No N fertilizer was applied to green manure plots; 2 treatments received urea applied at 60 and 120 kg N/ha and 1 treatment received no N. N supplied by the green manures was adjusted on a dry weight basis. Sesbania and sunn hemp were evaluated at two N levels.

Treatments were laid out in a randomized block design with three replications. Plant samples collected at harvest were analyzed for total N.

Rice responded linearly up to 120 kg N/ha applied as urea (see figure). Yields from green manure incorporated in amounts comparable to the N supplied by urea equaled or surpassed yields from urea. Cowpea and sunn hemp were the most efficient N sources, followed by sesbania and mungbean.☐

Mineralization of fresh and dry azolla in the tropics

D. Alexander, Regional Agricultural Research Station (RARS), Pattambi, Kerala; and N. Sadanandan, Directorate of Postgraduate Studies, Vellanikkara; and K. Karunakaran, RARS, Kerala, India

Effect of organic manure and time of incorporation (2, 4, 6, 8, 10, 12 wk after incorporation) on percentage of mineralizable N. Kerala, India, 1984.

Organic manure	Mineralizable nitrogen (%)					
	2	4	6	8	10	12
5 t azolla/ha (13.4 kg N)	34.1	63.0	76.0	84.6	86.3	76.6
10 t azolla/ha (26.8 kg N)	26.0	43.6	40.7	47.7	57.8	61.2
Dry azolla equal to 5 t azolla/ha (13.4 kg N)	37.0	50.1	63.0	78.0	39.5	64.3
Dry azolla equal to 10 t azolla/ha (26.8 kg N)	33.3	35.6	50.5	44.9	20.5	35.6
5 t cattle manure/ha (26.9 kg N)	19.1	35.0	59.6	53.4	39.0	58.3
Green leaves of venga *Pterocarpus marsupium* at 5 t/ha (25.4 kg N)	43.9	73.5	67.2	22.8	38.4	86.0

We studied rate of mineralization of fresh and dry azolla under tropical conditions in two pot culture experiments in Jun and Sep 1984. The experiment was laid out in circular 0.1 m^2 cement pots. Each pot contained 20 kg air-dried soil; a 5-cm water level was maintained. Organic fertilizers were incorporated and thoroughly mixed with the soil (see table).

Soil and water samples were taken at 2-wk intervals to week 12, and ammoniacal and nitrate N contents estimated and expressed as mineralized N. Percentages of available N to the quantity of N initially added were estimated by subtracting the N value of control from all treatments.

N release from 5 t fresh and dry azolla/ha compared with cattle manure and green leaves from week 6 to week 8. At that level, the highest available N was 86.6% from fresh azolla at week 6, 78.9% from dry azolla at week 8, 59.6% from cattle manure at week 6, and 86% from green leaves at week 12. In both fresh and dry azolla, 10 t/ha reduced and prolonged N release more than did 5 t/ha. At both levels, fresh azolla was slightly superior to dry azolla. ☐

Parthenium as green manure for rice

S. Purushothaman, S. Jeyaraman, and P. Sudhakar, Agronomy Department, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai 625104, Tamil Nadu, India

We compared urea, wet leucaena, dry leucaena, parthenium, and sunn hemp in the main and succeeding irrigated lowland rice crops during 1984-85 wet and dry seasons.

Treatments to the main crop were in a randomized block design with three replications. No fertilizer was applied to the second rice crop.

Grain quality characteristics—optimal cooking time, swelling rate, gruel loss, elongation rate, and palatability (color, smell, and taste)—were tested in both main and second crops.

Using parthenium as green manure had no effect on cooking and palatability characteristics. ☐

Physiology and plant nutrition

Supply and uptake of urea-^{15}N by rice

W. Lu, C. W. Lindau, and W. H. Patrick, Jr., Laboratory for Wetland Soils and Sediments, Louisiana State University, Baton Rouge, Louisiana 70803-7511, USA

We studied the behavior of soil, fertilizer, and plant N in a greenhouse pot experiment where urea-^{15}N was applied to rice grown under permanent flooding.

The soil was a Crowley silt loam (Typic Albaqualf), 11% clay and 71% silt, with 7.0 g total C/kg, 0.8 g total N/ kg, a cation exchange capacity of 9.4 meq/100 g soil; pH of 5.7 (1.1 soil/ water ratio).

Air-dried soil (2.2 kg) ground to pass through a 1-mm mesh sieve was placed in polyvinyl chloride (PVC) pots (20 cm

Table 1. Recovery of ^{15}N-urea and yield of Lemont rice.[a] Louisiana, USA.

Treatment no.	Treatment (% applied urea)				^{15}N recovery (%)				Grain yield (g/pot)
	Transplanting	Tillering	Panicle initiation	Milk stage	Soil	Roots	Shoots	Grain	
1	100	–	–	–	21	5	10	22	26.2
2	50	30	10	10	14	5	15	28	26.7
3	50	10	30	10	24	8	14	29	28.7
4	25	25	25	25	16	7	14	29	27.2
C	–	–	–	–	–	–	–	–	16.1
LSD (0.05)					ns	2	ns	ns	3.1

[a] Mean of 4 observations. C = control, no N applied.

