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Response of transplanted rice (*Oryza sativa*) to planting time and irrigation schedule

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ABSTRACT

A field experiment conducted for 2 years with transplanted rice (*Oryza sativa* L.) in clay-loam soil showed that 15 July planting gave higher yield as compared with 30 June and 30 July transplantings. Irrigation schedule had no significant effect on grain yield and yield attributes. Significant reduction in yield was not observed even up to 7-day drying period after disappearance of 7 cm ponded water when compared with 1-day drying period. However, there was a saving of 45% irrigation water compared 1-day drying of ponded water. However, higher water-expense efficiency was achieved with 1-day or 5-day drying period.

Rice (*Oryza sativa* L.) is the staple food of Chhattisgarh in Madhya Pradesh. Being a semi-aquatic plant it requires more water than other crops. However, during rainy season when humidity and temperature both remain high, intermittent submergence is advocated to save irrigation water and ultimate the cost (Hukkeri and Sharma, 1980; Jha *et al.*, 1981; Prasad and Sharma, 1984). A short-drying period during growth and reproductive stages might create more conducive condition for higher yield.

The double-cropping system is gaining popularity with the increase in irrigation potential of different commands in Chhattisgarh. However, the sowing of winter crops is delayed considerably due to late harvest of rainy-season (*kharif*) rice resulting substantial reduction in yields of winter-season (*rabi*) crops. Nevertheless, to overcome the above situation, advancement in rice planting helps vacate the field in time for winter sowing. In view of this, the present investigation was undertaken to assess the effect of planting time under different water regimes of transplanted rice.

MATERIALS AND METHODS

The experiment was conducted during rainy season of 1991–92 at Regional Agricultural Research Station, Bilaspur. The experiment was laid out in split-plot design with 3 planting dates, viz. 30 June, 15 July and 30 July, as main plots and 4 irrigation schedules, viz. 1, 3, 5 and 7 days drying after disappearance of 7 cm ponded water, as subplots, replicated thrice. The soil of the experimental site was clay loam with 0.76% organic carbon, 218 kg/ha available nitrogen, 20.05 kg/ha available P_2O_5 and 657 kg/ha available K_2O, having pH 7.3. The electrical conductivity of the soil was 0.246 mmhos/cm at 25°C. Seedlings of same age of 'IR 36' rice were planted as per treatment with a common dose of 80, 50 and 30 kg N, P_2O_5 and K_2O/ha respectively. Half N with

Table 1. Effect of transplanting time and irrigation schedule on growth and yield attributes of rice

Treatment	Plant height (cm)		Tillers/m row		Panicle length (cm)		Grains/ panicle		1,000-seed weight (g)	
	1991	1991	1991	1992	1991	1992	1991	1992	1991	1992
Transplanting date										
30 June	81.55	81.18	108.44	103.01	21.58	20.23	98.00	110.00	24.62	24.35
15 July	84.63	83.75	117.45	116.22	21.55	21.99	100.25	109.80	24.55	24.90
30 July	82.49	79.40	18.00	15.31	22.00	21.02	98.10	99.20	24.20	24.85
CD (P = 0.05)	2.52	3.72	8.38	6.24	NS	0.61	1.05	1.01	NS	NS
*Irrigation schedule**										
I_1	83.91	84.04	110.47	11.28	21.78	21.65	98.40	99.50	24.25	24.15
I_3	83.60	81.87	113.31	107.78	22.00	21.91	98.25	98.10	24.15	24.30
I_5	82.66	81.00	110.72	108.01	21.66	20.57	98.00	99.20	24.40	24.30
I_7	81.40	79.89	108.61	105.64	21.41	20.61	97.30	98.20	24.45	24.65
CD (P = 0.05)	NS	2.14	NS	NS	NS	0.94	NS	NS	NS	NS

*I_1, I_3, $I_5$and I_7 represents ponding of 7 cm water after 1, 3, 5 and 7 days during respectively

full dose of P_2O_5 and K_2O were applied at transplanting and remaining N was top-dressed in 2 equal splits, at maximum tillering and at panicle-initiation stages. Parshall flume was used to measure water. Water regime was maintained till 10 days before physiological maturity of the crop.

Considering the nature and data, the constants of quadratic crop-production function was worked out. From the data generated in this study the following quadratic production function was developed.

Quadratic crop production function:

$$Y = a + bx + cx^2$$

where X is the seasonal water expense (mm); Y is the crop yield (q/ha); and a, b, c, are the constants.

RESULTS AND DISCUSSION

Yield and yield attributes

During both the years, highest yield was recorded at 15 July transplanting which was significantly superior to both 30 June and 30 July transplantings. Under these dates, number of effective tillers and grains/panicle were significantly less resulting poor yield (Table 1). The weather prevailing during the crop period had a considerable influence on yield and yield attributes. Crop transplanted on 30 June experienced more number of cloudy days during panicle-initiation and flowering stages, and thereby adverse effect on fertilization. This was reflected through number of grains/panicle which were significantly less than those under 15 July transplanting (Table 1). Harvest index was also highest under 15 July transplanting (0.48). Normal transplanting significantly influences grain as well as straw yields (Panday and Agrawal, 1991; Mahapatra *et al.*, 1974). Krishna Kumar and Subramaniam (1989) also reported that 16 July transplanting gave higher grain yield than other dates.

Different irrigation schedules did not in-

Table 2. Effect of planting time and irrigation schedule on yield and harvest index of rice

Treatment	Grain yield (kg/ha)			Straw yield (kg/ha)			Total biomass (kg/ha)	Harvest index
	1991	1992	Mean	1991	1992	Mean		
Transplanting date								
30 July	5,013	5,540	5,276	5,853	6,082	5,967	11,243	0.47
15 July	6,326	6,665	6,495	7,082	7,070	7,076	13,571	0.48
30 July	5,192	4,725	4,958	6,536	5,410	5,973	10,931	0.45
CD (P = 0.05)	424	220	355	502	734	681		
Irrigation schedule								
I_1	6,661	5,816	5,733	6,826	6,366	6597	12,330	0.46
I_3	5,666	5,690	5,678	6,687	6,266	6467	12,154	0.47
I_5	5,392	5,626	5,509	6,447	6,180	6313	11,822	0.46
I_7	5,333	6,296	5,314	6,267	5,976	6096	11,410	0.46
CD (P = 0.05)	NS	NS	NS	NS	NS	NS		

Details of irrigation schedule are given under Table 1

fluence grain yield and yield attributes. Even up to 7-day drying period after disappearance of ponded water had no adverse effect on grain yield (Tables 1, 2). The reason for the absence of differential response to different irrigation schedule was the high and evenly-distributed rainfall during July–September. It was also observed that during peak period, when the water requirement of the crop is higher than early and later parts of the crop, there was excess rain compared with total evaporation for the period. Moreover, the water requirement during later part of the reproductive phase is comparatively less, therefore even 7-day drying period after disappearance of ponded water did not adversely affect the grain yield of early variety `IR 36' (Table 2). However, the highest harvest index (0.47) was recorded where irrigations were applied after 3 days of disappearance of ponded water (Table 2).

Water expense and water-expense efficiency

Total water expense including effective rains was higher under 30 July transplanting during both years (Table 3). This is mainly due to water received through rains was not sufficient to cause physiological maturity under late-transplanted condition. Therefore, it required more number of irrigations to mature, since there was no rains after mid-September. However, during both years the water-expense efficiency was higher when the transplanting was done on 15 July (Table 3).

The effective rainfall received during the crop season was higher with the increase in days of drying. Total water expense was highest when irrigations were applied after 1-day drying of ponded water than 3, 5 or 7 days drying of ponded water. On the basis of irrigation water applied (exclusive of rain water), saving of irrigation water was 21, 34 and 45% with 7-day drying period over 1, 3 and 5-day drying periods after the disappearance of ponded water (Table 3).

Correlation coefficients for different irrigation regimes are very low, indicating inability of this function to represent water production function of rice except 7-day

Table 3. Water-use components and water-expense efficiency (WEE) as affected by planting date and irrigation schedule in rice

Treatment	Water applied (cm)		Total water expense (cm)		WEE (kg/ha-cm)	
	1991	1992	1991	1992	1991	1992
Planting date						
30 June	36.00	26.25	89.87	106.67	55.78	51.93
15 July	43.50	28.00	98.70	98.87	64.09	67.41
30 July	54.75	40.25	105.37	112.52	49.27	44.84
*Irrigation schedule**						
I_1	46.00	33.25	106.83	111.96	52.90	51.95
I_3	35.00	28.00	97.00	107.66	58.41	52.85
I_5	31.50	21.00	96.53	102.46	55.86	54.91
I_7	24.50	19.25	91.56	102.10	58.25	51.87

*Details of irrigation schedule are given in Table 1

Table 4. Water production function in rice

*Irrigation schedule**	Constant			
	a	b	c	R^2
I_1	−645.60	13.11	−0.0606	0.532
I_3	−641.30	14.38	−0.0732	0.680
I_5	−774.00	17.11	−0.0878	0.464
I_7	−993.28	49.03	−0.251	0.838

*Datails of irrigation schedules are given under Table 1

drying period after disappearance of ponded water (Table 4). This function shows that increasing trend of water applied to early-maturing rice 'IR 36' does not increase the yield significantly under evenly distributed rainfall.

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