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Irrigation and weed management practices on water productivity and yield of rice in direct seeded rice (DSR) under semi-dry conditions

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Abstract
A field experiment was carried out at Agricultural Research Station, Paramakudi, Tamil Nadu during *rabi* season during 2017 and 2018 to study the interaction effect of irrigation and weed management strategies on total water consumed, water productivity and yield in semi-dry Direct Seeded Rice. The field experiments was laid out in split- plot design with irrigation in main plot and weed management in sub plot and replicated thrice. The main plot treatments comprises of three irrigation scheduling practices *viz*., I_1- Irrigation when water level drops to 10 cm below soil surface, I_2 - Irrigation when water level drops to 15 cm below soil surface, I_3 - Irrigation when water level drops to 20 cm below soil surface. In subplots six weed management treatments such as W_1 -Pre-emergence pendimethalin @ 1.0 kg.ha^{-1} at 3 days after sowing (DAS) *fb* (followed by) one hand weeding at 30 DAS,W_2 –early post-emergence bispyribac sodium 25 g.ha^{-1} at 15 DAS *fb* one hand weeding at 30 DAS,W_3-PE pendimethalin @ 1.0 kg.ha^{-1} at3DAS *fb* star weeder at 30DAS, W_4- early post- emergence bispyribac sodium 25 g.ha^{-1} at 15DAS *fb* star weeder at 30DAS,W_5-Pre-emergence pendimethalin@1.0 kg.ha^{-1} at 3DAS *fb* early post-emergence bispyribac sodium@ 25 g.ha^{-1}at 15 DAS,W_6 -hand weeding twice at 20 and 40 DAS-were assigned. It was found that direct seeded rice consumed less consumptive use of water with higher water productivity. Among the irrigation scheduling, alternate wetting and drying irrigation when water level drops to 15 cm below soil surface registered higher water productivity. Higher grain yield was recorded when water level drops to 10 cm below soil surface with combination of PE pendimethalin @1.0 kg / ha at 3DAS *fb* EPOE bispyribac sodium@ 25 g / ha at 15 DAS.

Keywords: Water use efficiency, water productivity, Irrigation, pendimethalin, bispyribac sodium

Introduction
Rice (*Oryza* sativa L.) is the staple food of India and more than 2/3rd population depends on rice and rice derive products for food. It is grown in 43 million hectares with a productivity of 2700 kg.ha^{-1} (ICAR-Annual Report 2020). Traditionally, major growing area is under wetland transplanted ecosystem which requires huge labour for nursery raising, puddling and transplanting operations. But under rainfed ecosystem, direct-sown rice is an alternative to conventional rice for *kharif* season. Direct seeding of rice offers certain advantages like labour saving by 34 percent (Ho and Romli, 2000) [4]., fast and easy establishment less drudgery, early maturity of crop by 7-10 days, less water requirement to a tune of 12-35% (Kumar and Ladha, 2011) [6], high tolerance to water deficit, often higher yield, low production cost with a saving of 29 percent (Ho and Romli, 2000) more profit, and also reduced methane emission (Balasubramanian and Hill, 2002) [1].
Currently about four billion world population is under the threat of water shortage (Mekonnen and Hoekstra 2016) [8].This situation demands minimizing water use and increasing productivity for growing population. With an idea to develop a suitable irrigation management practices in semi-dry DSR, an experiment was devised with the objectives of finding out the total consumptive use of wateron water productivity and yield of rice InDirect Seeded Rice (DSR) Under Semi-Dry Conditions.

Materials and Method
The experimental trail was conducted at Agricultural Research Station, Paramakudi situated at 9°21 N latitude and 78° 22 E longitudes with an altitude of 39.83 mean sea level. During the cropping season 2018-2019 the crop received a total rainfall of 407.2 mm in 20 rainy days. The maximum temperature ranged from 29.6 to 35.7 °C and the minimum temperature ranged from 16.2 to 21.6 °C. The soil type is clay loam with pH of 8.0. Experimental field was

homogeneously fertile with even topography and uniform textural make up and was attached to the main irrigation channel connecting the farm tube well for life saving irrigation. Proper drainage facility was also provided in order to remove excess water during the experimental period.

