

## Performance of puddling equipment and self-propelled rice transplanter in crop establishment and grain yield of rice (*Oryza sativa*)

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Received: January 2000

### ABSTRACT

A study was undertaken at Rice Research Station, Kaul, Haryana, during the rainy seasons of 1998 and 1999, to find out the suitable level of puddling and sedimentation period requirement for the smooth working of the transplanter in rice (*Oryza sativa* L.). Three puddling methods, viz. farmers' practice (2 puddling harrow), Chinese power tiller (once) and rotavator (once), were tried along with 3 sedimentation periods (2, 3 and 4 days after puddling). Better quality of puddling was obtained in the plot prepared by rotavator over the other methods. This might be due to higher puddling index (61.5 and 50.4%) and puddling depth (10 and 11.7 cm) during 1998 and 1999 respectively. Bulk density in the upper layer (0–15 cm) was found to be lower than 15–30 cm depth irrespective of puddling methods. Number of hills/m<sup>2</sup>, seedlings/hill and missing hills/m<sup>2</sup> did not vary significantly with puddling methods and sedimentation period. However, missing hills/m<sup>2</sup> were higher with rotavator puddling over other methods of puddling. These were also higher with sedimentation period of 2 days over 3 and 4 days of sedimentation. Significantly higher grain yield (68.15 and 66.11 q/ha) was recorded from the field puddled with rotavator than other methods of puddling, during both the years. Significantly higher grain yield and panicles/m<sup>2</sup> were recorded with 3 and 4 days sedimentation period than 2 days during 1999 of study.

**Key words :** Puddling index, Sedimentation period, Bulk density, Rotavator, Power tiller

Haryana is sharing in central pool of food by producing rice over its own need. Generally, rice is planted by manual random transplanting in the state. In many cases the proper plant population is not maintained by hired labour and consequently yield is reduced (Singh and Garg, 1976). For timeliness of transplanting and

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to optimize yield, dependence on the labour needs to be minimized. Rice yield increased by 6.7–15.8% with use of transplanter compared to the usual practice of random planting. The plant population/m<sup>2</sup> and tillers/hill are distinctly higher with machine transplanting (Garg and Sharma, 1984). Shallow and uniform water level, hard mud, well-levelled field are prime requirement along with mat-type nursery for successful transplanting rice by machine (Parida and Das, 1977).

Surface hardness of puddle, which affects performance of transplanter, depends on soil type, level of land preparation and time of sedimentation of puddle after final levelling. Therefore a study was undertaken with different puddling methods and sedimentation periods for successful working of self-propelled paddy planter.

### MATERIALS AND METHODS

A field experiment was conducted at Rice Research Station, Kaul, Haryana, during rainy season (*kharif*), 1998 and 1999. Three puddling methods, viz. P<sub>1</sub>, conventional (2 puddling harrow + planking); P<sub>2</sub>, power tiller Chinese (once) + planking; and P<sub>3</sub>, rotavator (once), and 3 sedimentation periods, i.e. transplanting after 2 (S<sub>1</sub>), 3 (S<sub>2</sub>) and 4 (S<sub>3</sub>) days of puddling, were tested in split-plot design. Puddling methods were kept in main plots, whereas sedimentation period in subplots. Mat-type nursery of 'IR 64' rice was raised and transplanting operation was started on 4 and 8 July during 1998 and 1999 respectively. Soil was clay loam in texture with bulk density of 1.55 g/cc and infiltration rate of 1.51 cm/hr, soil pH was 8.1 with EC 0.28 mmhos/cm and

organic carbon 0.38%. Fertilizer dose of 150 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 25 kg ZnSO<sub>4</sub>/ha was applied to the field. Butachlor @ 1.5 kg/ha was used to overcome the weed problem. Observations on bulk density, puddling parameters and seedling establishment were recorded along with grain yield and its attributes.

## RESULTS AND DISCUSSION

### *Soil physical properties*

Better quality puddling was observed in the plot prepared by rotavator than the others (Table 1). This might be owing to higher puddling index and puddling depth during 1998 and 1999 respectively under P<sub>3</sub>. The bulk density in the upper layer, i.e. 0–15 cm, was lower than 15–30 cm depth.

### *Seedling establishment*

The number of hills/m<sup>2</sup> was more during 1998 than 1999 with different methods of puddling and sedimentation time (Table 2). Number of seedlings planted by the transplanter was less during 1998 than 1999. The seedlings missed/hill were 3.0–4.4 and 4.6–5.33 during 1998 and 1999 respectively. The above variation in the parameters of crop establishment was observed to be not significant. Therefore, the crop establishment was not much affected by the factors.

