early growth of rice (land not flooded), when VAM fungi are colonizing young plants not yet fully established. It is possible that older, established rice plants in flooded fields may show a different response to VAM fungal colonization.

In all cases where nutrients were supplied, colonization of rice roots was significantly lower than that in roots of plants supplied with deionized water. It is possible that higher availability of nutrients to plant roots depressed VAM fungal colonization. Other studies have suggested this depression in colonization may be due to the reduction of exudate leakage and/or the greater availability of inorganic nutrients in the rhizosphere.

The high biomass of plants in the deionized water treatment may be due to higher VAM fungal colonization in this treatment.

This study suggests that VAM fungi may have a detrimental effect on early growth of rice, reducing establishment. This relationship may change as rice plants grow and become better established. The significance of the roles of VAM fungi and inorganic fertilizer needs further investigation. ■

Physiology and plant nutrition

Effects of paclobutrazol and KH_2PO_4 on rice seedlings and grain yield

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Paclobutrazol (Pac) treatment reduces rice seedling height in summer and lodging in autumn, but does not significantly increase yields.

We evaluated the effect on yield of applying Pac alone and in a mixture with KH_2PO_4 to rice seedlings. All treated plants were shorter, had wider seedling base, and more tillers than untreated controls.

Pac alone did not increase the height of the first tiller, production of new roots after transplanting, yield components, or yield. Pac plus KH_2PO_4, however, increased first tiller height and new root number (Table 1), thereby increasing the capacity for absorption of mineral nutrients.

As a result, panicle number, filled grain number, and 1,000-grain weight increased.

Shan You 63 yielded 10.6 t/ha in the late season (Table 2), a new record in a 200,000-ha area of Zhaoqing. ■

Table 1. Effect of paclobutrazol and KH_2PO_4 application on rice seedlings. Zhaoqing, China, 1988-89 early season.

Treatment	Seedlings		Tillers (no./seedling)	1st tiller length (cm)	New roots[a] (no./plant)
	Height (cm)	Base width (mm)			
		Shan You 2			
Control	32	4.0	0.6	15.0	3
270 ppm Pac	27	4.5	2.0	17.5	4
270 ppm Pac + 30 ppm KH_2PO_4	29	5.8	2.5	22.0	5
LSD (P = 0.05)	2	0.6	1.1	3.0	2
		Shan You 63			
Control	28	3.6	2.3	11.5	4
270 ppm Pac	24	4.5	3.0	12.5	5
270 ppm Pac + 30 ppm KH_2PO_4	25	5.4	3.8	19.2	7
LSD (P = 0.05)	2	0.6	1.0	3.0	2

[a] Measured 5 d after transplanting.

Table 2. Effect of paclobutrazol and KH_2PO_4 application on grain yield and yield components.[a] Zhaoqing, China, 1988-89 late season.[a]

Treatment	Panicles (no./m^2)	Filled grains (no./panicle)	1000-grain wt (g)	Yield (t/ha)
	Shan You 2			
Control	297	106	27.0	8.5
270 ppm Pac	296	105	27.6	8.6
270 ppm Pac + 30 ppm KH_2PO_4	306	108	28.0	9.2
LSD (P = 0.05)	7.5	4.0	0.9	0.4
	Shan You 63			
Control	292	116	28.1	9.5
270 ppm Pac	295	114	28.2	9.2
270 ppm Pac + 30 ppm KH_2PO_4	300	122	29.0	10.6
LSD (P = 0.05)	7.8	4.2	0.8	0.4

Fertilized with 225 kg N, 66 kg P, 149 kg K/ha.

Fertilizer management

Effect of straw + $(NH_4)_2SO_4$ application on rice

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We studied the influence of C:N ratio and preflooding on rice growth and production when rice straw was applied with $(NH_4)_2SO_4$ in a greenhouse pot experiment, 1988 late season.

Pearl River alluvial soil (medium loam, pH 6.5, 0.15% total N, 2.5% organic C, CEC 14 meq/100 g soil) was air dried and screened, and placed in pottery pots at 5 kg/pot. Superphosphate (5.0 g/pot) and KCl (2.0 g/pot) were basally applied. Rice straw (0.72% total N, C:N ratio 53) of 0, 9.8, 37.3, and 127.1 g, respectively, needed to establish 0, 10, 25, or 40 C:N ratio was thoroughly mixed with the soil. N (300 mg) as $(NH_4)_2SO_4$ solution was banded 5 cm deep into each pot in an 8-cm-diameter circle. The pots were preflooded at 2, 4, or 6 wk, and 9 seedlings/pot transplanted. The experiment was laid out in a completely randomized block design.

Preflooding had no significant effects on tiller number, panicle dry weight, or

Table 1. Effect of C:N ratio and preflooding on panicle number and rice yield.[a] Guangzhou, China, 1988.

