

Review Article

## Water Requirement of Rice Crop in Madras \*

by

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**Synopsis:** A brief review of the irrigation experiments on rice conducted in Madras State is presented. These experiments dealt with four aspects of the water requirement of rice i.e., intensity, frequency and quantum of irrigation water and the duty of water for rice crop in project areas. Smaller quantities of water in shorter intervals have produced higher yields in rice than larger quantities in longer intervals. In general two inches of standing water always maintained in the field has given maximum yields.

**Introduction:** The role of irrigation in the agricultural economy of a predominantly agricultural country like India cannot be over-emphasised. Great emphasis has therefore been laid on the development of irrigation projects in the Five Year Plans. The irrigation Projects involve heavy outlay and for proper and efficient utilisation of water resources a knowledge of the irrigation needs and water requirements of crops is necessary. A great deal of work has been done in India on water requirements of crops (Leather 1910-11; Rege 1937; Rege *et al.* 1943; Khanna *et al.* 1947; Ramiah *et al.* 1951; and Venkataraman 1956) However, although rice is the most important food crop of India and India has the largest irrigation system in the world, very little information is available regarding the water requirement of rice crop and whatever available is empirical and is not based on comprehensive research (Ghose *et al.*, 1956). The water requirement of rice is larger than that of any other crop of a similar duration and it varies with the soil, climate, cultivation practices and duration of the variety grown. An efficient use of water rests fundamentally on the extent of information on the optimum relationship between crop yield and water requirement.

In this paper a brief account of the irrigation experiments on rice conducted in Madras State is presented. Although the treatments were not based on the modern 'Water regime concept', useful information regarding the intensity, frequency and quantum of irrigation water required for rice crop to produce maximum yield is broadly indicated.

**Experiments and Results:** In Madras State irrigation experiments were

Aduthurai and Agricultural Research Station, Pattukottai. The experiments generally dealt with three aspects of the water requirement of rice (a) intensity or the depth of water in the rice field (2) the frequency or the interval of irrigation and (3) the quantum or the total quantity of water required for the rice crop. The first two aspects of the problem *Viz.*, depth of irrigation water and interval of irrigation were tackled together by conducting several experiments at these three centres during different seasons and years while the third aspect *Viz.*, total water requirement of rice crop was dealt with separately. Besides the above, duty of water experiments were also conducted in ryots' fields in ayacut areas as well as in Agricultural Research Stations. A brief account of the experiments conducted and results obtained is given below.

**DEPTH AND INTERVAL OF IRRIGATION:** In order to find out the optimum depth of water and the number of irrigations for producing the best yields in rice, experiments were laid out at Coimbatore, Aduthurai and Pattukottai. As the treatments of the experiments and the seasons in which they were laid out were different in each centre, the experimental results are presented for each Research Station separately.

(a) *Paddy Breeding Station, Coimbatore:* During 1938—'39 a systematic experiment with eight treatments and four replications in the Randomised Blocks Design was laid out for a period of five years. The treatments comprised two depths of water *viz.*, 2 inches and 4 inches and four intervals of irrigation *viz.*, once in, 6 and 9 days in the case of 2 inches depth and once in 6, 12 and 18 days in the case of 4 inches depth of water with another treatment *viz.*, standing water of 2 inches depth always maintained for 4 weeks and afterwards 4 inches of water once in 12 days and the control treatment of 2 inches depth of standing water always maintained in the plot.

The results were as follows:—

Year of experiment	Statistically significant or not	Conclusion
1938—'39	Yes	The control treatment was on a par with the treatments <i>viz.</i> , 2 inches of water once in 3 days,

Year of experiment	Statistically significant or not	Conclusion
1939—'40	No	Nil
1940—'41	No	Nil
1941—'42	No	Nil
1942—'43	Yes	The control treatment followed by treatment 2 inches of water once in 3 days gave the highest yields.

The general trend of results was that the control treatment *viz.*, 2 inches of water maintained always recorded as good a yield as 2 inches once in 3 days and 4 inches once in 6 days.

From 1943—'44 onwards another experiment with modified treatment was laid out and was conducted for five years till 1947—'48. This was also of Randomised Blocks Design with 4 replications. In this case, the depths of water were 1 inch, 2 inches, 3 inches and 4 inches with intervals of irrigation i. e., once in  $3\frac{1}{2}$  days in the case of 1 inch depth and once in 7 days in the case of 2 inches, 3 inches and 4 inches depth. The control treatment was the same *viz.*, 2 inches standing water always maintained as practised by cultivators. The experiments failed due to adverse seasonal conditions during two years *viz.*, 1945—'46 and 1947—'48 and the results of the experiments were not statistically significant in the other three years. The trend of the results however indicated that 2 inches of water always maintained (control treatment) recorded in general the highest yield.