Experimental material

Field water tube was used for monitoring the water level drop to ease the process of determining the irrigation timing. The tube was made of 20, 25 and 30 cm long PVC pipe with a diameter of 15 cm, perforated on all sides. The tubes were placed vertically at 10, 15 and 20 cm depth, inside the soil in a flat area of the field close to a bund for easy monitoring of water level drop in the tube

The test crop was rice (Anna (R) 4 variety). The weedicides used were pendimethalin (as pre emergence), bispyribac-sodium (as early post-emergence), star weeder for manual weeding and hand weeding. The experiment was laid out in split-plot design with eighteen treatment combinations and replicated thrice. Irrigation management consists of three treatments *viz.*, I_1- Irrigation when water level drops to 10 cm below soil surface, I_2 - Irrigation when water level drops to 15 cm below soil surface, I_3 - Irrigation when water level drops to 20 cm below soil surface which formed the main plots. In subplots weed management treatments such as W_1 -Pre-emergence pendimethalin @ 1.0 kg.ha^{-1} at 3 days after sowing (DAS) *fb* (followed by) one hand weeding at 30 DAS,W_2 – early post-emergence bispyribac sodium 25 g.ha^{-1} at 15 DAS *fb* one hand weeding at 30 DAS,W_3-PE pendimethalin @ 1.0 kg.ha^{-1} at3DAS *fb* star weeder at 30DAS, W_4- early post-emergence bispyribac sodium 25 g.ha^{-1} at 15DAS *fb* star weeder at 30DAS,W_5-Pre-emergence pendimethalin@1.0 kg.ha^{-1} at 3DAS *fb* early post-emergence bispyribac sodium@ 25 g.ha^{-1}at 15 DAS,W_6 -hand weeding twice at 20 and 40 DAS-were assigned.

Each individual plot was separated with buffer cannels for proper maintenance of the treatments. The irrigation water was measured with the parshall flume. In order to evaluate the effect of crop establishment methods and irrigation scheduling practices on water use efficiency (WUE), water productivity and yield, the data were statistically analyzed using "Analysis of variance test". The critical difference at 5% level of significance was calculated to find out the significance of different treatments over each other (Gomez and Gomez, 1984) [3]. The total consumptive use of water, water use efficiency and water productivity were calculated as per the standard procedure

Total water consumed

The total water consumed was computed by summing the irrigation water applied and the effective rainfall. Effective rainfall during the field experiment was calculated based on quantity of water received and quantity of rainfall water drained.

$$W = ND + Re$$

Where

W = Total water consumed in mm
N = Number of irrigation
D = Applied water depth for each irrigation (mm)
Re = Effective rainfall (mm), during the cropping period

Water productivity

Water productivity is a function of total water used and grain yield produced by the crop that is expressed in kg m^{-3} (Chapagain and Yamaji, 2010) [2].

$$\text{Water productivity} = \frac{\text{Grain yield (Kg ha}^{-1})}{\text{Total water consumed (m}^3)}$$

Results and Discussion

Effect on water Total water consumed

Consumptive water use constitute the amount of water required to meet the demands of evapotranspiration and metabolic activities of rice together, which also take effective rainfall during the growing season. The results obtained from the study are presented in Table.1

Among the irrigation management practises Irrigation when water level drops to20 cm below soil surface (I_3) consumed minimum water (407.9 and 480mm during *rabi* 2017 and *rabi* 2018 respectively) as compared to other treatment. The higher I_1- Irrigation when water level drops to 10 cm below soil surface recorded higher consumed water of (507.9 and 580.6 mm during 2017 and 2018). This was lined with Santheepan and Ramanathan (2016) [11].

No impact was created by weed management with respect to consumptive use.

Table 1: Effect irrigation and weed management on consumptive use (mm) 2017 and 2018

Treatments	Consumptive use (mm) 2017 -2018				Consumptive use (mm) 2018-2019			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
W_1	507.9	422.1	407.9	446.0	580.6	530	480	530.2
W_2	507.9	422.1	407.9	446.0	580.6	530	480	530.2
W_3	507.9	422.1	407.9	446.0	580.6	530	480	530.2
W_4	507.9	422.1	407.9	446.0	580.6	530	480	530.2
W_5	507.9	422.1	407.9	446.0	580.6	530	480	530.2
W_6	507.9	422.1	407.9	446.0	580.6	530	480	530.2
Mean	507.9	422.1	407.9		580.6	530	480	

Effect on water productivity (WP)

Water productivity is indicated as the unit quantity of water used to produce per unit of grain yield.Higher water productivity (WP) could be increased either by increasing yield or by maintaining the yield level with reduced quantity of water input. The WP was significantly influenced by irrigation and weed management practices during both the seasons. WP obtained from the study is presented in Table.2.

