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PAN EVAPORIMETER: A USEFUL TOOL FOR IRRIGATION SCHEDULING

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INTRODUCTION

Irrigation is essential to meet the crop water demand whenever rainfall and stored soil moisture is not sufficient for increasing / stabilizing crop yield. The availability of water resources for agriculture purpose is fast dwindling as the competitions from other sectors are increasing day-by-day. The per capita availability of surface water in our country would come down to 1401 m^3 and 1191 m^3 for the years 2025 and 2050 respectively, from 2309 m^3 in 1991 (Kumar *et al.,* 2005). It is estimated that the scope for increasing freshwater resources is narrowing and there is great need to increase water use efficiency to address the problem of dwindling freshwater availability. Injudicious application of irrigation water, for instance excess application lead to wastage of water, energy and labour, reduces soil aeration, nutrients leaching below the root zone of the plants and impact the crop yield. Similarly shortage of irrigation water causes, water and nutrient stress to the plants and hence yield reduction. In this context, scientific irrigation scheduling assists the farmers for effective utilization of the available water resources.

Fig.1. USWB Class A Open pan evaporimeter

Device which integrates the effect of weather factors while giving evaporation measurement can be used for irrigation scheduling. USWB (United States Weather Bureau) Class A evaporation pan (Fig 1) offers a collective effect of solar radiation, temperature, wind speed and humidity on evaporation measurement from a specific open water surface. This pan has been used extensively throughout the world owing to its better performance compared to other pans.

IRRIGATION WATER /CUMULATIVE PAN EVAPORATION (IW/CPE) RATIO

This approach was based on ratio of fixed irrigation water amount to cumulative pan evaporation amount and was more practicable at field level (Prihar *et al.,* 1974). They have tried this method of irrigation scheduling in wheat and concluded that irrigation scheduling on the basis of IW/CPE ratio gave practical way to judicious use of irrigation water without yield penalty. Several studies was found in literature by employing IW / CPE ratio for irrigation scheduling (using USWB Class A pan) in

different crops in India. Nonetheless, high cost of evaporation pan, big size, difficult in maintenance and daily measurement are certain drawbacks at farmers' level for practical utility. Hence, in order to make this device more practical, many attempts have been made to develop small size evapormeter at national and international level.

EXPERIMENTS WITH SMALL SIZE EVAPORIMETERS

Sharma *et al.,* (1975) used can evaporimeter (plastic container with diameter 10.3 cm and height 14.3 cm) with different colours (black, aluminium and white) covered with mesh screen. The can evaporimeter was filled with water up to 1.5 cm below the rim (Fig 2) and kept at crop height and 30 cm above crop height in berseem and wheat field at IARI, New Delhi. They compared evaporation data from can evaporimeter, USWB Class A pan and actual ET from wheat field which was estimated from soil moisture records. Results revealed that both aluminium and white can evaporimeters kept at crop height had highest correlation with actual ET by soil moisture depletion method.

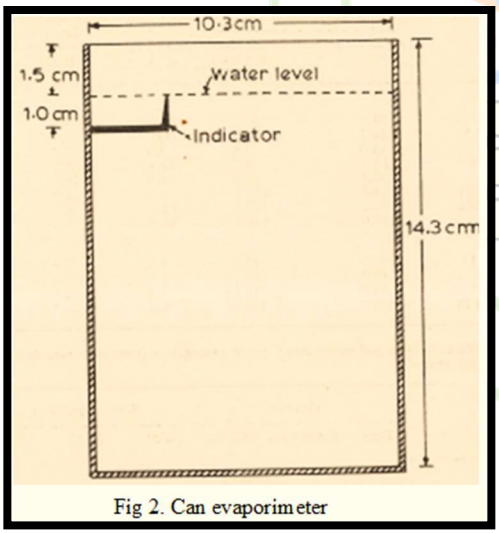

Fig 2. Can evaporimeter

Torres (1998) conducted irrigation scheduling experiment in sugarcane using device white cylindrical plastic bucket (0.30 m diameter and 0.40 m height; Fig 3) at Columbia. Evaporation from the scheduling bucket was 9% higher than the value obtained from the Class A pan evaporimeter. He conducted field trials with four irrigation scheduling treatments viz., Commercial irrigation based on farmer experience, daily water balance calculations, bi-weekly

