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in

Mourzelas M. (ed.).
Qualité et compétitivité des riz européens

Montpellier : CIHEAM
Cahiers Options Méditerranéennes; n. 15(4)

1995
pages 143-146

Article available on line / Article disponible en ligne à l'adresse :

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http://om.ciheam.org/article.php?IDPDF=CI010948

To cite this article / Pour citer cet article

Catala M. **Red Rice (Oryza sativa L.) control in rice fields with the puddling technique.** In : Mourzelas M. (ed.). *Qualité et compétitivité des riz européens* . Montpellier : CIHEAM, 1995. p. 143-146 (Cahiers Options Méditerranéennes; n. 15(4))

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Red rice (*Oryza sativa* L.) control in rice fields with the puddling technique

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Abstract. An experiment was conducted in 1993 to determine the effect of the duration of flooding before puddling on red rice control, the effect of two puddlings and the effect of hand weeding twice for red rice plants. A split-plot design with puddling treatments as the main plot and hand weeding treatments as the subplots, was used. There was no significant differences between treatment 1 (puddling 15 days after flooding), treatment 2 (puddling 20 days after flooding) and treatment 3 (puddling 25 days after puddling) with 11.9, 11.0 and 7.8 red rice plants/m² respectively; yet they differed significantly from treatment 4 (puddling twice at 15 and 25 days after flooding) with 0.9 red rice plants/m². A perfect correlation between red rice seed bank (no./m² in 15 cm depth) and red rice plants after puddling (no./m²) appeared, but this did not happen for treatment 4. Hand weeding 15 days after seeding can increase the yield (kg/ha) by 16% (when no weeding takes place), with significant differences when puddled once. However, hand weeding at heading (the traditional method in the area) did not affect the yield in comparison with no weeding in all puddling treatments.

Introduction

Red rice (*Oryza sativa* L.) is the major problem in the Ebro Delta (Català, 1993). The term of red rice is used to refer to plants in case of shattering with the pigmented aleurone layer that makes red rice a weed. The red aleurone layer reduces grain quality and the shattering of the grain results in harvest loss and reinfests the soil with seed. The seed dormancy mechanism assures a reservoir of seed for future years, which serves to stabilize the red rice ecotype (Baker and Sonnier, 1983). Two years of previous studies in the area testing chemical and cultural practices (Català, 1992, 1993; Català and Torres, 1993) concluded that puddling is the best technique to control red rice effectively and, what is more, without any environmental impact, but the variability of the results required to continue the studies in order to accurate the puddling technique.

Puddling (wet land preparation by using cage wheels) was the traditional wet land preparation for transplanted rice, but it was changed by dry land preparation when direct seeding appeared in the Ebro Delta. Seedling emergence, root growth, nutrient uptake, water efficiency and consequently growth and yield are more important for plants growing in puddled fields than those in unpuddled ones (Ghildyal, 1978). The puddling process has been repeatedly reported as a method for reducing weeds (Moody, 1977, 1982; Mabbayad *et al.*, 1983). Puddling buries the weeds in the lower layers of mud, where they decompose by anaerobic action (Wrigley, 1969, reported by Moody, 1992). Because puddling does not control red rice completely, an appropiate hand weeding is necessary to prevent red rice reinfestation.

This study was conducted to determine: 1) the effect of the duration of flooding before puddling on red rice control; 2), the effect of two puddlings on red rice control; and 3) the effect of hand weeding twice for red rice plants.

I – Material and methods

This experiment was conducted in 1993 in farmers' fields affected by natural red rice infestation and different soil textures. A split-plot design with puddling treatments as the main plot and hand weeding treatments as the subplots, was used. Plot size was 1 ha, and there were five replications. Dry land preparation consisted in ploughing three or four times; pregerminated seeds were sown four days after

treatments at 170 kg into 2 to 3 cm of standing water. Basal application of nitrogen (75%), phosphorus (100%) and potassium (100%) was done just before the last ploughing and top-dressing nitrogen (25%) at mid-tillering. Grass and sedges were controlled by herbicide application. After dryland preparation, the fields were irrigated to let weeds and red rice germinate. Puddling treatments in rice fields were: (a) puddling after 15 days of irrigation; (b) puddling after 20 days of irrigation; (c) puddling after 25 days of irrigation (d) puddling after 15 days of irrigation and one more puddling 10 days later. Hand weeding treatments took place: (a) 15 days after seeding; (b) at heading; and (c) there was no hand weeding.

Before puddling, red rice seeds from the soil were sampled by throwing 60 times per plot a cylinder of 36 mm diameter and 15 cm deep, and seedling development was registered. Red rice and cultivar density (number of plants/m^2) were determined by throwing at random six times a 5 m^2 square. For hand weeding treatments, red rice plants were sampled 15 days after sowing, at heading and just before harvest, from two 5 m^2 squares per subplot and dried at 80°C until no weight variation. Grain yield was determined from two 5 m^2 squares and converted to tons per hectare at 14% moisture. The whole plots were harvested individually.

II – Results and discussion

Red rice seed bank in the soil did not show significant differences between three duration of flooding in terms of rice seedling development *(Table 1)*. There was no correlation between accumulated temperature > 12°C and percentage of germinated seeds before puddling (data not presented).

As it can be seen in *Table 2*, there was no significant differences between treatment 1 (puddling 15 days after flooding), treatment 2 (puddling 20 days after flooding) and treatment 3 (puddling 25 days after flooding) with 11.9, 11.0 and 7.8 red rice plants/m^2 respectively, but treatment 4 (puddling twice at 15 and 25 days after puddling), with 0.9 red rice plants/m^2 gave the best result on red rice control with significant differences.

However, when the fields were harvested, yield did not increase in treatment 4, nor the cultivar density (rice plants/m^2); one possible reason could be the different seeding phases which presented difficulties for the farmers (or were not properly executed).

For treatments 1, 2 and 3, *Figure 1* shows a perfect correlation between red rice seed bank (no./m^2, depth of 15 cm) and red rice plants (no./m^2). Whereas, for treatment 4, no correlation is showed. In some fields, seed bank was really very high. Traditional hand weeding in the area is carried out at heading, but by this time red rice has competed wih the cultivar.

After puddling is achieved, it is possible to recognize red rice seedling from cultivar seedling because of its different size. As *Table 3* shows, hand weeding l5 days after seeding showed the best results; when the field was puddled twice (treatment 4), no significant difference was observed between the two weedings. Considering the average yield, for all puddling treatments, weeding 15 days after sowing differs from traditional weeding (at heading). When comparing no weeding with weeding, whether puddling was done once or twice made no significant difference. Hand weeding very early can increase the yield by 16% compared to no weeding treatment. When hand weeding is done 15 days after seeding, the dry weight (gr/m^2) for red rice plants is always less than 1 g, while at heading it is between 9.60 g and 37.4 g depending on puddling treatment. The lower dry weight in no weeding treatment must be imputed to shattered panicles because sampling was done just before harvest *(Table 4)*.

References

• **Baker, J.B. and Sonnier, E.A.** (1983). Red rice and its control. In: IRRI (Ed.), *Weed Control in Rice*, pp. 327-333.

• **Catala, M.M.** (1992). Estudio del uso del molinato del thiobencarb y del fangueado para el control del arroz salvaje en los campos de arroz (*Oryza sativa* L.) del Delta del Ebro. Lerida, *Congreso 1992 de la Sociedad Española de Malherbologia*, pp. 247-254.

• **Catala, M.M. and Torres, A.** (1993). Control of red rice *(Oryza sativa L.)* in Ebro Delta (Spain). *Eighth EWRS Symposium "Quantitative approaches in weed and herbicide research and their practical application"*, Braunschweig, 1993, pp. 275-284.