(b) *Agricultural Research Station, Aduthurai*: During 1937—'38 an irrigation experiment with eight treatments and four replications in the Randomised Blocks design was laid out. The depth of water taken for the treatments were 1 inch,  $1\frac{1}{2}$  inches, 2 inches and  $2\frac{1}{2}$  inches with intervals of once in four days and eight days between irrigations. The results indicated that addition of 1 inch depth of water at 4 days interval or 2 inches at 8 days interval gave best yields.

From 1938—'39 onwards for a period of five years a modified experiment with 8 treatments and 4 replications in the Randomised Blocks Design

4 inches depth of water once in 12 days with the control treatment i. e., irrigation given as and when required so that 2 inches of water was always maintained in the field.

Although the results were not significant in all the five years the indications were that a depth of not more than 2 inches of water is required if supplied at 4 days interval and that 2 inches of water maintained always produced better yields.

From 1943—'44 to 1947—'48 for a period of five years an experiment was conducted with eight treatments and 4 replications in Randomised Blocks Design. This was more or less on the lines of the experiments conducted at Coimbatore during the same period. The treatments consisted of four depths of water i. e., 1 inch, 2 inches, 3 inches and 4 inches with intervals of irrigation once in  $3\frac{1}{2}$  days in respect of 1 inch depth and once in 7 days in respect of other depths of water with control i. e., 2 inches standing water always maintained as practised by the cultivators.

In all the five years the treatmental differences were not statistically significant. However the control treatment i. e., maintaining 2 inches of water always in the field recorded the highest yield.

(c) *Agricultural Research Station, Pattukottai*: From 1943—'44 to 1947—'48 an irrigation experiment on the lines conducted at Coimbatore and Aduthurai was laid out with eight treatments and 4 replications. The treatments comprised four depths of water i. e., 1 inch, 2 inches, 3 inches and 4 inches with 2 intervals of irrigation *viz.*, once in  $3\frac{1}{2}$  days in the case of 1 inch depth and once in 7 days in the case of other depths of water, the control being 2 inches standing water always maintained as practised by cultivators.

The experiment was conducted during all the three seasons and the results are presented below:

Years of trial	Season	Statistically significant or not	Conclusion or remarks
1	2	3	4

1	2	3	4
1944—'45	<i>Kuruwai</i>	No	Nil
	<i>Samba</i>	No	Nil
	<i>Thaladi</i>	Yes	The control-2 inches standing water gave significantly the highest yield.
1945—'46	<i>Kuruwai</i>	...	Crop failed due to adverse conditions.
	<i>Samba</i>	Yes	The control-recorded the maximum yield.
	<i>Thaladi</i>	No	Nil
1946—'47	<i>Kuruwai</i>	Yes	The control treatment <i>viz.</i> , 2 inches standing water maintained always gave significantly the highest yield than other treatments.
	<i>Samba</i>	Yes	The control recorded higher yields than the other treatments.
	<i>Thaladi</i>	No	Nil
1947—'48	<i>Kuruwai</i>	No	Nil
	<i>Samba</i>	No	Nil
	<i>Thaladi</i>	Yes	The control-2 inches standing water recorded the maximum yield.

In the years and seasons when the results attained the level of statistical significance, it was found that the control treatment where 2 inches of standing water was maintained throughout, has recorded significantly higher yield over the other treatments.

*Total water requirements:* An experiment was conducted from 1948-'49 to 1950-'51 for a period of three years in the three Rice Research Centres at Coimbatore, Aduthurai and Pattukottai. The experiment had 12 variants in a split plot design with 4 replications.

MAIN PLOT TREATMENTS: Three times of planting at weekly intervals.

*First batch*

*Second batch*

*Third batch*

First planting

Planting one week after

Planting one week after

At Coimbatore the experiment was conducted in the main season only.

At Aduthurai the experiment was conducted in the main season during 1948-'49 and in all the three seasons i. e., first crop (*Kuruvai*) second crop (*Thaladi*) and the main crop (*Samba*) in the other two years.

At Pattukkotai, the experiment was conducted in the *Kuruvai* and *Samba* seasons for all the three years.