Irrigation when water level drops to 15 cm below soil surface (I_2) required lesser quantity of water to produce per unit quantity of grain yield of (0.83 and 0.63 kg m^{-3}) respectively during *rabi* 2018 and *rabi* 2019which was on par with I_1- Irrigation when water level drops to 10 cm below soil surface WP of (0.75 and 0.62 kg m^{-3}) and it was followed by

Irrigation when water level drops to20 cm below soil surface.This findings were in accordance with Santheepan and Ramanathan (2016) [11] and Sureshkumar and Pandian (2017) [12]

Among weed management treatments, Pre-emergence pendimethalin@1.0 kg.ha^{-1} at 3DAS *fb* early post-emergence bispyribac sodium@- 25 g.ha^{-1}at 15 DAS registered higher WP of (0.89 and 0.72 kg m^{-3}) respectively during *rabi* 2017, *rabi* 2018was followed by early post-emergence bispyribac sodium 25 g.ha^{-1} at 15 DAS *fb* one hand weeding at 30 DAS. The lowest WP where accounted with PE pendimethalin @ 1.0 kg.ha^{-1} at3DAS *fb* star weeder at 30DAS.

Among irrigation and weed management practices recorded considerable interaction with each other. Irrigation when water level drops to 15 cm below soil surface combined with Pre-emergence pendimethalin@1.0 kg.ha^{-1} at 3DAS *fb* early post-emergence bispyribac sodium@- 25 g.ha^{-1} (I_2W_5) recorded higher water productivity during both the seasons of two year experimentation. The lower water productivity was observed with Irrigation when water level drops to 20 cm below soil surface combined with PE pendimethalin @ 1.0 kg.ha^{-1} at3DAS *fb* star weeder at 30DAS (I_3W_3) during *rabi* 2017 and 2018 season of two year study.The present study findings were in agreement with those of Sangavi and Porpavai (2018) [10]

Table 2: Effect of irrigation and weed management on water productivity (kg/m^3) of semi dry direct seeded rice during *rabi* 2017 and 2018

Treatments	Water productivity (Kg/m^3) -2017				Water productivity (Kg/m^3) -2018			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
W_1	0.76	0.84	0.80	0.80	0.62	0.64	0.63	0.63
W_2	0.81	0.90	0.84	0.85	0.67	0.67	0.68	0.67
W_3	0.65	0.72	0.61	0.66	0.54	0.53	0.49	0.52
W_4	0.70	0.77	0.64	0.70	0.58	0.59	0.51	0.56
W_5	0.86	0.94	0.88	0.89	0.72	0.72	0.72	0.72
W_6	0.72	0.81	0.73	0.76	0.60	0.62	0.59	0.60
Mean	0.75	0.83	0.75		0.62	0.63	0.60	
	I	W	I at W		I	W	I at W	
SEd	0.017	0.008	0.022		0.010	0.006	0.015	
CD(*P=0.05)*	0.049	0.017	0.046		0.029	0.013	0.030	

Effect on grain yield (kg ha^{-1}) during *rabi* 2017 and 2018

On irrigation and weed management practices had a profound and significant influence on rice grain yield of *rabi* 2018, *rabi* 2019 (Table 3).

As regard the grain yield among the irrigation treatment (I_1) Irrigation when water level drops to 10 cm below soil surface recorded maximum yield of 3820 kg ha^{-1} and 3610 kg ha^{-1} during 2017 and 2018 *rabi* season. Irrigation when water level drops to 20 cm below soil surface (I_3) produced relatively lesser grain yield of 3064 and 2896 kg ha^{-1} during the cropping period. The increased yields might be due to better control of biotic and abiotic stresses. Thus roots function normally and resulted in increased nutrient availability throughout the cropping period which improved yield attributes such as productive tillers per m² and number of filled grain per panicle and thereby resulted in increased rice yield. This result was in line with Rolaniya *et al.* (2015) [9].

Among weed management the highest grain yield of 3980 kg ha^{-1} and 3810kg ha^{-1} during both a year was registered in (W_5) Pre-emergence pendimethalin@1.0 kg.ha^{-1} at 3DAS *fb* early post-emergence bispyribac sodium@- 25 g.ha^{1}at 15 DAS.(W_3) PE pendimethalin @ 1.0 kg.ha^{-1} at3DAS *fb* star weeder at 30DAS failed to control weed as the lowest grain yield (2952 kg ha^{-1} and 2771kg ha^{-1}) was recorded during the study.These corroborate with the findings of Madhukumar *et al.* (2013) [7].

