Water use studies on aerobic Rice under drip irrigation system by using daily soil water balance

M. ANBARASU [1] and A. GURUSAMY [2]

*[*1]Post Doctoral Fellow and [2]Professor, Department of Agronomy (Farm), Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai - 625104. Tamil Nadu, India.*

**Corresponding author email: manbarasu102@gmail.com*

To evaluate the water studies on aerobic rice under drip irrigation system. A field experiment was conducted during summer 2020 at AICRP Water Management Scheme research field, Agricultural College and Research Institute, Madurai. The drip irrigation was scheduled once in 3 days at 120 %, 100 %, and 80 % PE, and Fertigation in 100 %, 75 %, 50 % RDF was given weekly intervals from 15 DAS to 70 DAS and separately maintain the control of Surface irrigation at IW/CPE 1.25 with Soil application of RDF (150:50:50 NPK ha^{-1}). Daily Pan Evaporation and irrigation maintained by daily soil water balance method. Total water use, water use efficiency, and Water productivity were significant variations by different drip irrigation and fertigation levels. The highest WUE and WP of aerobic rice cultivation under drip irrigation and fertigation system was at 120 % PE and 100 % RDF is a promising one.

Rice (*Oryza sativa* L.) is the staple food crop for more than half of the world population and influences the livelihoods and economics of several billion peoples. Lowland irrigated rice requires a lot of water for puddling, transplanting, and irrigation. Further, significant water losses occur through seepage, percolation, and evaporation. It is estimated that it consumes 3000 to 5000 liters of water to produce one kilogram of rice. In India, annual per capita availability of water may reduce to 1340 cubic meters in 2025 and 1140 cubic meters in 2030 (Suhag, 2016).

The present field experiment was conducted during summer (22.02.200 to 31.05.2020) 2020 at Agricultural College and Research Institute, Madurai (9˚54'N latitude and 78˚54'E longitude), Tamil Nadu, India. The field experiment was laid out in a strip plot design with replication thrice. The spacing of rice sown at 20 × 15 cm in raised beds was formed with a top bed width of 90 cm and furrows were formed to a width of 30 cm (120 cm). The laterals were placed in the center of the raised bed with 40 cm emitter spacing with a discharge rate of 5.8 lph. The soil of the experimental site was clay loam (pH-7.04, Ec-0.33 dS $m^{-1,}$ and Organic carbon-0.42 percent). Rice variety CO 51 was used for the field experiment. The drip irrigation was scheduled once in 3 days at 120 %, 100 %, and 80 % Pan Evaporation (PE) and Fertigation in 100 %, 75 %, 50 % Recommended Dose of Fertilizer (RDF) was given weekly intervals from 15 Days After Sowing (DAS) to 70 DAS and separately maintain the control of Surface irrigation at Irrigation Water / Cumulative Pan Evaporation (IW/CPE) 1.25 with Soil application of RDF (150:50:50 NPK ha^{-1}).

The quantity of water was calculated as follows

$WRc = CPE \times Kp \times Kc \times Wp \times A$

Where, WRc - Computed water requirement (l plant^{-1}), CPE - Cumulative pan evaporation for three days (mm), Kp - Pan factor (0.8), Kc - Crop factor, Wp - Wetting percentage (0.2), A - Area per plant.The crop evapotranspiration (ETc) was estimated using daily pan evaporation data recorded with the help of USWB class A pan evaporimeter by using a daily soil water balance is rather like a bank account.

The total water use of Surface irrigation at IW/CPE 1.25 of 740 mm included irrigation water and effective rainfall. Whereas, the drip irrigation of 80% PE, 100% PE, and 120% PE was 621.36 mm, 709.8 mm, and 730.52 mm included irrigation water and effective rainfall respectively (Table 1). The drip irrigation of 120 PE was seen with higher water use efficiency of 7.88 kg ha^{-1} mm^{-1} and water productivity of 110.35 Rs ha^{-1} mm^{-1} in aerobic rice cultivation under drip irrigation system and it was followed by 100 PE. The lowest WUE and WP were registered of 80 PE (5.80 kg ha^{-1} mm^{-1} and 81.16 Rs ha^{-1} mm^{-1}) respectively.

Concerning drip fertigation doses, 100 percent of RDF significantly registered higher WUE (7.65 kg ha^{-1} mm^{-1}) and WP (107.05 Rs ha^{-1} mm^{-1}) aerobic rice cultivation under drip fertigation system and it was followed by 75 percent RDF. The lowest WUE and WP were registered of 50 percent RDF (6.06 kg ha^{-1} mm^{-1} and 84.84 Rs ha^{-1} mm^{-1}) respectively.