C:N ratio	Panicle no.	Dry matter (g/pot)	
		Straw	Panicle
Preflooded 2 wk			
0	31 a	63 b	33
10	28 b	65 ab	29
25	23 c	45 c	29
40	9 d	16 d	3
Preflooded 4 wk			
0	29 ab	72 a	21
10	25 c	63 b	22
25	24 c	51 c	21
40	10 d	16 d	6
Preflooded 6 wk			
0	31 a	67 ab	23
10	27 bc	61 b	23
25	23 c	45 c	28
40	10 d	15 d	10

[a]In a column, means followed by the same letter are not significantly different by DMRT, P = 0.05.

straw yield (Table 1). Significant differences in tiller number and straw yield occurred with C:N ratio treatments (Table 1, 2).

With a C:N ratio of 25, tillers were fewer than those with no added rice straw and with a C:N ratio of 10, but more than those with a C:N ratio of 40.

The panicle number at harvest and straw dry weight were significantly lower with increased C:N ratios (Table 1). Panicle dry weight did not differ significantly among C:N 0, 10, and 25 treatments, but was much lower with C:N 40.

Adding large quantities of rice straw appeared to reduce the efficiency of applied N. Preflooding did not change this effect. At C:N ratios above 10, microorganisms and rice plants may compete for available N as organic materials decompose. ■

Table 2. Effect of C:N ratio on rice tiller number at 2-15 wk after transplanting.[a] Guangzhou, China, 1988.

C:N ratio	Tillers[b] (no.)								
	3	4	5	6	7	9	11	13	15
0	6.0 a	24.8 a	27.9 a	32.4 a	33.4 a	31.6 a	24.6 a	22.6 a	22.1 a
10	5.7 a	24.3 a	28.8 a	31.4 a	31.4 a	29.8 a	20.8 b	18.7 b	17.2 b
25	4.0 b	19.7 b	22.6 b	25.7 b	25.9 b	24.3 b	17.7 c	15.0 c	14.7 c
40	0.3 c	2.2 c	1.8 c	2.9 c	2.9 c	2.8 c	1.7 d	1.8 d	1.9 d

[a]In a column, means followed by the same letter are not significantly different by DMRT, P = 0.05. [b]No tillers appeared at 2 wk after transplanting.

Crop management

Effect of cultural practice for semideep water rice on yield and net income

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Poor crop stands due to low seeding rates, poor germination under premature flooding, high seedling mortality, and inadequate and untimely fertilizer application result in low productivity of direct seeded rice grown in semideep water.

We compared five cultural practices during the 1988 and 1989 wet seasons (see table). The trial was laid out in random block design with four replications. Soil was clay loam with pH 8.2, 0.53% organic C, 10 kg P, and 234 kg K/ha. Rice cultivar Madhukar was seeded at 100 kg/ha. Maximum water level was 65 cm in Sep 1988 and 59 cm in Oct 1989.

Crops direct seeded at 100 and 150 kg/ha with recommended fertilizer (40 kg N + 8.8 kg P/ha) before the onset of monsoon had the highest yields. Their gross income, net return, and benefit:cost ratio were also the highest. ■

Effect of cultural practices on yield and net income at Ghagharaghat, U.P., India, 1988 and 1989 wet seasons.

Treatment[a]	Grain yield (t/ha)		Gross income ($/ha)		Total cost (US$/ha)	Net income ($/ha)		Net income/$ invested	
	1988	1989	1988	1989		1988	1989	1988	1989
FPOF	1.2	1.4	154	178	134	20	44	0.15	0.32
FPWF	1.5	2.0	193	257	162	31	95	0.19	0.58
DSNS	2.4	2.9	309	377	168	141	209	0.84	1.24
DSES	2.8	3.4	360	436	181	179	255	0.99	1.40
DSPI	2.1	2.3	263	292	193	70	99	0.36	0.51
LSD (0.05)	0.5	0.1	-	-	-	-	-	-	-

[a]FPOF = farmer's practices without fertilizer (direct sown with onset of monsoon) - check. FPWF = farmer's practices with fertilizer (40 kg N + 8.8 kg P/ha) - direct sown at onset of monsoon. DSNS = direct sown with normal seeding rate (100 kg/ha) and 40 kg N + 8.8 kg P/ha in well-prepared field before onset of monsoon. DSES =direct sown with 150 kg seed/ha + 40 kg N + 8.8 kg P/ha in well-prepared field before onset of monsoon. DSPI = dry sowing with 40 kg N + 8.8 kg P/ha and presowing irrigation on 15 May; crop was grown with supplementary irrigation till onset of monsoon.

Effect of seedling age on growth and yield of T. aman rice

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We evaluated growth and yield of 30-, 40-, and 60-d-old seedlings of rice varieties BR11, BR22, BR23, and Nizersail during 1988 T. aman season at BRRI, Joydebpur. Test plots were transplanted 15 Sep.

Tiller and panicle numbers did not differ significantly with seedling age in BR11 and Nizersail (see table). In BR22, seedling age was inversely related to tiller and panicle numbers. With 60-d-old seedlings, BR23 had the lowest tiller number but the most panicles. Grain yield, however, was no higher than at other seedling ages, probably, because late tillers increased competition for nutrients.

All the varieties are photoperiod sensitive so days to flowering and maturity of the different seedlings were similar.

Grain yield was highest with 45-d-old seedlings of BR23.

Transplanting 30- to 60-d-old seedlings had no significant effect on grain yield of BRl1, BR22, or Nizersail. These