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A volumetric lysimeter system for use with puddled rice and its rotational crops

S. VENKATARAMAN, K. SUBBA RAO and R. P. SARKER

Meteorological Office, Pune

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सार – इच्छित स्तर पर पानी रोके रखने या उप-सतही जल स्तर को बनाए रखने का प्रावधान रख सकने वाले लाइसीमीटर का वर्णन किया गया है। धान और उसकी फेरबदल वाली वायुजीवी फसलों से वाष्पोत्सर्जन में होने वाली हानि को मापने के लिए इसके उपयोग का वर्णन किया गया है।

ABSTRACT. A volumetric lysimeter with provision for maintaining standing water or subsurface water table at any desired level is described. Its use for measuring evapotranspiration losses of rice and its rotational, aerobic crops is detailed.

1. Introduction

Except under upland conditions, rice is grown mostly under irrigation. For rice, besides evapotranspiration, the fieldwater requirements include the need for maintaining standing water in the field. The above practice leads to an inevitable loss of water as percolation. Comprehensive data on the quantum of percolation losses under various soil and water regime conditions is needed for water and crop management-planning for rice. Accurate assessment of the evapotranspiration needs of irrigated rice is a must for this *earlier work* techniques for measuring Evapotranspiration (ET) of the rice crop have been presented by Dastane *et al.* (1970) and Evans (1971). The above techniques are not suitable for use with aerobic crops which commonly follow or precede rice. Fieldwater balance methods (Talsma and VanDer Lelij 1976; Brown *et al.* 1977) for estimating ET are not accurate since errors in evaluating the various component would equal the magnitude of ET losses.

In light of the above a volumetric lysimeter system that has been designed to measure ET losses of puddled rice and its rotational crops is described below.

2. The volumetric lysimeter

In actual field practice standing water is required to be maintained over the soil surface for puddled rice, while the rotational crop, if aerobic, would not be able to stand saturated conditions. Certain modifications, as detailed below, have, therefore, been made in the Volumetric lysimeter system used by Vankataraman (1956, 1961) for measuring ET losses of aerobic, irrigated crops.

2.1. *Description*

The Volumetric lysimeter consists (Fig. 1) essentially of a field tank (1) connected by means of an underground pipeline (2) to a float mechanism (3) which in turn is connected through a needle valve to a supply tank (4). The float mechanism is housed in a chamber and is mounted on an adjustable stand. It has an outlet pipe to remove any excess backflow of water into the mechanism. The supply tank and the float chamber are kept outside the cropped area. The former

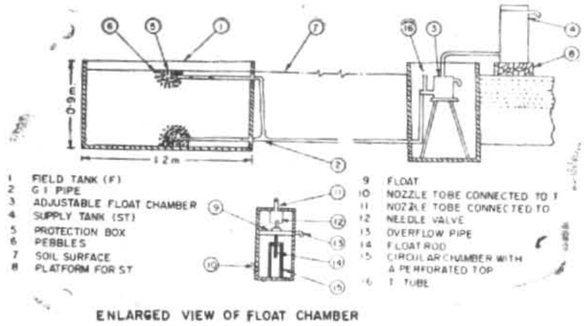

Fig. 1. Volumetric lysimeter

is again placed at a slightly higher level and is used as a water source for the crop in the field tank.

