

Original Research Article

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Effect of Sprinkler Irrigation Levels on the Performance of Rice Genotypes under Aerobic Condition

G. Senthil Kumar^{*}, T. Ramesh, K. Subrahmaniyan and V. Ravi

Tamil Nadu Rice Research Institute (TNAU), Aduthurai - 612 101, Tamil Nadu, India

**Corresponding author*

ABSTRACT

A Field experiment was conducted at Tamil Nadu Rice Research Institute, Aduthurai during *Kharif*, 2015 – 2016, to study the response of rice under different levels of irrigation through applied sprinkler system. Three levels of irrigation I₁ - Surface irrigation method, I₂ - Sprinkler irrigation at 125% pan evaporation, I₃ - Sprinkler irrigation 150 per cent pan evaporation in main plot and five rice entries viz., ADT 43, ADT 45, Anna (R) 4, CORH 3 and CO(R) 51 were evaluated in strip plot design with three replications. The results revealed that in aerobic rice cultivation, grain yield of 3844 kg ha⁻¹ was recorded in CORH 3 under surface irrigation method which was followed by CO(R) 51 with a grain yield of 3418 kg ha⁻¹. Under sprinkler irrigation levels at 150% pan evaporation in CORH 3 recorded 25.1% lesser grain yield (2875 kg ha⁻¹) when compared to surface irrigation method. Among the genotypes, CORH 3 hybrid performed better under sprinkler irrigation followed by CO(R) 51. The varieties ADT 45 and ADT 43 registered lower grain yield. Surface irrigation method utilized higher amount of irrigation water 1382 mm and 1335 mm whereas, sprinkler irrigation at 150% pan evaporation utilized 1097 mm and 1068 mm during *kharif* 2015 and 2016, respectively. Water saving of around 20.6 % and 20.1 % registered under sprinkler irrigation at 150% pan evaporation during *kharif* 2015 and 2016, respectively when compare to surface irrigation method.

Keywords

Irrigation levels,
Sprinkler irrigation,
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Yield, Economics

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Introduction

Rice is the staple food for 65% population in India. It occupies an area of 45 m.ha with an average production of 105 m.t. in India. Tamil Nadu is one of the biggest producers of rice in India. Demand for rice is growing every year and it is estimated that in 2025 AD the requirement would be 140 m.t. Rice cultivation requires large quantity of water and for producing one kg of rice, about 3000 – 5000 litres of water is required depending on

the method of rice cultivation. Because of the increasing demand for food with the increasing population growth and scarcity of water, rice producers face three major challenges: i) To face water scarcity, ii) To increase productivity, iii) To produce more rice with less water. Hence, it is necessary to develop an alternative rice production system that requires less water and increases water productivity. Micro irrigation techniques is one such tool that can reduce water use and at the same time increase yield. Drip and

sprinkler irrigation are needs to be tested for its suitability in rice cultivation. Sprinkler irrigation for rice production can be a water saving alternative to conventional flood irrigation (Mc Cauley, 1990). Recently, water scarcity in Cauvery delta zone threatens the rice cultivation which forced the farmers to find alternate methods of rice cultivation which requires lesser water. Under these situations, it is highly necessary to study the feasibility of sprinkler irrigation for rice cultivation. It is also essential to screen the suitable rice genotypes for sprinkler irrigation method under aerobic condition. Hence, a study was carried out to study the feasibility of sprinkler irrigation for rice cultivation in Cauvery delta zone.

Materials and Methods

Field experiments were conducted to study the feasibility of sprinkler irrigation for rice cultivation during *Kharif* season, 2015 and 2016 at Tamil Nadu Rice Research Institute, Aduthurai, Tamil Nadu. The field trial was laid out in strip plot design with three replications. The main plot treatments consisted of three levels of irrigation I_1 - Surface irrigation method, I_2 - Sprinkler irrigation at 125% pan evaporation, I_3 - Sprinkler irrigation 150 per cent pan evaporation and sub-plot treatments consisted of five rice entries *viz.*, ADT 43, ADT 45, Anna (R) 4, CORH 3 and CO(R) 51.

The experimental soil was clay loam in texture with pH 7.17, organic carbon 0.32% and available N, P and K was 178, 37, 244 kg/ha, respectively. In all the sprinkler treatments, first irrigation was given on the date of sowing through sprinkler (50 mm) for better soaking and germination of seeds and the next irrigation given based on the pan evaporation, measured by using USWB open pan evaporimeter. In surface irrigation method, first irrigation is given on the date of sowing

and next irrigation is given based on the soil moisture condition. Soil moisture was measured by using tensiometer in the field. Irrigation was given whenever tensiometer reading goes beyond 12 Kpa. Total water usage for each treatment was calculated by using water meter. Rainfall received during the cropping period is 141.4 mm and 212.6 mm and mean average temperature is 36.7⁰ C and 36.5⁰ C during 2015 and 2016, respectively. Economics of sprinkler irrigation levels were worked out by using the current market price of inputs and rice grain. All the recorded data were analysed statistically as per the method suggested by Gomez and Gomez (1984).

Results and Discussion

Growth and yield attributes

Growth and yield parameters of rice genotypes varied considerably under different levels of sprinkler irrigation and surface irrigation method (Table 1). Among the sprinkler irrigation levels, 150% pan evaporation registered higher plant height over lower levels. More number of panicles / m² (316) and number of filled grains / panicle (109) was recorded under surface irrigation method followed by sprinkler irrigation at 150% pan Evaporation. Among the different genotypes, CORH 3 recorded higher number of panicles / m² (327) followed by CO(R) 51. Under aerobic rice cultivation, application of sprinkler irrigation method produced lesser yield attributes when compared to surface irrigation method.