• **Catala, M.M.** (1993). Control del arroz salvaje en los arrozales dd Delta del Ebro con o sin adición de molinato mediante la técnica del fangueado. Lugo, *Congreso 1993 de la Sociedad Española de Malherbologia*, pp. 205-211.

• **Ghildyal, B.P.** (1978). Effects of compactation and puddling on soil physical properties and rice growth. In: IRRI (Ed.), *Soils and Rice*, pp. 317-336.

• **Mabbayad, M.O.; Pablico, P.P.; Moody, K.** (1983). The effect of time and method of land preparation on weed populations in rice. *Proc. 9th Asian-Pac. Weed Sci. Soc. Conf.*, Manila, pp. 357-368.

• **Moody, K.** (1977). *Weed control in rice. Fifth Biotrop Weed Science Training Course*, Rubber Research Institute, Malaysia, pp. 374-424.

• — (1982). Weed control in sequential cropping in rainfed lowland rice growing areas in tropical Asia. Weed Control in small farms. *Weed Sci. Soc. Biotrop,* spec. Publ. No. 15, pp. 49-62.

• — (1992). Weed management in wet-seeded rice in tropical Asia. *Proceedings of the International Symposium on Biological Control and Integrated Management of Paddy and Aquatic Weeds in Asia.* National Agric. Res. Cent. and Food Fert. Tech. Center, Japan, pp. 1-20.

Table 1. Red rice seedling stages in percentage

		Red rice seedling stage[b]						
	Puddling method[a]	NG	CI	Cp2	Cp4	Cp5	R	PL
1	P15 DAF	68.14	5.69	8.90	2.74	8.78	2.04	2.22
2	P20 DAF	70.01	10.49	1.35	3.40	9.52	0.00	5.24
3	P25 DAF	53.50	14.24	4.52	14.52	4.21	0.00	0.00
	CV'S	32.73	49.32	72.47	103.00	70.11	35.36	59.64
		ns	ns	ns	ns	ns	ns	ns

a P15 DAF - Puddling 15 days after flooding
P20 DAF - Puddling 20 days after flooding
P25 DAF - Puddling 25 days after flooding
Data were transformed [arcsin.($\sqrt{\frac{x+1}{100}}$)] for statistical analysis.

b Average of five replications

ns: Not significant ; NG: Not germinate ; CI: Only coleorhiza visible; Cp2: Coleoptile less than 2 mm long; Cp4: Coleoptile between 2 and 4 mm long; Cp5: Coleoptile more than 5 mm long and radicle visible; R: Radicle more than 5 mm long; PL: Primary leaf.

Table 2. Effect of four pudding treatments on red rice plant density (no./m²) on cultivar plant density (no./m²) and yield (kg/ha) at 14% moisture

Puddling treatments	DFP[a]	Red rice seed bank[b] (no./m²)	Red rice plants[c] (no./m²)	Red rice plants[d] (adjusted means)	Yield (kg/ha)	Cultivar rice plants (no./m²)
1 - Puddling once	15	779.2	11.9	10.5 a	4717 a	105.38 b
2 - Puddling once	20	720.4	11.0	10.4 a	5321 a	245.43 a
3 - Puddling once	25	510.8	7.8	10.1 a	5157 a	150.95 ab
4 - Puddling twice	15-25	697.2	0.9	0.6 b	5194 a	164.87 ab
CV's					12.59	52.33

Within the same column, means followed by the same letter are not significantly different at the 5% level with a T-test.
a DFP: Days between flooding the field (after dry land preparation) and puddling.
b Red rice seed density in the 15 cm depth (no./m²). Average of five replications.
c Average of five replications.
d Adjusted means with red rice seed bank data.