2.2. *Setting up in the field*

The soil tank of size $1.2 \times 1.2 \times 0.9$ m is used for raising the plants under observation and is installed in the centre of a well exposed field such that the top of the tank is 5 cm above the level of water that would be required to be maintained over the soil surface of the rice crop. This ranges from 5-10 cm for dwarf rice varieties. A trench about 30 cm wide and 1 metre deep is dug from the centre of the tank to the float container site outside the field. Along the central vertical line of the tank side facing the trench, two holes each 12 mm in diameter are made at 20 cm from the top of the tank and 7.5 cm from the bottom. 12 mm GI threaded flanges are fixed to the outer and inner side of the tank, so that they form along with the hole, a continuous water-tight passage. 12 mm GI tubes of 60 cm in length are threaded into the inner flanges, 12 mm GI pipe of length 15 cm and fitted with a socket joint at one end are threaded into the outer flange. The 12 mm GI pipe lines are connected to the two socket joints outside the field tank. The pipelines pass through 12 mm holes into the flot container. The space, formed by the hole around the pipeline is made water-tight. The pipe line which is in operation is connected to the outlet tube of the float chamber through a flexible tubing connected to the two sides of a short inverted 'T' tube. A transparent plastic tubing is attached to the vertical portion of the 'T' tube. This facilitates one to have a view of the water level in the soil tank. The 'T' tube arrangement also helps any trapped air bubble in the pipeline to escape. The inlet of the float chamber is connected to the outlet of the supply tank through a flexible tubing passing through a water-tight hole in the lid of the float chamber container. The end of the GI pipes inside the field tank are covered with a fine brass mesh. Additionally, a perforated hemispherical cup with a 12 mm hole and filled with small pebbles, is fitted to the end of the tubes.

The upper underground pipe line lying outside the field tank is often seen to be a hindrance in intercultural operations and in pre-planting field preparations. This is dispensed with as follows. Two short 12 mm GI pipes of length 20 cm are fixed to pass through the holes (upper and lower) in the float chamber so as to be 10 cm in and out of the float chamber. The GI tubes threaded to the flanges on the outside of the field tank and the two GI tubes emerging out of the float chamber into the field are interconnected vertically by means of a suitable length of 12 mm GI pipe.

For aerobic crops, a sub-surface water table of 60 cm is adequate to ensure normal crop development (Misra and Subramaniam 1948). Therefore, the height of the float stand must be such as to ensure that the water table in the tank would be 75 cm from the top of the field tank when the float chamber is connected to the reservoir drum and the lower pipe. This is done by pouring water into the field tank and by adjusting height of the float stand to obtain a water table exactly 75 cm from the rim of the tank. The height of the float device from the bottom of the chamber for achieving the 75 cm water table is noted. Water is removed from the field tank. The field tank and the trench are backfilled with soil to maintain the same profile and the compaction as in the surrounding field. The soil surface in the tank is adjusted to be at the same level as in the surrounding field. The float mechanism is moved in the adjustable stand so as to provide a water table in the field tank at the desired depth for the aerobic, rotational crop of rice. The next step is to adjust, by trial and by recompaction of the soil, the rate of replenishment from the supply tank to the soil in the field to about 3 litres, equivalent to 0.4 mm of water, per day. This is to ensure that while the root zone moisture for the rotational crop will be at field capacity, the evaporative loss from the soil surface in the tank will not be much in excess of that occuring from the surrounding field. The lysimeter system is now ready for operation.

2.3. *Operation*

When rice is transplanted, the lower pipe is sealed water-tight. The float chamber is connected to the upper pipe and the height of the float stand adjusted to give the desired depth of standing water. When rice is harvested, the float is disconnected from the upper pipe and reservoir. The lower pipe is opened and all excess water is allowed to drain out. Before the sowing of the rotational aerobic crop, the float mechanism is connected to the lower pipe and the height of the float stand is adjused to obtain the desired, pre-determined depth of water table in the field tank.

2.4. *Observations*

The amount of inflow from the supply reservoir is noted. At the same time, the outflow, if any, due to rain is collected in a vessel placed below the outflow pipe of the float mechanism and is measured. The amount of rain recorded in a nearby observatory enclosure is noted. The inflow and outflow amounts are converted into equivalent depths of water. ET is given by the amount of inflow *plus* rain *minus* outflow. The observations are recorded at 0700 and 1700 hrs local mean time to help gauge the day and night time ET losses of the rice crop.

In the case of aerobic crops, the soil mass is watered from above at the time of first field irrigation to produce a small outfiow. At subsequent irrigations the amount of water needed to just produce an outflow is noted. The ET in the interval between two irrigations is given by inflow *plus* rain *plus* amount of water added to the tank as surface irrigation at the end of the interval *minus* the outflow.

In the case of rice as well as its rotational crop, the density of plants in the tank must be the same as in the field. The field and tank rows must be contiguous and there should be no non-cropped periphery around the lysimeter. The tank and field crop must be subject to identical cultural treatments.

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