Grain yield

Irrigation levels influenced the grain yield significantly under aerobic rice cultivation (Table 2). Higher grain yield was recorded under surface irrigation method when compared to sprinkler irrigation levels.

Table.1 Growth and yield parameters of rice genotypes under different irrigation levels
(Mean of two years)

Treatment	Plant height (cm) at maturity stage	No. panicles/m ²	No. filled grains/panicle	No. ill filled grains/ panicle
Irrigation levels				
Surface irrigation	91.5	316	109	11
Sprinkler Irrigation at 125% PE	90.6	208	102	20
Sprinkler Irrigation at 150% PE	92.2	227	104	19
Mean	91.1	250	105	17
S.Em+	1.8	6.5	2.3	0.86
CD (p = 0.05)	NS	14	4	2
Genotypes				
ADT 43	88.6	243	102	22
ADT 45	89.4	264	103	21
Anna(R) 4	95.7	272	105	20
CORH 3	92.3	327	110	12
CO(R)51	87.2	321	108	13
Mean	90.6	285	106	18
S.Em+	2.5	8.2	2.1	0.92
CD (p = 0.05)	5.7	16	4	2

Table.2 Grain yield (kg/ha) of rice genotypes as influenced under different irrigation levels
(Mean of two years)

Irrigation levels / Genotypes	ADT 43	ADT 45	Anna(R) 4	CORH 3	CO(R)51	Mean
Surface irrigation	2837	2987	3293	3632	3372	3225
Sprinkler irrigation at 125% pan evaporation	1932	1949	2113	2521	2306	2164
Sprinkler irrigation at 150% pan evaporation	1971	2062	2261	2735	2530	2312
Mean	2247	2333	2556	2963	2736	
	Irrigation	Variety	Irrigation x variety			
S.Em+	112	125	213			
CD (P = 0.05)	227	256	437			

Table.3 Water usage and water saving under different irrigation levels in
rice under aerobic condition

Irrigation levels	<i>Kharif, 2015</i>		<i>Kharif, 2016</i>	
	Total water used (mm)	Water Saving %	Total water used (mm)	Water Saving %
Surface irrigation	1382	-	1335	-
Sprinkler Irrigation at 125% pan evaporation	1052	23.9	1022	23.5
Sprinkler Irrigation at 150% pan evaporation	1097	20.6	1068	20.1

Table.4 Economics (Rs./ha) of rice genotypes as influenced by irrigation methods (mean of two years)

Irrigation levels	ADT 43			ADT 45			Anna(R) 4			CORH 3			CO(R)51		
	CC	GR	B:C ratio	CC	GR	B:C ratio	CC	GR	B:C ratio	CC	GR	B:C ratio	CC	GR	B:C ratio
Surface irrigation	30376	42555	1.41	30376	50624	1.67	30376	53396	1.76	30376	64988	2.13	30376	47852	1.99
Sprinkler irrigation at 125% pan evaporation	35214	28980	0.82	35214	27678	0.79	35214	28518	0.81	35214	37968	1.08	35214	36064	1.02
Sprinkler irrigation at 150% pan evaporation	36312	29565	0.81	36312	28476	0.78	36312	31094	0.86	36312	41650	1.14	36312	39788	1.09

(*Sprinkler unit initial cost is worked out based on depreciation value for the average of five years)

[*CC – Cost of cultivation; GR – Gross returns; B: C ratio – Benefit: Cost ratio]

Among the genotypes, CORH 3 hybrid recorded higher grain yield followed by CO(R) 51. In the interaction effect showed that, under surface irrigation method in CORH 3 recorded higher grain yield of 3632 kg/ha which was followed by CO(R) 51 with a yield of 3372 kg/ha. Whereas under sprinkler irrigation levels, sprinkler irrigation at 150% pan evaporation recorded 24.6% lesser grain yield (2735 kg/ha) when compared to surface irrigation method.

The reason is adoption of sprinkler irrigation method under aerobic rice cultivation could not be sufficient to meet out the yield potential; it might be due to the application of sprinkler irrigation during flowering period causes pollen shedding which resulted lesser grain yield.

Such findings were earlier reported by Bouman *et al.*, (2005) and Yoichiro Kato (2009).

Water usage

Quantity of irrigation water used for aerobic rice cultivation varied with irrigation treatments (Table 3).

Surface irrigation method utilized higher amount of irrigation water 1382 mm and 1335 mm whereas, sprinkler irrigation at 150% pan evaporation utilized 1097 mm and 1068 mm during *kharif* 2015 and 2016, respectively.

Water saving of around 20.6 % and 20.1 % registered under sprinkler irrigation at 150% pan evaporation during *kharif* 2015 and 2016, respectively when compare to surface irrigation method. In general, sprinkler irrigation level registered lesser amount of water usage when compared to surface irrigation method.

Economics

Economic analysis pooled over two years (Table 4) revealed that, Surface irrigation method in CORH 3 hybrid recorded maximum net returns of Rs. 34,612/- and benefit: cost ratio of 2.13, whereas under sprinkler irrigation levels at 150% pan evaporation recorded lesser net returns of Rs. 5338/- and benefit: cost ratio of 1.14 only. This is mainly due to yield increment under surface irrigation over sprinkler irrigation level at 150 % pan evaporation.

It can be concluded that, sprinkler irrigation level at 150 % pan evaporation under aerobic rice cultivation recorded lesser grain yield and net profit when compared to surface irrigation method during *kharif* season.

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