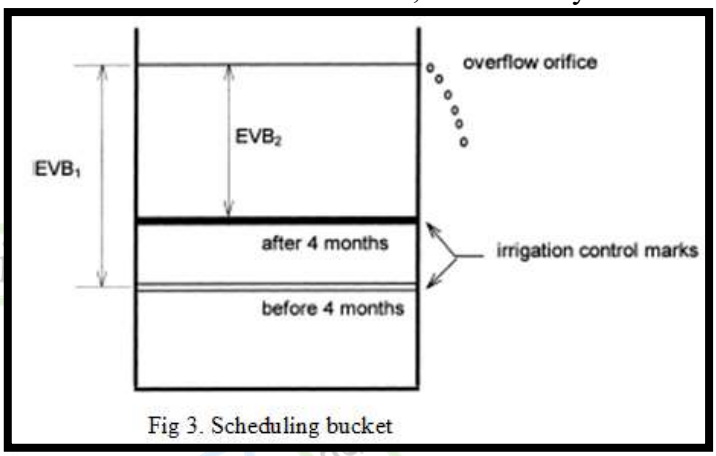

Fig 3. Scheduling bucket

calculation of water budget and calibrated plastic bucket. Results showed 12% more cane and sugar yield and also he could able to skip four irrigations compared to the commercial treatment. He concluded that the scheduler bucket can be used for different crops after calibration to save irrigation water and also for higher yield with less water.


Fig 4. Mini evaporation pan

In Burdekin and Bundaberg district of Queensland, Australia a mini evaporation pan (half cut 200 litre plastic drum; Fig 4) was used for irrigation scheduling in sugarcane (Holden *et al.,* 1997) The methodology is based on cumulative evaporation registered by the time stalk growth rate had fallen to 50% of the observed

maximum rate and the depth of water evaporated from the mini pan indicates the soil water deficit. They observed that mini pan evaporation was 15% higher than USWB Class A pan. Water use efficiency of mini pan users increased by 0.5 t/ML (7.8-8.3 t/ML) in Burdekin and 0.9 t/ML (9.6-10.5 t/ML) in Bundaburg district. They pointed out that factors like simplicity, easy to understand and use led to successful adoption of the mini pan for sugarcane irrigation scheduling where other irrigation scheduling tools have failed. Shannon and Raine (1996) informed that mini pan irrigation schedulers could save reduce water usage by 10 – 47% in sugarcane when compared to non users.

Thomas *et al.,* (2004) designed a simple, low cost, reduced size pan irrigation scheduler (Fig 5) called as UGA EASY (University of Georgia – Evaporation-based Accumulator for Sprinkler-enhanced Yield) at Tifton Campus, University of Georgia, USA. This pan irrigation scheduler is made up of galvanized iron with 65 liter capacity.

Fig 5. UGA EASY irrigation scheduler

The top diameter, bottom diameter and height of the pan evaporimeter is 61 cm, 52 cm and 28 cm, respectively. This irrigation scheduler weighs around 2.5 kg. They used under sprinkler irrigation applications with row crops and they informed that the unit was performed well in Tifton loamy sand soil.

In China, for evaporation measurement purpose, Chinese pan (20 cm diameter pan made up of stainless steel; thickness 5 mm; depth 11 cm; weight 2 kg; covered with stainless steel metal screen; Fig 6) has been used. It is reported that the

Fig 6. Chinese 20 cm pan

advantages of a 20 cm pan are its small size, ease of transport, low cost, and simplicity of measurement (Liu and Kang, 2007). Many researchers in China did experiment using the 20 cm pan for irrigation scheduling in different irrigation methods like surface, drip and sprinkler for many crops. Results of these studies showed that pan evaporation from Chinese pan is closely related to actual evapotranspiration (ET) measured using weighing lysimeter and it can be used by farmers very easily for irrigation scheduling purpose in order to increase water use efficiency.

CONCLUSION

Judicious application of irrigation water and getting more yield per drop of water used are inevitable in the days to come as the availability of water as well as its quality is reducing day-by-day. Though, many scientific methods / instruments are there for irrigation scheduling, they have been failed at farmers' level as they require

technical knowledge. However, from the above said experiments results, it is understood that small size pan evaporimeter is handy device for farmers to follow scientific irrigation scheduling in their field in order to save water without yield decline.

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