### *Yield and yield attributes*

Significantly higher grain yield was recorded from the plot puddled with rotavator (P<sub>3</sub>) than other methods of puddling. This might be owing to significantly higher panicles/m<sup>2</sup> under this treatment (P<sub>3</sub>). Other yield attributes, i.e. panicle weight, grains/panicle and test

**Table 1.** Soil physical properties of rice field as affected by puddling methods

Treatment	Puddling index (%)		Puddling depth (cm)		Bulk density (g/cc)			
					0-15 cm		15-30	
	1998	1999	1998	1999	1998	1999	1998	1999
P <sub>1</sub>	49.3	40.6	9.9	10.6	1.55	1.51	1.68	1.70
P <sub>2</sub>	53.0	42.4	8.4	10.2	1.50	1.48	1.64	1.65
P <sub>3</sub>	61.5	50.4	10.0	11.7	1.61	1.58	1.63	1.66

Treatment details are given in Materials and Methods

**Table 2.** Seedling establishment in rice as affected by puddling method and sedimentation period of 1998 and 1999

Factor	Hills/m <sup>2</sup>		Seedlings/hill		Missing hills/m <sup>2</sup>	
	1998	1999	1998	1999	1998	1999
<i>Puddling method</i>						
P <sub>1</sub>	31.3	32.3	2.33	3.78	3.50	4.66
P <sub>2</sub>	32.0	29.6	2.50	3.89	3.00	5.33
P <sub>3</sub>	30.6	30.0	2.33	3.33	4.40	5.00
<i>Sedimentation period</i>						
S <sub>1</sub>	31.0	29.6	2.33	3.89	4.00	5.33
S <sub>2</sub>	32.0	30.0	2.33	3.44	3.00	5.00
S <sub>3</sub>	31.3	30.3	2.50	3.67	3.50	4.66
CD (P = 0.05)	NS	NS	NS	NS	NS	NS

Treatment details are given in Materials and Methods

weight were not affected significantly due to different methods of puddling (Table 3). Sedimentation period had no significant effect on yield attributes during both the years except panicles/m<sup>2</sup> during 1999. Significantly higher grain yield was recorded with 3 and 4 days of sedimentation period than 2 days during the second year. Panicles/m<sup>2</sup> were also significantly higher with 3 and 4 days of sedimentation period during second year. Sedimentation period of 24 hr is required in

sandy-loam soils but puddling depth should not be more than 10 cm (Singh and Garg, 1976). Moreover, this period of 10 days is required for Korean rice planter in Pakistan (Khan *et al.*, 1979) and 4 days are sufficient for manual planter at IRRI in silty clay soil (Sharma, 1982).

The highest grain yield was recorded with the puddling by rotavator and then transplanting by self-propelled transplanter after 3 and 4 days of puddling during 1998 and 1999 respectively.

**Table 3.** Yield and its attributes of 'IR 64' rice as affected by puddling methods and sedimentation period

Factor	Grain yield (q/ha)		Panicles/m <sup>2</sup>		Panicle weight (g)		Grains/panicle		Test weight (g)	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
<i>Puddling method</i>										
P <sub>1</sub>	65.18	64.41	245	278	2.58	2.50	99	85	25.0	25.0
P <sub>2</sub>	66.18	64.61	246	280	2.60	2.54	99	87	24.9	25.3
P <sub>3</sub>	68.15	66.11	253	286	2.57	2.53	98	86	24.5	24.8
CD (P = 0.05)	1.46	1.32	6	5	NS	NS	NS	NS	NS	NS
<i>Sedimentation period</i>										
S <sub>1</sub>	66.35	63.40	249	276	2.62	2.57	100	87	24.4	25.0
S <sub>2</sub>	67.48	65.70	250	284	2.58	2.51	98	85	25.3	24.9
S <sub>3</sub>	66.06	66.04	245	284	2.55	2.50	98	86	24.7	25.1
CD (P = 0.05)	NS	1.10	NS	6	NS	NS	NS	NS	NS	NS

**Table 4.** Interaction effect of puddling methods and sedimentation period on grain yield of rice

Puddling	Sedimentation period (days)							
	S <sub>1</sub>		S <sub>2</sub>		S <sub>3</sub>		Mean	
	1998	1999	1998	1999	1998	1999	1998	1999
P <sub>1</sub>	66.50	62.91	65.50	65.32	64.05	65.00	65.18	64.41
P <sub>2</sub>	67.20	63.92	66.30	65.16	65.05	64.75	66.18	64.61
P <sub>3</sub>	65.38	63.27	71.15	66.61	69.10	68.36	68.53	66.11
Mean	66.35	63.40	67.48	65.70	66.06	66.04		
CD (P=0.05)			1998	1999				
P × S			NS	1.10				

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