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EFFECT OF PUDDLING EQUIPMENT ON PUDDLING CHARACTERISTICS UNDER PADDY CULTIVATION IN PUNJAB

Varinder Singh Saimbhi

Assistant Engineer, School of Energy Studies for Agriculture
P.A.U., Ludhiana 141004, Punjab, India

ABSTRACT

Stabilized puddled bed conditions are essential for an efficient operation of mechanical transplanting of paddy. Three different puddling treatments consisting of Cultivator & Planker (CP), Pulverizing roller attachment to cultivator (PR) and Rotavator (RT) were used to ascertain the puddling performance. Puddling was done after fields were flooded to saturation and 2 passes of cultivator & planker and pulverizing roller attachment each and 1 pass of rotavator were performed. Depth of puddle was 9.4, 12.4 and 11.5 cm in these treatments, respectively. Puddling index and average percolation rate was 65, 79, 84 % and 0.26, 0.13, 0.11 cm/h, respectively in CP, PR and RT treatments. Effective field capacity of different puddlers was 1.0, 0.8 and 0.3 ha/h, respectively in CP, PR and RT treatments. Transplanting of paddy was done by contract labour in each plot. Cost of puddling was 578.2, 390.0, 626.6 Rs/ha for CP, PR and RT, respectively. Average grain yield differs marginally in CP, PR and RT treatment.

Keywords: Paddy cultivation, Puddling equipments, Pulverizing roller attachment, Puddling index, Rotavator

INTRODUCTION

India is world's one of the largest producers of paddy (105.2 million tonnes) and more than one forth of the total cultivable area of the country is under paddy crop (Anonymous, 2014). In Punjab, area under rice has increased from 0.23 million ha in 1960-61 to 2.85 million ha in 2013-14 and annual production has increased from 0.22 to 11.27 million tonnes in 2013-14 (Anonymous, 1999 & Anonymous, 2014). This is due to use of high yielding varieties, improved weed and pest control, mechanization, assured marketing and Government support. Paddy can be

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grown both in upland and lowland conditions. In Punjab the cultivation of paddy in upland conditions is not very popular due to high percolation losses, long crop duration and problems of weeds. By cultivating paddy in lowland conditions, the above problems can be solved through various tillage practices. These tillage practices viz. compaction, subsurface barriers and puddling have been evaluated for decreasing percolation losses (Patel *et al.,* 1979; Sharma and De Datta, 1986; Aggarwal *et al.*, 1995).

Puddling is the most popular practice under transplanted rice culture as apart from reducing percolation losses, it helps to control weeds and creates soft medium for easy transplantation of rice seedlings (De Datta *et al.*, 1979). Puddling is considered to be prerequisite for the successful cultivation of paddy.

Puddling in general refers to the destruction of soil aggregates into ultimate soil particles at moisture content near saturation. It is also defined as the destruction of aggregated condition of the soil by mechanical manipulation within a narrow range of moisture contents above and below field capacity, so that soil aggregates loose their identity and converted into structurally more or less homogenous mass of ultimate particles. From farmer's point of view, puddling is simply the mixing of saturated soil with water to make it soft for transplanting and impervious to water (De Datta, 1981). Puddling helps in better growth of rice seedlings, maintain standing water conditions and check nutrient loss by reducing leaching besides controlling weeds.

Puddling is the process of churning of soil and water upto a depth of 10-15 cm. This causes soil particles to go under suspension for some time and then settle. The bigger particles settle first and then the finer ones with passage of time. Thus, the finer particles formed a layer at the top which helps in reducing infiltration (Singh, 2001).

In Punjab, farmers mainly use tractor-mounted cultivators for puddling operation. The shape of cultivators and its operation is such that it opens the soil but does not churn the soil for effective puddling. Planking generally follows the cultivator operations to seal the soil at the surface only. In fact, the rice crop requires a well-prepared soil with a compact layer of low infiltration rate below the root zone to impede water leaching. In comparison with cultivator operation, rotary tillage achieves the essence of puddling by virtue of its ability to pulverize to high degree and to transform compaction to lower layer of soil by scrubbing (Razzaq, 1987).

A study was therefore under taken to study the field performance of different tillage equipment in term of percolation losses and puddling index and the effect of these treatments on grain yield.

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MATERIAL AND METHOD

The plot size for each treatments were kept at 1500 m^2 (60mx25m) after harvesting of previous wheat crop, with medium weed infestation and about 7-10 cm of stubble height. There was no dry tillage runs performed in all the plots under different treatments. The field were flooded with water. The standing water was kept in the fields overnight for saturation. Three different puddling treatments consisting cultivator & planker (CP), pulverizing roller attachment to tractor drawn cultivator (PR) having two passes each and rotavator (RT) having one pass, were evaluated to ascertain the puddling performance. The sedimentation period was kept for 24 hours.

As prescribed by BIS (IS: 11531-1985) puddling index was calculated by taking the samples of soil-water suspension by immersing a glass tube upto a depth of 120 mm. Samples were collected from each plot immediately after puddling for all treatments. These samples were kept undisturbed for 48 hours to allow the soil particles to settle down. Volume of settled soil as well as total volume of soil-water suspension was recorded and puddling index was determined as follows:

$$P\ I = (V_s/V_t) \times 100 \qquad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where P I is Puddling Index expressed in per cent, V_s is volume of settled soil and V_t is the total volume of soil-water suspension.

Transplanting of paddy was done by random transplanting with contract labour in each plot. Percolation rate can also be taken as an index of puddling (Tyagi *et al.*, 1975). As the quality of puddle improves, the rate of percolation decreases. So, this method was adopted for comparing the puddling efficiency of different puddling implements.

RESULTS AND DISCUSSION

The percolation rate of water in all the plots with different tillage treatments were measured and shown in Table 1. The average infiltration rate for cultivator & planker (CP) treatment was found to be 0.26 cm/h after nine days. Similary, the average infiltration rate for pulverizing roller attachment to cultivator (PR) and rotavator (RT) treatments were found to be 0.13 cm/h and 0.11 cm/h. This shows that pulverizing roller attachment to cultivator (PR) and rotavator (RT) has performed better than conventional implements i.e. cultivator & planker (CP) in creating a better puddled conditions for saving of water.

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Table 1: Percolation rate of water

Sr. No.	Time in hours after previous reading	Infiltration rate in different fields Puddled with		
		Field I (CP)	Field II (PR)	Field III (RT)
1	24	9.3	5.0	5.52
2	24	8.1	3.6	3.8
3	24	7.1	3.7	2.7
4	24	6.8	3.1	2.4
5	24	6.6	2.8	2.2
6	24	5.5	2.9	2.3
7	24	4.7	2.4	1.9
8	24	4.3	2.5	1.8
9	24	4.1	2.2	1.8
Total	216	56.5	28.2	24.42
Average infiltration rate, cm/h		0.26	0.13	0.11

The depth of puddled bed, puddling index and cost of puddling was noted in all the treatments and given in Table 2. The depthe of puddling was found to be were also noted down in all the treatment and found to be highest in pulverising roller attachment treatment. The average cost for developing good puddled bed and field capacities were also calculated for all the treatments. The cost for developing good puddled bed was found to be least in the case of pulverizing roller attachment, whereas field capacity was higher in conventional method of cultivator & planker.

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Table 2: Depth of puddling, puddling index and cost of operation of different treatments.

