brim. After 6 to 12 hours, the water from these channels seeps out through the vertical cuts made between the two rows of cane and by capillarity, rise to surface and brings the soil to near field capacity. By this method of irrigation the open structure of soil and the soil pore space remain least disturbed atleast for two consecutive irrigations. The quantity of water utilised per irrigation is roughly $\frac{3}{4}$ to 1 acre inch.

This irrigation technique combined with surface trash mulch to soil is very helpful to overcome drought. The little available water could be spread over 3 to 5 times the area as compared to normal furrow irrigation. In saline soils, there is greater tendency for salts to concentrate near the surface. This is mitigated by trash mulching. These salts could be easily flushed out with the first irrigation when canals reopen by June or as soon as normal supply of water becomes available. Operational techniques to substitute manual labour for tractor power are under investigation.

REFERENCE

Renfro, G. M. 1958 Applying water under surface of the ground. *The Australian Irrigator* 3 : 11.

Meteorological Factors Influencing Soil Temperature at Coimbatore

by

C. BALASUBRAMANIAN, KOMALAM P. NAYAR and M. V. JAYARAMAN

Introduction : With a view to study the fluctuations of soil temperature, particularly under rain-fed conditions, soil thermographs were installed at the Central Agricultural Meteorological Observatory, in field No. 61, Central Farm, Coimbatore in 1951 and data on the soil temperature at depths of 3", 6" and 12" are being collected since then. The soil in the observatory is of a red-brown sandy loam type, with calcareous substrata, even at 18" depth and moderately