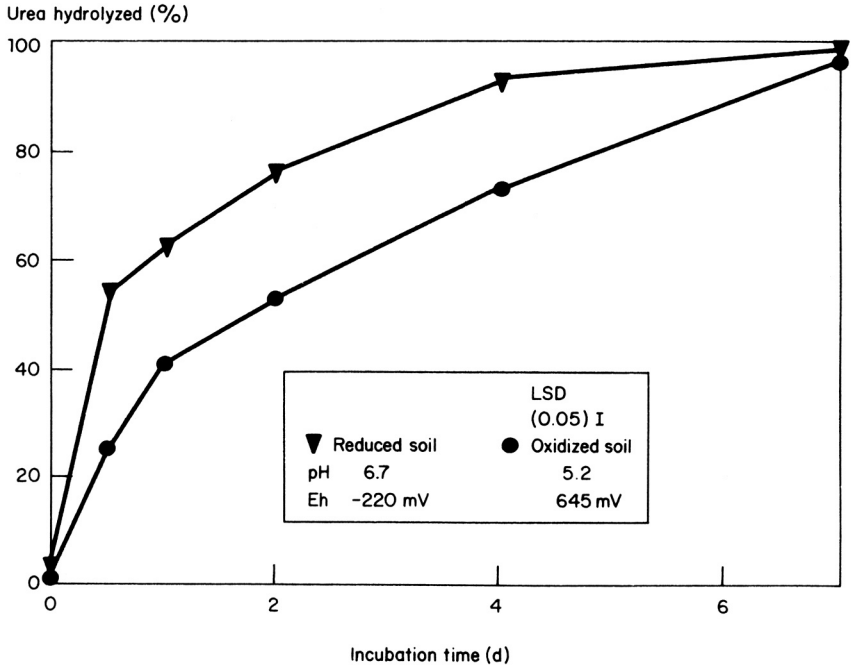

2. Urea hydrolyzed in oxidized and reduced flooded Sumatra soil at 25 °C. Louisiana State University, Baton Rouge, USA, 1988.

The results show that rate of urea hydrolysis in the oxidized soil proceeded at a significantly slower rate than in the reduced soil for all the incubation periods (Fig. 2). At 1 d after application, 40% of added urea was hydrolyzed in the oxidized soil, and 62% in the reduced soil. At 4 d, 72% of added urea was hydrolyzed in the oxidized soil, and 93% in the reduced soil. At 7 d, a small amount of urea still remained in the oxidized soil, but no trace was found in the reduced soil. □

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Soil microbiology and biological N fertilizer

Influence of P, K, micronutrients, and dolomite on azolla growth

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We studied the effects of P, K, micronutrients (M), and dolomite (D) on azolla growth and its P accumulation in 1.2- × 2.3-m plots in a randomized complete block design with 3 replications. The test was conducted at 1,260 m altitude at the end of the warm season Mar 1985 (air temperature 16-25 °C; water temperature 11-40 °C) in Antananarivo.

Soil was sandy clay loam mineral hydromorph, with pH 5.2, 1.13% total P, 0.155% Olsen P, 3% organic matter, 1.7% C, and ex-K 0.18 meq/100 g.

Treatments were P alone; P and K; P, K, and M; P, K, and D; and P, K, M, and D. P was applied at 7 kg/ ha as triple superphosphate, K at 5 kg/ ha as KCl, and M at 10 kg/ha as a commercial cocktail containing 0.3% B, 1.5% Fe, 0.5% Cu, 1.5% Mn, 0.01% Mo, 1.5% Zn, 4% MgO, 5% N, and 5% S. Dolomite was applied at 300 kg/ ha. P was applied weekly at 7 kg/ ha; the other materials were applied only at the beginning of the test. Dolomite was applied to estimate the influence of pH changes.

Azolla growth and P accumulation during 37 d at the end of the warm season in 1985, Antananarivo, Madagascar.

Treatment	Azolla wt		P accumulated	
	g	Increase over control (%)	%	Increase over control (%)
Control	110	–	0.059	–
P	270	157	0.197	235
P+K	280	169	0.200	239
P+ K + M	340	218	0.198	236
P+K+D	310	189	0.205	247
P+K+M+D	350	228	0.211	258
LSD (0.05)	101		0.102	

Azolla pinnata var. *pinnata* (var. *africana*) was inoculated at 50 g/plot. Azolla fresh weight and P accumulation were recorded 37 d after inoculation.

Results show that P is essential to azolla growth (see table). Fronds cultivated with P were reddish green. P-deficient fronds were reddish brown, and their roots were long and easily detached. Dolomite, micronutrients, P, and K together induced uniform azolla multiplication. K did not influence frond proliferation.

P accumulation was remarkable. Azolla incorporated as green manure could be a source of available P. □

Response of flooded rice to green manure

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We studied the relative contribution of N from aboveground (shoot) and

belowground (root) portions of *Sesbania aculeata* to wetland rice and the effect of green manure and a nonleguminous crop fortified with fertilizer N on yield and N uptake of rice.

Soil was calcareous sandy loam with pH 8.2, 0.37% organic C, and 0.08% total N. The experiment, conducted during 1987 wet season, was in a randomized complete block design with three replications. The 12 treatments comprising green manure and urea N are described in the table.

Sesbania and maize crops grown for 51 d were incorporated 1 d before transplanting rice. Sesbania accumulated 4.1 t dry matter and 125 kg N/ha. Maize accumulated 1.64 t dry matter and 20.7 kg N/ ha. Long-duration rice PR108 was transplanted 27 Jun 1987 in 23.4-m^2 plots at 20- × 15-cm spacing. N as urea was applied in 2 equal splits — 21 and 42 d after transplanting (DT) — in green manure plots and in 3 equal splits — 7, 21, and 42 DT — in fallow and maize plots. All plots received 26 kg P and 25 kg K/ha at final puddling.

At 35 DT, dry matter and N uptake of rice were significantly higher in plots fertilized with sesbania or urea. The plots receiving belowground portion of sesbania showed no significant gain over fallow plots. In maize plots, growth and N uptake of rice did not differ significantly from those in fallow plots. Without green manure, rice responded up to 180 kg N/ha. Incorporating sesbania produced yields equivalent to those with 120 kg N/ha. This shows that efficiency of N contained in sesbania is similar to that of urea N.

Yields from plots green manured with sesbania shoots did not differ significantly from those with sesbania grown and buried *in situ.* This suggests that the mineralizable N in sesbania is contained mainly in the aboveground portions. Yield from plots from which sesbania shoots were removed did not differ significantly from yield in fallow plots.

Without fertilizer N, incorporation of the maize crop containing 1.26% N did not prove beneficial. With 60 kg N/ha, maize-incorporated plots produced spectacularly high rice yields, equal to those with 120 kg N/ ha. Total N uptake of rice at maturity showed a similar pattern.

Apparent recovery of fertilizer N was about 50% in fallow plots and 40% from plots with N applied as green manure. Apparent recovery of fertilizer N in maize plots was surprisingly high. It seems that N applied in maize plots narrowed the C:N of maize residue, which then behaved as a slow-release fertilizer. □

Effect of green manure and N level on growth and N uptake of rice. Ludhiana, India, 1987 wet season.

Treatment		Dry matter at 35 DT (t/ha)	Grain yield (t/ha)	N uptake (kg/ha)		Apparent N recovery[a] (%)
Green manure	Urea N (kg/ha)			35 DT	Maturity	
Sesbania grown and incorporated	0	1.8	7.6	31	133	41.6
	60	2.3	8.7	41	164	51.7[b]
Sesbania grown and aboveground portion removed	0	1.2	5.3	19	86	–
	60	1.5	6.5	26	111	41.7[b]
Sesbania not grown but aboveground portion from preceding treatment incorporated	0	1.9	7.4	28	134	42.4
	60	2.2	9.0	36	170	60.0[b]
Maize grown and incorporated	0	1.1	5.4	17	89	38.1
	60	1.6	7.9	26	149	100.0[b]
Fallow	0	1.2	5.0	18	81	–
	60	1.6	6.2	26	109	46.7
	120	1.9	7.5	33	141	50.0
	180	2.0	8.6	38	174	51.7
LSD		0.39	0.81	5.1	11.6	–

[a]Apparent N recovery of green manure N was calculated by subtracting N uptake in no-N control of fallow treatment. [b]Value corresponding to apparent N recovery for 60 kg N/ha in the presence of green manure.

Azolla growth under different rice planting methods in Kerala

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A study of the effect of rice planting method on azolla growth during 1980 dry season (Sep-Jan) and 1981 wet season (Jun-Sep) showed that the bulk planting method favored maximum azolla growth. We conducted a more extensive trial during 1981 dry season to confirm this finding.

Yields of azolla and rice as affected by method of planting rice. Pattambi, India, 1981 dry season.

Planting method	Azolla yield (g/m^2) 3 wk after inoculation	Rice yield (t/ha)	
		Grain	Straw
20 × 10 cm east-west direction	182	4.8	3.3
20 × 10 cm north-south direction	179	4.7	3.1
40 × 5 cm east-west direction	160	4.3	3.1
40 × 5 cm north-south direction	181	4.6	3.4
Bulk method (equidistant, 50 hills/m^2)	191	4.1	3.0
Fallow (without rice)	68	–	–
LSD (0.05)	15	ns	ns