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RESEARCH ARTICLE :

Studies on efficacy of AWDI method with field water tube on rice production under SRI

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SUMMARY : The Field experiments were laid out in the wetlands of Agricultural College and Research Institute, Coimbatore during *Rabi* season of 2013-14 and 2014-15, to study the efficacy of Alternate Wetting and Drying Irrigation method on growth, yield parameters and grain yield of SRI rice with help of field water tube. Nine AWDI treatments were tested along with SRI and conventional rice irrigation methods in Randomized Block Design, replicated thrice. The AWDI levels tested were irrigation at different depletions *viz.*, 10, 15 and 20 cm below soil surface with their combinations. In both seasons, AWDI after 10 cm depletion from 7 days after transplanting upto 10 days prior to harvest was found to be superior than other AWDI practices which recorded the highest water use efficiency of 6.82 and 6.27 kg/ha-mm and grain yield of 6352 and 6441 kg/ha during *Rabi* 2013-14 and 2014-15 seasons, respectively. SRI method gave comparable yields with AWDI at 10 cm depletion, but the water use efficiency was higher under AWDI at 10 cm depletion.

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KEY WORDS :
AWDI, Field water Tube, Water use efficiency, SRI, Yield

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BACKGROUND AND OBJECTIVES

Rice (*Oryza sativa* L.) is the major staple food crop by supplying 21 per cent calories in world food (39 % in Asian food), through producing 697.22 million tonnes from an area of 153.43 million hectares with average productivity of 4.40 t ha^{-1} (IRRI, 2012). More than 90 per cent of the world's rice is produced and consumed in Asia, which is the livelihood for 60 per cent of global population (Mangala, 2007). The water for agriculture is getting increasingly scarce and it is prophesied that by 2025, 15-20 million hectares of irrigated rice may suffer due to water paucity. Increased rice supply is constrained by the lack of sufficient water availability (Ndiiri *et al.*, 2012). The greatest challenge for growing decades is the water for agriculture and is getting increasingly scarce. Irrigation is the largest water user in the world, using upto 85 per cent of the available water in the developing countries. Population growth, along with development, will double global food demand by 2050. This will require increased agricultural production and put increased pressure on water resources (FAO, 2008).

Alternate Wetting and Drying (AWD) is a water-saving technology that farmers can apply to reduce their irrigation water use in rice fields without any yield penalty. One such strategy to address this need is the use of Alternate Wet/Dry Irrigation method (AWDI) for cultivated rice. AWDI is one method that can increase the water use efficiency at the field level. With this background the present investigation was carried out to study the effect of Alternate Wetting and Drying Irrigation (AWDI) method on growth and grain yield of rice under SRI with help of field water tube.

RESOURCES AND METHODS

Field experiments were carried out in the wetlands of Agricultural College and Research Institute, Coimbatore during *Rabi* season of 2013- 14 and 2014-15. The field was located in the north-western tract of Tamil Nadu at 110 N latitude, 770 E longitude and at an altitude of 426.72 m above Mean Sea Level. Nine AWDI treatments were tested along with SRI and conventional rice irrigation methods in Randomized Block Design, replicated thrice. The AWDI levels tested were irrigation at different depletions *viz.*, 10, 15 and 20 cm below soil surface with their combinations. The rice variety CO (R) 50 with field duration of 135 days was used in the trial. Separate nurseries were raised for SRI and Conventional planting. Method of planting was SRI, transplanted with 14 days old seedlings. For conventional planting, 30 days old seedlings were used. All other package of practices were carried out as per recommendation of (CPG, 2012) for the treatments. In the net plot area, five sample plants were selected randomly and tagged for recording biometric observations. In the tagged plant, the plant height, tillers, panicle length and grain yield of rice were recorded.