Table 3. Yield (kg/ha) of puddled rice as affected by hand weeding treatments

	Cage wheel method			
Hand weeding treatments	Cage wheel[a] once	Cage wheel[b] twice	Average[c]	Yield increased[d]
Weeded 15 DAS[e]	6995.6 a	7028.7 a	7012.1 a	16.04%
Weeded at heading	6062.3 b	6520.a ab	6291.5 b	4.12%
No weeding	5902.p b	6182.2 b	6042.6 b	
CV's	6.77	6.53		

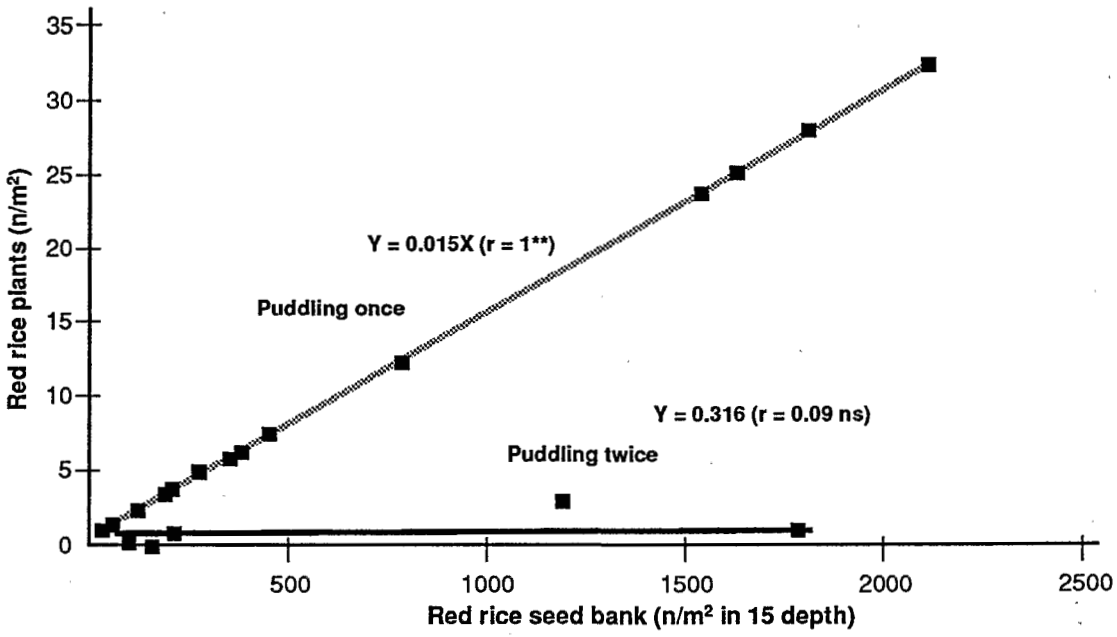
Within the same column, means followed by the same letter are not significantly different at the 5% level DMRT.
a Average of treatments 1, 2 and 3 and five replications.
b Treatment 4. Average of five replications.
c Average of treatments 1, 2, 3 and 4. Average for five replications.
d Yield increase in percentage with respect to no weeding.

Table 4. Dry weight (gr/m²) of the red rice plants in puddled fields to control red rice as affected by hand weeding treatments

Hand weeding treatments	Puddling method		Average
	Puddling once[a]	Puddling twice[b]	
Weeded 15 DAS	0.08 b	0.06 b	0.07
Weeded at heading	32.00 a	9.60 a	20.8
No weeding	25.95 a	6.27 a	16.11
CV's	48.79	67.59	

Within the same column, means followed by the same letter are not significant at the 5% level DMRT.
a Average of treatments 1, 2 and 3 and five replications.
b Average of five replications. Data were transformed (log [x+1]) for statistical analysis.

Figure 1. Effect of red rice seed bank (n°/m²) in 15 cm depth on puddling effectivity for red rice control



* Puddling once (treatments 1, 2 and 3)
* Puddling twice (treatment 4)