Sr. No.	Parameters	Cultivator & Planker (CP)	Pulverizing Roller Attachment (PR)	Rotavator (RT)
1.	Depth of puddling, cm	9.4	12.4	11.5
2.	Puddling index, %	65	79	84
3.	Effective field capacity, ha/h	1.0	0.8	0.3
4.	Cost of operation, Rs/ha	578.2	390.0	626.6

The agronomic conditions like fertilizer application, plant protection and weed control were kept same for all the field plots under investigations. The agronomic yield data during the crop growth period was noted down in all the different treatments plots and shown in Table 3. The no. of hills/m^2 were as 18.8, 19.6, 19.4 hills/m^2 in CP, PR and RT treatments, respectively. The total number of tillers/hill and effective tillers/hill comes out to be 18.4 and 17.8, 20.6 and 20.2, 19.2 and 18.8 respectively for CP, PR and RT treatments. Not much difference in effective tillers/hill were observed in all the treatments. The number of grains/panicle, grain weightin grams/panicle and test weight in grams for CP, PR and RT treatments were found to be 182.2, 3.9 and 22.3; 180.4, 3.9 and 21.96; 183.6, 4.0 and 21.77 respectively. Higher no. of hills/m^2 effects the weight of grains/hill, no. of grains/panicle, weight of grains/panicle and a thousand grain weight. The grain yield in tonnes/ha were found to be 5.97, 6.09 and 5.85, respectively for CP, PR and RT treatments. The grain yield was observed as slightly but non significantly low in rotavator (RT) puddled field as compared to other treatments of puddling.

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Table 3: Data showing crop parameters of different puddling treatments.

Sr. No.	Parameters	Cultivator & Planker (CP)	Pulverizing Roller Attachment (PR)	Rotavator (RT)
1.	Plant ht. at harvest, cm	106.7	112.8	111.9
2.	Hills/m2	18.8	19.6	19.4
3.	Total tillers/hill	18.4	20.6	19.2
4.	Effective tillers/hill	17.8	20.2	18.8
5.	Panicle length, cm	24.4	25.1	25.1
6.	No. of grains/panicle	182.2	180.4	183.6
7.	Wt. of grains/panicle, gm	3.9	3.9	4.0
8.	Test wt, gm	22.30	21.96	21.77
9.	Grain yield/hill, gm	57.2	61.7	58.5
10.	Grain yield/10m^2, kg.	6.46	6.98	6.56
11.	Grain yield, t/ha	5.97	6.09	5.85

CONCLUSIONS

The rotavator and pulverizing roller attachment were found suitable for development of puddle bed in term of puddling index and percolation rate. The depth of puddle bed was found highest in pulverising roller attachment treatment. The cost for developing puddle bed was found least in the case of pulverizing roller attachment, whereas field capacity was higher in conventional method of cultivator-planker. The yield in cultivator-planker and pulverizing roller attachment differs marginally, but yield was slightly less in rotavator treatment.

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REFERNCES

Aggarwal G C, Sidhu A S, Sekhon N K, Sandhu K S and Sur H S (1995) Puddling and Nitrogen management effects on crop response in a rice-wheat cropping system. *Soil Tillage Res.* **36**: 129-39.

Anonymous (2014) Statistical Abstracts of Punjab, Economic and Statistical Organisation, Chandigarh, Punjab.

Anonymous (1999) Statistical Abstracts of Punjab, Economic and Statistical Organisation, Chandigarh, Punjab Chandigarh.

De Datta S K (1981) *Principles and Practices of Rice Production.* pp 460-512. John Willey and Sons, New York.

De Datta S K, Bolton F R and Lin W L (1979) Proposal for using minimum and zero tillage in tropical lowland rice. *Weed Res* **19**: 9-15.

Singh J (2001) Puddling performance evaluation of rotary blade attachment of strip-till drill, Unpublished M. Tech Thesis, Punjab Agricultural University, Ludhiana.

Patel M S, Singh N T and Singh Hardip (1979) Flow rate and pressure distribution in the leyered soil profile as affected by depth of puddling. *Indian J. Ecol* **6**: 46-52.

Razzaq Abdul (1987) Percolation of fine textured soil for rice production. *AMA* **18**: 36-39.

Sharma P K and De Datta S K (1986) Physical properties and process of puddled rice soils. *Advances in Soil Sciences* **5**: 139-78.

Tyagi N K, Acharya N and Mohanty P C (1975) Effect of puddling implement on percolation losses and water use efficiency in rice field. *Indian J Agric Sci* **45**: 132-35.