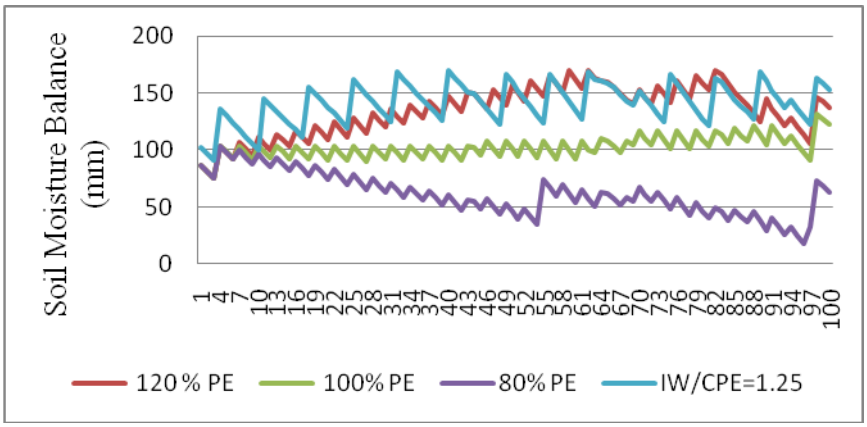

Fig. 1: Soil moisture balance (From day 1 - 100)

Interaction between drip irrigation and fertigation *viz.*, I_1 - 120 percent PE × F_1 - 100 percent RDF registered the highest WUE (8.30 kg ha^{-1} mm^{-1}) and WP (116.17 Rs ha^{-1} mm^{-1}) of aerobic rice cultivation under drip irrigation and fertigation system and it was on par with I_1× F_2 and I_2× F_1 in both of WUE and WP respectively. The lowest interaction effect on WUE and WP registered in I_3× F_3 both of WUE and WP.

Whereas, the control (Surface irrigation at IW/CPE 1.25 with 100 percent RDF soil application) revealed the WUE (7.07 kg ha^{-1} mm^{-1}) and WP (98.95 Rs ha^{-1} mm^{-1}) combatively lowest of 120 % PE and

100 % PE and comparatively highest of 50 % PE due to highest water applied in the field as per the treatment (Table 2).

Water use efficiency can be calculated by using yield and total water use. Water productivity can be calculated by gross income and total water use. Surface (IW/CPE) irrigation to spread over the soil surface and distributed in gravimetric force. Whereas, drip irrigation only irrigate in root rhizosphere region that had higher water use efficiency and water productivity due to better availability of water and nutrient resources during its entire growth period. This has enhanced the productivity in terms of seed yield of aerobic rice cultivation under drip irrigation system. This result is conferred with the findings of Ehdaie and Waines, 1993; Basha *et al.*, 2017; Haindavi *et al.*, 2018; Kumar *et al.*, 2019.

The highest WUE and WP of aerobic rice cultivation under drip irrigation and fertigation system was at 120 % PE and 100 % RDF is a promising one. The method of daily soil water balance is the easiest method to adopt the researchers and farmers to retain their crop of 50 % available soil moisture and treatments effect is a precise and friendly calculation of water requirement.

REFERENCES

Basha, S. J. A. and Sarma, S. R. (2017). Yield and water use efficiency of rice (Oryza sativa L.) relative to scheduling of irrigations. *Annals of Plant Sci.*, 6: 1559-1565.

Ehdaie, B. and Waines, J. G. (1993). Variation in water-use efficiency and its components in wheat: Well-watered pot experiment. *Crop Sci.*, 33: 294-299.

Haindavi, P., Chandrasekhar, K., Lakshmi, N. V. and Prakash, K. K. (2018). Interaction of Irrigation and Weed Control Options on Weed Management and Yield of Dry Sown Rice (Oryza sativa L.). *International J. Current Microbiology Applied Sci.*, 66: 2218-2227.

Kumar, S. Narjary, B., Kumar, K., Jat, H., Kamra, S. and Yadav, R. (2019). Developing soil matric potential based irrigation strategies of direct seeded rice for improving yield and water productivity. *Agricultural Water Managem.*, 215: 8-15.

Suhag, R. (2016). Overview of ground water in India. PRS Legislative Research ("PRS") standing committee report on Water Resources examined, 10: 1-10.