

4. Effect of deep Plowing on Growth and Yield of rice (1977 — 1978)

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In rice cultivation plowing depth is usually around 12 to 15 cm which may not be enough for vigorous growth of rice. Deep plowing up to 20 to 25 cm is expected to contribute not only to enlarging rhizosphere by breaking hard pan of paddy soil but also preventing paddy field from degradation. The experiment aimed at examining effect of deep plowing on growth of rice with reference to rate of fertilizer application.

Material and methods

First crop:

1. Variety : RD 7
2. Transplanting time : September 9, 1977
3. Depth of plowing : customary : 13 cm (Rotavator)
Deep : 25 cm (Disc plow)
4. Fertilizer application : F₁ : Non fertilizer
F₂ : Basal dressing: N-20, P₂O₅-25 (Kg/ha)
(5 days after transplanting)
Top dressing: N-20 (Kg/ha)
(40 days after transplanting)
5. Spacing : 25 cm × 25 cm, 16 hills/m²
6. Harvesting time : December 16, 1977.
7. Plot size ; customary land preparation: 149 m²
deep plowing: 109 m²
two replications

Second crop

The same as the first crop except the following:

1. Transplanted on March 6, 1978: harvested on June 19, 1978.
2. Land preparation was done by a power tiller only, in every plot.

Result

First crop

1. There was observed no difference of rice growth between the plots of deep plowing and customary one at the initial growth stage, but rice growth in the plot of deep plowing got more vigorous than the other in about 35 days after transplanting (Table 4-1 and 2).
2. The positive effect of deep plowing on grain yield exceeded that of fertilizer application in the plot of customary plowing (table 4-1).
3. Vigorous root development resulting from deep plowing was observed remarkably in the lower layer of the paddy soil (15—25 cm from surface) (Table 4-3).
4. In the plot of deep plowing, nitrogen content of top part of rice plant at 35 days after transplanting was higher than that in the plot of customary one. This trend was also observed at heading time (Table 4-2).
5. The increasing rate of grain yield caused by deep plowing was 20 and 7 percent in the plots without fertilizer and with fertilizer, respectively.

Second crop

1. There was no appreciable difference in the growth and grain yield of rice due to plowing depth except for nitrogen absorption by top part of rice at 39 days after transplanting and at heading stage (Table 4-4 & 5).
2. The growth and yield of rice was superior in fertilizer applied plots regardless of the plowing depth.

Discussion

In the paddy field used in the experiment lies the hard pan at the depth of 18 to 28 cm below the surface. If the hard pan is broken by deep plowing water percolation will be improved and rhizosphere enlarge. Also, the available nutrients accumulated in the lower layer will be brought back to the arable one. However, it is known that deep plowing results in inhibition of growth of rice plants at the initial growth stage because it increases the amount of cations fixed by soils.

As reported above, the delay of growth at the initial growth stage in the first crop was not observed. This is mainly due to the high soil fertility of the experimental field and the way of basal dressing under which fertilizer was applied on the soil surface 5 days after transplanting. Moreover, the positive effect of high air temperature in the tropics might have exceeded the negative effect of deep plowing.

In the first crop the remarkable effect of deep plowing on growth, grain yield and nitrogen absorption by rice plants was observed but that effect did not appear clearly in the second crop except on nitrogen absorption. In the second crop, the difference of the grain yields between the plots with and without fertilizer became larger than in the 1st crop. That is, in the deep plowing plot of the first crop the high grain yield was obtained without applying fertilizer but in the second crop the application of fertilizer was needed to get high yield. The fact is different from most of the experimental results obtained in Japan.

As a conclusion, it is desirable to deeply plow paddy field of heavy clay once every a few years to increase rice yield as well as to protect paddy field from degradation.

Table 4-1. Effect of deep plowing on growth and yield of rice (First crop)

Plot	Depth of plowing cm	Fertilizer N: P ₂ O ₅ Kg/ha	Oct. 27		Number of panicles /m ²	Number of spikelets /m ²	Degree of ripening g	Grain Yield t/ha
			Plant height cm	Number of tillers /m ²				
1	13	0:0	69.8	189	182	177786	25.0	4.45
2	13	40:25	72.4	202	189	20672	23.2	4.79
3	25	0:0	71.2	219	213	22909	23.2	5.32
4	25	40:25	74.5	222	214	23726	21.6	5.12

Table 4-2. Dry weight and nitrogen content of rice plant in relation to depth of plowing and fertilizer application (First crop)

Plot	Depth of plowing cm	Fertilizer N: P ₂ O ₅ Kg/ha	Top dry weight (g/m ²)		Total nitrogen content***			
			Oct. 14*	Nov. 21**	Oct. 14	%	Nov. 21	Oct. 14
1	13	0:0	86.4	739.3	1.89	0.64	1.63	4.73
2	13	40:25	96.0	788.8	1.81	0.97	1.74	7.65
3	25	0:0	99.2	814.4	2.05	0.71	2.03	5.78
4	25	40:25	100.8	841.6	2.07	1.03	2.09	8.67

Remarks * : 35 days after transplanting
 ** : About 1 week after heading time
 *** : Nitrogen was analyzed on the top part of rice plant.

Table 4-3. Effect of deep plowing on dry weight of root in the first crop of rice

Plot	Depth of plowing cm	Fertilizer N: P ₂ O ₅ K/ha	Soil layer	
			0—15 cm g/hill	15—25 cm g/hill
1	13	0 : 0	2.31	0.38
2	13	40 : 25	2.72	0.15
3	25	0 : 0	2.78	0.87
4	25	40 : 25	3.05	0.88

Remarks: The root was sampled at harvesting times.

Table 4-4. Effect of deep plowing on growth and yield of rice (Second crop)

Plot	Depth of plowing (cm)		Fertilizer N : P ₂ O ₅ (kg/ha)	Apr. 24*		Number of panicles /m ²	Number of spikelets /m ²	Degree of ripening (%)	Grain yield (t/ha)
	1st crop	2nd crop		Plant height (cm)	Number of tillers /m ²				
1	13	13	0 : 0	56.7	314	219	18432	21.3	3.92
2	13	13	40 : 25	66.1	346	248	23496	20.5	4.82
3	25	15	0 : 0	57.2	322	214	18944	20.9	3.96
4	25	15	40 : 25	64.1	374	261	23814	20.8	4.95

Remarks: * 49 days after transplanting.

Table 4-5. Dry weight and nitrogen content of rice plant in relation to depth of plowing and fertilizer application (Second crop)

plot	Depth of plowing (cm)		Fertilizer N : P ₂ O ₅ (kg/ha)	Top dry weight (g/m ²)		Total nitrogen content*** (%) (g/m ²)			
	1st crop	2nd crop		Apr. 14*	May 24**	Apr. 14	May 24	Apr. 14	May 24
	1	13	13	0 : 0	157.7	870.4	1.47	0.63	2.32
2	13	13	40 : 25	167.5	971.2	1.28	0.79	2.14	7.67
3	25	15	0 : 0	154.5	883.2	1.96	0.78	3.03	6.89
4	25	15	40 : 25	181.4	969.6	1.70	0.91	3.08	8.82

Remarks * : 39 days after transplanting
 ** : 5 days after heading
 *** : Nitrogen was analyzed on the top part of rice plant.