The interaction was significant the maximum grain yield was registered by the treatment combination of Irrigation when water level drops to 10 cm below soil surface combined with pendimethalin@1.0 kg ha^{-1} at 3DAS *fb* early post-emergence bispyribac sodium@- 25 g.ha^{-1}at 15 DAS (I_1W_5) 4363 kg ha and 4172 kg ha. The lowest grain yield was achieved in Irrigation when water level drops to20 cm below soil surface along with PE pendimethalin @ 1.0 kg.ha^{-1} at3DAS *fb* star weeder(I_3W_3) (2487 kg ha^{-1} and 2347 kg ha^{-1}) respectively.

Table 3: Effect of irrigation and weed management on grain yield (Kg ha^{-1}) *rabi* during 2017 and 2018

Treatments	Grain yield (Kg ha^{-1}) 2017				Grain yield (Kg ha^{-1}) 2018			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
W_1	3874	3554	3265	3565	3610	3381	3002	3331
W_2	4122	3795	3445	3787	3873	3573	3263	3570
W_3	3327	3043	2487	2952	3149	2818	2347	2771
W_4	3565	3258	2601	3142	3381	3124	2529	2991
W_5	4363	3979	3598	3980	4172	3819	3441	3810
W_6	3666	3428	2987	3360	3474	3265	2854	3198
Mean	3820	3509	3064		3610	3330	2896	
	I	W	I × W		I	W	I ×W	
SEd	108.1	38.2	123.9		105.4	36.5	120.2	
CD (P=0.05)	300.10	78.10	252.94		292.53	74.59	245.38	

Conclusion

Direct dry seeded rice along with irrigation and weed management Irrigation when water level drops to 10 cm below soil surface combined with pendimethalin at the rate of 1.0 kg ha^{-1} at 3DAS *fb* early post-emergence bispyribac sodium@- 25 g.ha^{-1}at 15 DAS recorded higher grain yield which was found to be on par withIrrigation when water level drops to 10 cm below soil surface combined with early post-

emergence bispyribac sodium 25 g.ha^{-1} at 15 DAS *fb* one hand weeding at 30 DAS. Hence direct seeded rice is an alternate crop establishment method over puddled transplanted rice during labour and water scarcity situation.

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References

1. Balasubramanian V, Hill JE. Direct seeding of rice in Asia: emerging issues and strategic research needs for the 21st century. Direct seeding: Research strategies and opportunities 2002,15-39.
2. Chapagain T, Yamaji E. The effects of irrigation method, age of seedling and spacing on crop performance, productivity and water-wise rice production in Japan. Paddy and Water Environment 2010;8(1):81-90..
3. Gomez KA, Gomez AA. Statistical procedures for agricultural research. John Wiley & Sons 1984.
4. Ho NK, Romli Z. Impact of direct seeding on rice cultivation: lessons from the Muda area of Malaysia. Direct Seeding: Research Strategies and Opportunities 2002,398.
5. Kumar V, Ladha JK. Direct seeding of rice: recent developments and future research needs. Advances in agronomy 2011;111:297-413.
6. Madhukumar V, Murthy KK, Sanjay MT, Prashanth R, Sunil CM. Economics and crop weed competition for nutrients in aerobic rice (*Oryza sativa* L.) as influenced by weed control practices. Plt. Archives 2013;13(2):731-4.
7. Mekonnen MM, Hoekstra AY. Four billion people facing severe water scarcity. Science advances 2016;2(2):e1500323.
8. Rolaniya LK, Vivek MA, Kumar V, Punia M. Effect of irrigation scheduling and weed management on weed dynamics, water productivity and performance of dry seeded rice. Green Farm 2015;6:1281-6.
9. Sangavi S, Porpavai S. Impact of irrigation scheduling and weed management on water use efficiency and yield of direct dry seeded rice. Madras Agricultural Journal 2018;20;105.
10. Santheepan S, Ramanathan SP. Investigation on AWDI method with field watertube for rice production under SRI. International journal agriculture science research 2016;6(3):117-24.
11. Sureshkumar R, Pandian BJ. Water Production Parameters and Yield of Rice-Affected by Methods of Transplanting and Irrigation Management Practices. International journal of current microbiology applied science 2017;6(7):142-8.