Field water tube :

A field water tube was devised and installed to monitor safe AWD method of irrigation with a view to eliminate the need for complex tables or charts. To avoid over drying of soil and to determine when to re-flood can be judged by using indicator tool (field water tube) devised by IRRI. The field water tube is a PVC pipe of 40 cm of length and 15 cm diameter in which 20 cm pipe is perforated with holes of 0.5 cm and both the side of the tube is opened. The tube was mounted in the soil by using wooden plank and hammer so that 20 cm protrudes above the soil surface and care was taken that the tube is not penetrating through the bottom of the plow pan. The field water tube was installed in each plot, to measure the depth of standing water and water table in the field, either above or below the soil surface. Nine different irrigation regimes based on water table levels were imposed using the tube and irrigation was given when water depth goes below the soil surface to 10, 15 and 20 cm as per treatment schedule. Water depth in the tube was measured by using scale. The subsequent irrigation was given by re-flooding the field to a depth of 2.5 and 5 cm depends upon the treatment. Irrigation was withheld 10 days prior to harvest.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Growth attributes :

The mean data on plant height (cm) of rice for the treatments over the years showed in Table 1. The plant height was increased at the crop growth advance from active tillering stage and it was maximum at harvest stage. The differences due to treatments were found to be significant on plant height. The higher plant height of 104.35 and 104.13 cm in *Rabi* 2013-14 and 2014-15 were registered at flowering stage under SRI method of irrigation (T_{10}). Irrigation after 10 cm depletion from 7 DAT to 10 DPH (T_1) recorded plant heights (103.86 and 103.20 cm in *Rabi* 2013- 14 and 2014-15) comparable with SRI method. Irrigation after 20 cm depletion from 7 DAT to 10 DPH (T_3) resulted in shortest plant height (81.57 and 79.76 cm in *Rabi* 2013-14 and 2014-15). This result is in conformity with the findings of Geethalaksmi *et al*. (2009).

Irrigation after 10 cm depletion from 7 DAT to 10 DPH (T_1) produced more number of tiller (411 and 405 m^{-2} in *Rabi* 2013-14 and 2014-15) at the flowering stage which was on par with SRI method of irrigation (416 and 406 m^{-2} in *Rabi* 2013- 14 and 2014-15). The lower number of tillers (256 and 261 m^{-2} in *Rabi* 2013-14 and 2014-15) were recorded in irrigation after 20 cm depletion from 7 DAT to 10 DPH (T_3). Higher number of tillers m^{-2} recorded under SRI method of irrigation (T_{10}) might be due to better aeration resulted in favourable root growth and more absorption of nutrients as observed from

Table 1 : Effect of different levels of AWDI on plant height, number of tillers m^{-2}, and days to maturity of rice

Treatments	*Rabi* 2013-14			*Rabi* 2014-15		
	Plant height (cm)	No. of tillers (m^{-2})	Days to maturity (days)	Plant height (cm)	No. of Tillers (m^{-2})	Days to maturity (days)
T_1 : Irrigation after 10 cm depletion from 7 DAT to 10 DPH	103.86	411	129	103.20	405	131
T_2 : Irrigation after 15 cm depletion from 7 DAT to 10 DPH	96.14	347	127	95.87	349	129
T_3 : Irrigation after 20 cm depletion from 7 DAT to 10 DPH	81.57	256	124	79.76	261	127
T_4 : Irrigation after 10 cm depletion up to MT and 15 cm depletion up to 10 DPH	96.20	355	128	95.95	360	130
T_5 : Irrigation after 10 cm depletion up to MT and 20 cm depletion up to10 DPH	87.48	299	126	87.93	315	128
T_6 : Irrigation after 15 cm depletion up to MT and 10 cm depletion up to10 DPH	97.19	397	129	96.28	400	130
T_7 : Irrigation after 15 cm depletion up to MT and 20 cm depletion up to10 DPH	86.21	293	127	86.35	304	128
T_8 : Irrigation after 20 cm depletion up to MT and 10 cm depletion up to10 DPH	96.04	341	129	91.45	347	130
T_9 : Irrigation after 20 cm depletion up to MT and 15cm depletion up to 10 DPH	95.16	325	127	90.70	336	129
T_{10} : SRI method	104.35	416	130	104.13	406	132
T_{11} : Conventional method	95.97	304	134	90.54	286	135
S.E.$\pm$	3.17	19.9	0.5	3.12	21.4	0.4
C.D. (P=0.05)	6.61	41.7	1.1	6.52	44.7	0.8

DAT: Days After Transplanting, DPH: Days Prior to Harvest, MT: Maximum Tillering stage (30-35 DAT)

increased uptake of nutrients consequently resulted in more growth and tiller production (Hameed *et al.*, 2011).