Table 2. N derived from fertilizer in rice plant components. Louisiana, USA.

Treatment no.	N derived from fertilizer[a] (%)		
	Roots	Shoots	Panicles
1	22	32	33
2	22	37	37
3	30	34	35
4	27	38	39

[a] Mean of 4 observations.

long and 15 cm internal diameter). Deionized H_2O containing 0.15 g P/kg soil and 0.20 g K/kg soil was added to establish water depth of 2-4 cm.

Three 20-d-old Lemont seedlings previously grown in a sand culture were transplanted into each of 20 pots. Four N treatments were applied using urea-^{15}N (29.991 atom %) at 0.44 g urea N/pot. Urea-^{15}N solutions were injected into the rice root zone. Each N treatment, including control, was replicated four times.

At harvest, each pot was destructively sampled and total Kjeldahl N and ^{15}N content determined on soil and plant components (roots, shoots, grain).

Plant recovery of applied urea-^{15}N was from 58% in the roots, 10-15% in the shoots, and 22-29% in the grain (Table 1). Total plant ^{15}N recovery was 38-51%; highest recovery was with treatment 3. Control grain yields were significantly different from those of the N treatments.

About 60% of the ^{15}N taken up by the rice plant was in the grain. ^{15}N remaining in the soil after harvest ranged from 14 to 24%. About 34% of the ^{15}N applied was unaccounted for.

The two sources of N to rice are soil N (% NdfS) and fertilizer N (% NdfF). In treatment 1, plant N was 69% NdfS and 31% NdfF; in treatment 2, 65% NdfS and 35% NdfF; in treatment 3, 67% NdfS and 33% NdfF; and in treatment 4, 64% NdfS and 36% NdfF. Rice uptake of fertilizer N was significantly correlated with grain yield ($r = 0.634^{**}$).

Percentage of NdfF in the root, shoot, and panicle rice tissues is shown in Table 2. Panicle NdfF accounted for 33-39% of the total panicle N content, slightly higher than the 32-38% NdfF taken up by the rice shoots. NdfF was lowest in the root tissues.☐

Soil fertility and fertilizer management

Comparison of prilled urea (PU) and large granule urea (LGU) and time of application on rice yield

S. K. Sahu, S. K. Pattanayak, S. K. Nanda, and G. N. Mitra, Soils and Agricultural Chemistry Department, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar 751003, India

We compared PU (26-30 mg) and LGU (6-8 mm diameter) at 30, 60, and 90 kg N/ ha broadcast in saturated soil at 4 rice growth stages in a 1986 dry season field experiment. The 10 treatments (including no N) were in a randomized block design with 3 replications.

Soil was sandy loam (Aeric Haplaquept) with pH 5.2, 0.47% organic C, CEC 5.7 meq/ 100 g, 290 kg available N/ha (alkaline permanganate method), 15.7 kg available P/ ha ($NaHCO_3$ extract), and 110 kg K/ha (ammonium acetate extract).

Seedlings of Lalat (130 d duration) were transplanted on 18 Jan. All plots received 13.2 kg P. 24.9 kg K/ha at transplanting (TP).

Grain and straw yields and N uptake were significantly higher with 90 kg N/ ha from LGU applied 2/3 at 7 d after transplanting (DT) and 1/3 at panicle initiation (PI). Apparent N recovery and yield response (kg grain/ kg N) were highest at 30 kg N/ ha from LGU applied 2/3 at TP, 1/3 at PI (see table).☐

Effect of PU and LGU on yield and N efficiency. Bhubaneswar, Orissa, India, 1986 dry season.

N level (kg/ha)	Time of N application (kg/ha)				Yield (t/ha)		N uptake (kg/ha)		Total N uptake (kg/ha)	Apparent N recovery (%)	Yield response (kg grain/ kg N)
	TP	7 DT	15 DT	PI	Grain	Straw	Grain	Straw			
0	–	1	–	–	2.2	2.6	20.0	11.7	31.7	-	-
30 (PU)	20	2	–	10	2.7	3.0	25.3	17.2	42.5	36.0	16.7
60 (PU)	15	2	30	15	3.1	3.5	31.8	20.9	52.7	35.0	15.0
90 (PU)	22.5	2	45	22.5	3.5	3.6	34.1	22.9	57.0	28.1	14.4
30 (LGU)	20	2	–	10	3.0	3.4	26.9	21.1	48.0	54.3	26.7
30 (LGU)	–	2	–	10	3.0	3.3	28.9	18.3	47.2	51.7	26.7
60 (LGU)	15	2	30	15	3.3	3.5	29.0	17.9	46.9	25.3	18.3
60 (LGU)	–	2	–	20	3.7	3.4	37.7	24.3	62.0	50.5	25.0
90 (LGU)	22.5	12	45	22.5	3.9	4.1	37.5	23.8	61.3	32.9	18.9
90 (LGU)	–		–	30	4.4	4.7	42.3	28.7	71.0	43.7	24.4
LSD (0.05)					0.2	0.3	3.3	2.5			