

Table 2. Rice yield and monetary value in the plots treated with granular insecticides at 1 kg a.i./ha. Chainat, Thailand.

Insecticide	Rice yield (t/ha)	Income ^a (\$/ha)	Cost of insecticide (\$/ha)	Profit ^b (\$/ha)
Carbofuran	6.26	783	94	689
Chlorfenvinphos	5.44	680	127	553
Lindane	3.53	441	11	408
Check	3.38	423	—	423

^aValue of rice based on price of rice at \$125/t. ^bValue of crop (income) minus cost of insecticide and application.

16-20-0 NPK was applied at 375 kg/ha, split into 3 applications.

Carbofuran was the most effective insecticide against the stem borer and lindane the least effective (Table 1). The insecticides did not affect the number of

parasites but carbofuran severely reduced the predator population. The net increase from supplying carbofuran was about 61% more than from the untreated check (Table 2). ■

Soil and crop management

Effect of seed, seedbed, and main field treatments on the yield of ADT31 and IR20

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Two experiments on seed, seedbed, root nutrient treatments, and main field manuring were carried out at Ambasamudram during 1977 and 1978 kar (Jun—Sep). The 1977 experiment

Table 1. Effect of seedbed and main field manuring on grain yield of 25-day-old IR20 seedlings grown in a farmer's field, Paddy Experiment Station, Ambasamudram, Tamil Nadu, India, 1977 kar.

Treatment		Yield (t/ha)
Seedbed ^a	Main field ^b	
None		4.0
Diammonium phosphate		4.8
Diammonium phosphate	Recommended NK fertilizer (no phosphorus)	4.9
None	”	3.8
Diammonium phosphate	Recommended NPK	4.7
None	”	4.2
CD = 0.3		

^aDiammonium phosphate treatment: 2 kg/40 m².

level. The 1978 experiment studied the combined effect of seed, seedbed, and root-dip nutrient treatments on the yield of the short-duration variety ADT31 transplanted at both 25 and 40 DS.

Seedbed manuring significantly affected the yield of IR20. The seedlings that received 2 kg diammonium phosphate/40 m² in the seedbed had 0.8 t/ha higher grain yield than the seedlings that did not (Table 1). Seedlings that received seedbed manuring but no phosphorus fertilizer in the main field yielded significantly more than the control (4.9 vs 3.8 t/ha) but about the same as the seedlings that received both seedbed manuring and main field phosphorus fertilizer application (4.7 t/ha). The finding suggests that seedlings treated with diammonium phosphate in the seedbed need no phosphate application in the main field.

The grain yield of ADT31 was significantly affected by 1) the interaction between seedling age at transplanting and seedbed manuring, 2) the interaction between seedling age

examined the combined effect of seedbed and main field manuring on the yield of IR20 transplanted 25 days after sowing (DS) into a field with low phosphorus

Table 2. Effect of seedbed, sprouted seed, and root-dip nutrient treatment on grain yield of ADT31 seedlings, Paddy Experiment Station, Ambasamudram, Tamil Nadu, India, 1977 kar.

Seedling age at transplanting (days after sowing)	Grain yield (t/ha)					
	Diammonium phosphate treatment ^a			Root-dip treatment ^b		
	2 kg/40 m ² to seedbed	3% soln to sprouted seed	None	4% manganese sulfate soln	3% zinc sulfate soln	None
25	6.1	5.7	5.2	5.8	5.6	5.5
40	5.4	4.9	5.1	5.4	4.6	5.4

^{ab}CD = 0.2

Table 3. Effect of seed and seedbed treatment on grain yield of 25-day-old ADT31 seedlings, Paddy Experiment Station, Ambasamudram, Tamil Nadu, India, 1978 kar.

Treatment			Grain yield (t/ha)
Seed	Seedbed	Sprouted seed	
1% potassium chloride soln			5.1
1% potassium chloride soln	2 kg diammonium phosphate/40 m ²		6.4
1% potassium chloride soln		3% diammonium phosphate soln	5.9
	2 kg diammonium phosphate/40 m ²		5.9
		3% diammonium phosphate soln	5.6
		Control	5.3
CD = 0.3			

at transplanting and root dipping, and 3) the combined effect of seedling age and seed and seedbed nutrient treatments.

Of the ADT31 seedlings transplanted at 25 DS, those that received 2 kg diammonium phosphate/40 m² in the seedbed yielded 6.1 t/ha (Table 2). Those that were treated with 3% diammonium phosphate solution at seed sprouting yielded 0.5 t/ha more than those that were not. Of the seedlings transplanted at 40 days old, those that received a seedbed application of diammonium phosphate yielded 0.3 t/ha

higher than those that did not; those that were treated with diammonium phosphate at seed sprouting yielded 0.2 t/ha less than those that were not.

The application of diammonium phosphate to the seedbed or to the sprouted seed may be desirable for increasing the yields of 25-day-old seedlings. When the roots of such seedlings were previously dipped in 4% manganese sulfate solution, the yield was significantly higher than that of the control, but almost the same as that of the seedlings whose roots had been dipped in 3% zinc sulfate solution. In

seedlings transplanted at 40 DS, root dipping in zinc sulfate adversely affected grain yield.

The 25-day-old seedlings that received both potassium chloride seed treatment and diammonium phosphate treatment of the sprouted seed yielded the same as the seedlings that received diammonium phosphate seedbed treatment alone (Table 3). The best combination was seed treatment with 1% potassium chloride solution, seedbed manuring with diammonium phosphate, and transplanting at 25 DS. ■

Straw as a source of nutrients for wetland rice

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Rice straw is a natural source of plant nutrients. It contains about 0.6% nitrogen, 0.1% phosphorus, 3% potassium, 8% silicon, and several micronutrients. The common Southeast Asian practice of burning the straw at threshing sites in the field sends up in smoke almost all the nitrogen and renders spotty the distribution of other elements. If the straw is incorporated into the soil, about 30 kg N/ha, 6 kg P/ha, and 150 kg K/ha, and 400 kg Si/ha will be returned to the soil evenly each season. Besides, the added organic matter should encourage nitrogen fixation by anaerobic bacteria. Because no information on the long-term effects of straw on nutrient balance in soils and the growth of rice in the tropics was available, two field experiments on Maahas clay (pH: 6.4, O.M.: 3.3%, total N: 0.130%, exchangeable K: 1.05 meq/100 g, Olsen P: 5.5 ppm) were started in 1972 at IRRI.

In one experiment we compared the long-term effects of four straw management practices — removal, burning in situ, plowing in, and application as compost — on the nutrient content of the soil and growth of wetland rice. The results are in Table 1.

Compared with straw removal, straw

incorporation caused significant increases of 0.47% organic matter, 0.023% nitrogen, 3.9 ppm available phosphorus, and 0.26 meq/100 g of exchangeable potassium. The accumulated nutrients

amounted to 38 kg N, 0.7 kg available P, and 17 kg exchangeable K/ha per season.

In a parallel experiment on Maahas clay, we studied the influence of straw incorporation under four water regimes.

Table 1. Effects of 4 straw treatments on the nutrient status of Maahas clay after the 12th cropping season.^a

Straw treatment	pH	Organic matter (%)	Total N (%)	Olsen P (ppm)	Exchangeable K (meq/100 g)
Removed	6.2 a	3.26 b	.187 b	11.6 c	1.19 c
Burned	6.2 a	3.17 b	.187 b	13.4 bc	1.35 ab
Plowed in	5.9 a	3.13 a	.210 a	15.5 b	1.45 a
Applied as compost	6.2 a	4.01 a	.211 a	27.6 a	1.27 bc

^a In each column, any two means followed by a common letter are not significantly different at the 5% level.

Table 2. Effects of straw incorporation on the nutrient status of Maahas clay under 3 water regimes after the 12th cropping season.

Water regime	Difference between straw and no-straw treatments				
	pH	Organic matter (%)	Total (%)	Olsen p (ppm)	Exchangeable K (meq/100 g)
Dry fallow	-0.3 *	0.38 *	0.021 *	1.8*	0.20*
Dry fallow with msd ^a	-0.2 ns	0.60**	0.020ns	2.3*	0.10ns
Flood fallow	-0.3 *	0.52*	0.029*	1.1ns	0.20⊗
Mean	-0.2 *	0.50**	0.023**	1.7**	0.17*

^aMidseason drying. * = significant at the 5% level. ⊗ = nearly significant at the 5% level. ** = significant at the 1% level. ns = nonsignificant.

Table 3. Effects of straw incorporation on the nutrient content of 3 soils and the yield of the 6th rice crop on them.

Soil	Increase due to straw incorporation ^a				
	Organic matter (%)	Total N (%)	Olsen P (ppm)	Exchangeable K (meq/100 g)	Yield (g/drum)
Luisiana clay	0.34**	0.013*	1.0 ns	0.102**	51*
Maahas clay	0.08 ns	0.008 ns	0.7 ns	0.183**	40 ns
Pila clay loam	0.25 *	0.023**	3.0**	0.128**	50*
Mean	0.22 **	0.015**	1.6*	0.138**	47*

^aSignificant at the 5% (*) and 1% (**) levels. ns = nonsignificant.