

Application of 30 kg N (urea)/ha increased yield by 55% in 1979 and 42% in 1980. Application of 30 kg N/ha and 5 t azolla/ha increased yields 86.4% over the control in 1979 and 92% in 1980.

Results showed that inoculating fields

with 1 t fresh azolla/ha after planting and incorporating after 20 days increased yield by 38% in 1979 and 36.5% in 1980. Increased yield caused by raising azolla application from 5 t/ha to 10 t/ha was significant only in 1980.

Rice yields were significantly higher from 30 kg N/ha and 10 t fresh azolla/ha than from single applications of nitrogen in both years. *h*

Effects of growth regulators applied to the main crop on ratoonability of IR9784-52-2-3-2 in pots

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A rice ratoon crop begins growth using carbohydrates left in the stubble and roots after the main crop is harvested. If leaf senescence is early in the main crop, less carbohydrate is accumulated and fewer ratoon tillers grow.

Growth regulators have been reported to delay leaf senescence in certain crops. Growth regulators at various concentrations applied to the main crop at various growth stages were tested for their effect on the ratoon crop in a pot experiment at IRRI during the 1981 dry season.

Aqueous solutions (1, 10, and 100 ppm) of indoleacetic acid (IAA), naphthaleneacetic acid (NAA), gibberellic acid (GA3), and dichlorophenoxy acetic acid (2,4-D) were sprayed (3 ml/plant), and carbofuran at 1 kg ai/ha was broadcast in prill form.

The growth regulators did not significantly affect the yield of the main crop or the ratoon crop (see table). *h*

Effect of growth regulators applied to the main crop on yield and yield components of the ratoon crop of IR9784-52-2-3-2, IRRI, 1981 dry season.^a

Growth regulators	Concn (PPm)	Time of application ^b	Grain yield (g/plant)	Panicles (no./plant)	Filled gras (no./panicle)	100-grain weight (g)
IAA	1	F	15.0	26	28	1.94
		LMS	13.4	25	29	1.91
	10	F	16.7	27	31	1.94
		LMS	14.1	26	29	1.94
	100	F	17.4	27	35	1.94
		LMS	15.3	25	29	1.95
NAA	1	F	13.0	22	38	1.94
		LMS	12.7	22	30	1.95
	10	F	14.6	26	32	1.93
		LMS	15.3	28	28	1.91
	100	F	15.7	26	33	1.91
		LMS	15.9	26	30	1.94
GA3	1	F	15.5	26	31	1.91
		LMS	13.8	24	30	1.96
	10	F	15.0	26	27	1.95
		LMS	18.5	28	30	1.95
	100	F	13.8	24	32	1.96
		LMS	14.9	29	26	1.93
2,4-D	1	F	13.8	24	34	1.93
		LMS	12.3	26	29	1.93
	10	F	16.4	26	33	1.94
		LMS	15.6	26	32	1.92
	100	F	15.9	27	32	1.93
		LMS	16.3	23	31	1.94
Carbofuran	1 kg ai/ha	F	12.3	24	28	1.94
		LMS	15.2	24	29	1.97
Control			17.2	29	32	1.91

^aAnalysis of variance indicated nonsignificant treatment differences at 5% probability level. ^bF = flowering, LMS = late milk stage.

Studies on multiplication of azolla

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Azolla Azolla pinnata is a floating fern with nitrogen-fixing blue-green algae *Anabaena azollae* in its leaves. Phosphorus (P) fertilizer is necessary for good azolla yields. Azolla is attacked by the larvae of Lepidoptera (Nymphula)

and Diptera (Chironomus) insects that roll the leaves and feed on the plants.

Azolla was multiplied in plots with 5, 10, and 15 cm standing water using 4.4, 8.8, and 13.2 kg P/ha per week and 2 levels of carbofuran (5 and 10 kg/ha). Fifty-four 1-m² plots were inoculated with 300 g freshly collected azolla plants. Breeding plots were harvested weekly and fresh weight was recorded. Total N and P contents were determined (see table).