At Coimbatore, the results showed that 'Z' test was satisfied for the "quantities of water" and not for the time of planting in all the seasons. The interaction was however significant. Treatment 67 inches of water recorded the highest yield expressed as yield of grain per acre inch. In the interaction, the treatment with 80 inches of water gave the highest yield in the first planting while in the second and third plantings, the treatment with 80 inches of water occupied the third and fourth places respectively. At Aduthurai, the results of the experiments were not statistically significant for quantities of water and interaction in all cases and significant for intervals of planting during *Kuruvai* 1949-'50. Thus no conclusive results could be obtained from this trial. At Pattukottai, the following results were obtained :

Year of trial	Season	Statistically significant or not	Conclusion or remarks
1948-'49	<i>Kuruvai</i>	No	Nil
"	<i>Samba</i>	No	Nil
1949-'50	<i>Kuruvai</i>	Yes	Third time of planting and 80 inches of water gave the highest yield.
"	<i>Samba</i>	...	Crop was a failure.
1950-'51	<i>Kuruvai</i>	Yes	Under the first planting the treatment receiving 106 inches and 67 inches gave higher yields than the rest.
"	<i>Samba</i>	Yes (Significant)	In the first planting the treatment receiving 106 inches, in the second

DUTY OF WATER: Experiments on duty of water for rice were conducted in the old Bhavani channels from 1930-'34 and in Agricultural stations from 1938 onwards. The results are furnished below

Name of Station	Season	Duty of water
1. Tadepalli channel (old Bhavani Ayacut)	Main crop	40
2. Aduthurai	<i>Kuruvai</i>	68
	<i>Thaladi</i>	80
	<i>Samba</i>	76
3. Pattukottai	<i>Kuruvai</i>	37
	<i>Thaladi</i>	67
	<i>Samba</i>	57
4. Central Farm, Coimbatore	Single crop (Main season)	51

Conclusion: With regard to depth and interval of irrigation, it is seen that at Pattukottai the control treatment *viz.*, 2 inches of standing water always maintained in the field gave the maximum yield in all seasons and years when the results were statistically significant. At Coimbatore also the control treatment gave higher yields than most other treatments. However the treatments 2 inches of water once in 3 days, 4 inches once in 6 days and 2 inches maintained for 4 weeks and thereafter 4 inches of water once in 12 days were found to give higher yields but they were on a par with the control treatment. At Aduthurai also the trend of results was in favour of 2 inches of standing water always maintained in the field. The results obtained at Nagina in Uttar Pradesh reported by Ghose *et al* (1956) that a small dose of 2 inches given every 4th day gave the best yield conforms more or less to the trend of results obtained here. As regards the total water requirement of rice crop in Madras the indications are that it may be between 67 acre inches and 93 acre inches depending upon the nature of the soil. Ramiah and Vachhani (1951) have reported that a medium duration rice crop at Cuttaek conditions requires 75 acre inches of water. In 1961 has fixed the average requirement of rice varieties of

**Summary :** From the experiments conducted at the three centres and in ryots' fields confirmatory results could not be obtained because in most cases the treatmental differences were not significant and in others the results were not consistent. However the following inferences are broadly indicated :

1. The control treatment *viz.*, two inches of water maintained always in the field gave highest yields in rice in Madras and in general smaller quantities of water in shorter intervals have recorded higher yields than larger quantities in longer intervals.

2. The total water requirement of rice crop in Madras is between 67 acre inches and 93 acre inches in the soil and climatic zones represented by Coimbatore, Aduthurai and Pattukottai.

3. The mean duty of water for rice in Madras is 60. The irrigation experiments so far conducted in Madras State bring out clearly the need for having more comprehensive experiments on the water requirement of rice crop under agro-climatic zones of varied soil types and different irrigation systems in Madras for maximum crop production. Bhaktavatsalam (1959) while reviewing the work in Madras has stated in the report of the Committee on Agricultural Production, Madras as follows. "It is necessary to conduct fresh experiments to obtain definite results regarding the optimum quantities of water and the optimum intervals between irrigation to obtain the maximum yield from one acre of land and to get the maximum return from one cubic foot of water".

The future experiments may be planned in such a way that not only the yield response of rice to the intensity, frequency and quantum of irrigation water is determined but also the consumptive use of water at different phases of crop growth like seedling stage preflowering stage, flowering stage, ripening stage and harvest. The recent experiments at Cuttack and Delhi indicate that submergence of the transplanted crop is not necessary and the crop irrigated at 50 per cent moisture availability gives as high yield as under submerged conditions. This clearly indicates that the future experiments should be based on the different moisture regimes in combination with treatments for control of weeds which may come up under non-submerged conditions. Fertilizer levels with irrigation treatments may also be included so that the efficient use of irrigation water with the best utilization of fertilizers for maximum yield can be determined.



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