Number of days required for attaining crop maturity influenced by different irrigation treatments is furnished in Table 1. The conventional method of irrigation (T_{11}) recorded longer durations (134 and 135 days during *Rabi* 2013-14 and 2014-15) and the lowest duration of 124 and 127 days were recorded under AWDI after 20 cm depletion from 7 DAT to 10 DPH (T_3), which was on par with AWDI after 10 cm depletion upto MT and 20 cm depletion upto 10 DPH (T_5) and AWDI after 15 cm depletion upto MT and 20 cm depletion upto 10 DPH (T_7). The same trend was observed in *Rabi* 2014-15 also. Early flowering and maturity was observed under the treatment, AWDI after 20 cm depletion from 7 DAT to 10 DPH (T_3). This result is in conformity with findings of Chapagain *et al*. (2010), which might possibly due to moisture stressed condition.

Grain yield :

Grain yield of rice was significantly influenced by different irrigation methods the system of rice cultivation (SRI) produced significantly higher grain yield (6612 and 6736 kg ha^{-1} in *Rabi* 2013-14 and 2014-15), which is comparable with irrigation after 10 cm depletion from 7 DAT to 10 DPH (6352 and 6441 kg ha^{-1} in *Rabi* 2013-14 and 2014-15) and followed by irrigation after 15 cm depletion upto MT and 10 cm depletion upto 10 DPH (T_6) Fig. 1. The lowest grain yield of 3107 and 3198 kg ha^{-1} in *Rabi* 2013-14 and 2014-15 were recorded under irrigation 20 cm depletion from 7 DAT to 10 DPH (T_3). This may probably due to reduction in soil moisture levels resulting in more number of chaffy grains. Water stress affected photosynthesis and subsequent translocation of photosynthates from source to sink as reported by Agnes (2004).

Water use efficiency (WUE) :

The irrigation treatments showed significant variation in. WUE as influenced by the treatments is depicted in Fig.1. Irrigation after 10 cm depletion from 7 DAT to 10 DPH recorded higher WUE (6.82 and 6.27 kg/ha-mm in *Rabi* 2013-14 and 2014-15) and lowest WUE were

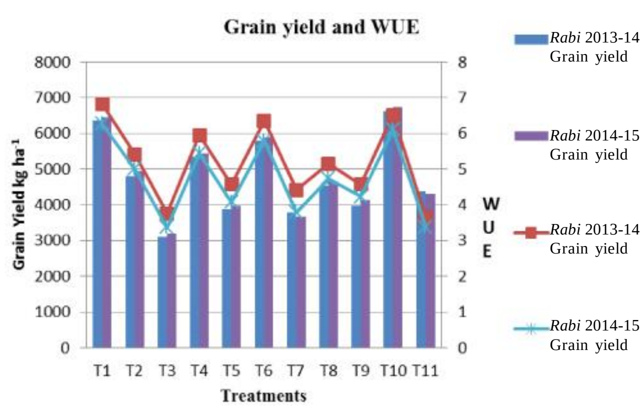

Fig. 1 : Effect of different levels of AWDI on grain yield and WUE of rice

recorded in conventional method of irrigation (3.65 and 3.38 kg/ha-mm in *Rabi* 2013-14 and 2014- 15). Irrigation after10 cm depletion from 7 DAT to 10 DPH saved 22.1 and 19.5 per cent of water as compared to the amount of total water required in the conventional method of irrigation (T_{11}) during *Rabi* 2013-14 and 2014 -15. Alternate drying and wetting of the fields allows for good aeration of the soil and better root growth thereby increasing rice yield and water use efficiency (Uphoff, 2006). This result is in conformity with the findings of Chapagain *et al.* (2011).

From this study, it was concluded that, higher plant height, No.of tillers, panicle weight, increased thousand grain weight and higher grain yields were recorded with SRI method of irrigation which is on par with AWDI at irrigation after 10 cm depletion from 7 DAT to 10 DPH followed by irrigation after 15 cm depletion upto MT and 10 cm depletion upto 10 DPH in both the years of experimentation.

This AWDI at irrigation after 10 cm depletion from 7 DAT to 10 DPH in irrigated rice cultivation with benefits of higher water use efficiency (6.82 and 6.27 kg/ha-mm during *Rabi* 2013-14 and 2014- 15) and maintaining comparable yield (6352 and 6441 kg ha^{-1} during *Rabi* 2013-14 and 2014- 15) to SRI method of irrigation over conventional method of irrigation. Hence, this AWDI after 10 cm depletion from 7 DAT to 10 DPH will make farmers to adopt safe AWDI in farming areas where the water potential is limited.

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