Results showed that P is essential for azolla multiplication. Plants with P deficiency had reddish brown fronds and roots, and roots were long, fragile, and easily detached. Best growth was obtained by applying 8.8 kg P/ha and 10 kg carbofuran/ha weekly to plots with 10 cm standing water. There was no significant growth difference between plots at 5 cm and 15 cm water depth.

Application of 8.8 kg P/ha and 10 kg carbofuran/ha per week increased N

Effect of phosphorus (P), water depths, and carbofuran on biomass production, nitrogen (N) fixation, and P content of *Azolla pinnata*, West Bengal, India. ^a

Treatment	Fresh weight (g/m ² per week)	N ₂ content (g/m ² per week)	P content (g/m ² per week)
Dose of P (kg/ha)			
4.4	1016.4	2.22	0.09
8.8	1203.6	2.84	0.22
13.2	1068.1	2.35	0.18
Mean	1096.0	2.47	0.16
S.Em (±)	0.22	0.034	0.02
C.D. at 5%	0.63	0.097	0.05
Water depth (cm)			
5.0	1084.4	2.48	0.16
10.0	1115.8	2.47	0.17
15.0	1087.8	2.47	0.16
Mean	1096.0	2.47	0.16
S.Em (±)	0.22	ns	ns
C.D. at 5%	0.63	-	-
Carbofuran (kg/ha)			
5.0	1087.0	2.41	0.17
10.0	1105.0	2.54	0.16
Mean	1096.0	2.47	0.16
S.Em (±)	0.18	0.028	ns
C.D. at 5%	0.57	0.079	

^a ns = nonsignificant.

content in azolla plants. P content was also highest at this level of application, but was not affected by carbofuran application. Water depths did not affect N or P content. ✎

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Rice-based cropping systems

Transplanting time and grain yield relationships of late rice for a triple-cropping system

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Production duration for late rice is short in the triple-crop system (barley - early rice - late rice) used near Shanghai. Late rice yield is high and stable with early transplanting, but yields decline if transplanting is late. An experiment to explore the relationship between transplanting time and late rice variety yields was conducted in Shanghai in 1981.

Three japonica varieties — Nong Fu No. 6, late maturity; Jia Nong No. 15, medium maturity; and Hua Han-zao, early maturity — were transplanted on 2, 6, 10, and 14 August in 10-m² plots with 3 replications.

Delayed transplanting significantly reduced grain yields for all varieties (see table). From 2 to 14 August, yield decreased 11.3 kg/day for Nong Fu No. 6, 17.5 kg/day for Jia Nong No. 15,

Yields of late rice at different transplanting times, Shanghai, China.

Variety	August transplanting date	Yield (t/ha)			Mean
		Replication 1	Replication 2	Replication 3	
Nong Fu No. 6	2	4.4	4.6	4.7	4.6
	6	3.6	3.6	3.6	3.6
	10	2.9	3.3	3.0	3.1
	14	2.4	2.4	2.5	2.4
Jia Nong No. 15	2	4.7	4.7	5.0	4.8
	6	4.2	4.0	4.0	4.1
	10	3.3	3.4	3.0	3.2
	14	1.8	1.6	1.4	1.6
Hua Han-zao	2	4.8	5.0	4.9	4.9
	6	4.2	3.9	3.8	4.0
	10	3.8	3.8	4.1	3.9
	14	3.6	3.5	3.3	3.5
Variety		Calculated <i>F</i> (treatment)		Tabular <i>F</i> (at 1%)	
Nong Fu No. 6		143.79**		7.59	
Jia Nong No. 15		227.30**		7.59	
Hua Han-zao		49.48**		7.59	

and 7.2 kg/day for Hua Han-zao. The relationship between transplanting time and yield is illustrated by the equation:

$$W = \frac{1}{A+Bt}$$

(*W* = yield, *A*, *B* = parameter, *t* = transplanting time 2-14 August)

The coefficients of correlation (*R*) were 0.9749** for Nong Fu No. 6, 0.9620** for Jia Nong No. 15, and 0.8421** for Hua Han-zao. All were significant at the 1% level. However, cold injury causes a deviation from calculated data if transplanting time is too late. A rectifying equation is: