International Rice Research Newsletter

VOLUME 4 NUMBER 3 JUNE 1979

Published by the International Rice Research Institute, P.O. Box 933, Manila, Philippines

Style for IRRN Contributors

Units of measure and styles vary from country to country. To improve communication and to speed the editorial process, the editors of the *International Rice Research Newsletter (IRRN)* request that contributors use the following style guidelines:

- Use the metric system in all papers. Avoid national units of measure (such as cavans, rai, etc.).
- Express all yields in tons per hectare (t/ha) or, with small-scale studies, in grams per pot (g/pot) or grams per row (g/row).
- Define in footnotes or legends any abbreviations or symbols used in a figure or table.
- Place the name or denotation of compounds or chemicals near the unit of measure. For example: 60 kg N/ha; not 60 kg/ha N.
- The US dollar is the standard monetary unit for the *IRRN.* Data in other currencies should be converted to US$.
- Abbreviate names of standard units of measure when they follow a number. For example: 20 kg/ha.
- Express time, money, and measurement in numbers, even when the amount is less than 10. For example: 8 years; 3 kg/ha at 2-week intervals; 7%; 4 hours.
- Write out numbers below 10 except in a series containing some numbers 10 or higher and some numbers lower than 10. For example: six parts; seven tractors; four varieties. *But* There were 4 plots in India, 8 plots in Thailand, and 12 plots in Indonesia.
- Write out all numbers that start sentences. For example: Sixty insects were added to each cage; Seventy-five percent of the yield increase is attributed to fertilizer use.
- Type all contributions double spaced.
- Indent first lines of each paragraph.
- Do not hyphenate words at the end of a line.

Genetic evaluation and utilization

OVERALL PROGRESS

Interrelationship of seedling and mature plant heights in transplanted cultures

Arun K. Saha, scientific officer, and Md. Nasiruddin, rice breeder, Bangladesh Rice Research Institute, G.P.O. Box 911, Dacca, Bangladesh

Modern rice varieties — both irrigated and rainfed — are usually transplanted. Farmers in Bangladesh grow transplanted irrigated rice in the winter and transplanted rainfed rice in the monsoon.

In both seasons, farmers have difficulty planting rice because seedlings of modern varieties are short — one reason why farmers prefer traditional varieties when they cannot manage water depth. Even for irrigated winter rice, modern varieties have shorter seedlings than traditional ones because of low December–January temperatures. In the monsoon, most rice fields receive excess water which is sometimes difficult to remove and which farmers are also reluctant to remove because they are uncertain of the next rain. In both situations, modern varieties with taller seedlings are desirable.

Rice varieties with tallest and shortest seedlings and mature plants. Seeded 12 Nov, planted 17 Dec, Bangladesh Rice Research Institute, 1977.

Designation	Seedling ht (cm)	Plant ht (cm)
Shortest seedlings		
CN216	9	71
B2266b-CW-23-4-2	11	90
R/T-47	11	59
Iri 329	11	70
CN217	11	88
Tallest seedings		
IR2298-PLPB-11-4-1-5B	31	86
IR2298-PLPB-11-4-1-48	30	79
B2266b-CW-16-2-1	30	89
Habiganj Boro IV	27	104
B2266b-CW-13-3-2	27	88
Shortest mature plants		
Ainan early	16	42
IR579-ES44	18	58
IR2053-521-1-1	14	58
IR2298-PLPB-3-19-1-2B	18	60
ARCRIP 111-17	14	66
Tallest mature plants		
Banauc	17	170
Gogo puthi	22	127
C21	18	123
CN297	18	121
HP46(HPU13)	20	113

Correlation coefficient between seedling and plant height: $r = .086$, $t = 0.95$. Regression of byr = 0.31, $t = 0.94$, $bxy = 0.02$, $t = 1.0$. Tabulated t for correlation and regression = 1.98. Correlation and regression are nonsignificant at .05. x = seedling ht, y = plant ht.

Plant breeders are concerned about whether seedling height can be increased and the semidwarf or intermediate plant height still be retained at maturity. Therefore the relationship of seedling and plant heights was investigated, using 120 entries from the International Rice Cold Tolerance Nursery. Plant height was recorded at 35 days and at maturity. Correlation and regression of seedling and plant heights showed that the two factors were in no way related. Data for 20 entries with the tallest and shortest seedlings and mature plants are in the table. A visual examination also indicated no relationship between heights of seedlings and of mature plants. Varieties whose seedlings were 9–11 cm were 71 to 90 cm tall at maturity. Entries whose seedlings were 27–31 cm tall were 79–104 cm at maturity. The tallest varieties that were 113 to 170 cm at maturity (Banauc, Gogo Puthi, etc.) had 17- to 20-cm seedlings. That indicates that tall varieties are not necessarily tall at seedling stage and that varieties with tall seedlings are not necessarily tall at maturity.

This situation should encourage plant breeders to breed varieties with taller seedlings and a wide range of mature plant heights (semidwarf, intermediate, and tall). It also indicates that a different gene or genes control seedling and mature-plant heights and that the genes are not linked. We should mention that the seedling consists of leaf sheath and leaf blade whereas the plant at maturity consists of nodes, internodes, and panicles — different morphologic components of the rice plant.

An improved blast-resistant rice cultivar for irrigated paddy in West Africa

S. S. Virmani, F. J. Sumo, and I. W. Buddenhagen, IITA/IDA-Liberia rice project, Suakoko, Liberia, and the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria

Among the several thousand cultivars introduced into West African programs since the early 1970s, the line IR1416-131-5, from the IRRl cross Peta*4/TN1//Tetep, has proven to be both resistant to blast and excellent for irrigated conditions.

Until now, IR5 has been the most widely recommended and planted variety in irrigated swamps in Liberia. The swamps have been developed in rolling lowland terrain in a rain forest area where 1,800 to 3,000 mm of rainfall falls over an 8- to 10-month period.

Since its 1974 introduction, IR1416 has yielded better than IR5 in both wet and dry seasons in areas of Liberia where water control and soil conditions are good (see table). But IR5's yield in the wet season under poor water control or undefined imbalanced soil Conditions remains superior. When sown directly at high seed rate and with fertilization (NPK, 150-50-70), IR1416 lodged moderately 2 weeks before maturity.

In Nigeria, IR1416 and BG90-2 from Sri Lanka are now the two main varieties grown at the high-technology Japanese/Nigerian irrigated rice project at Adani, Anambra state. This area is a derived savanna zone with about 1,400-mm rainfall from April to October. The objective of the project is to grow 10 t/ha per year from 2 crops — a goal reached on part of the area. Commercial yields of both IR1416 and BG90-2 have ranged from 4.5 to 5.5 t/ha. IR1416 is preferred for its blast resistance. its adaptability to direct sowing of pregerminated seeds, and its consistent performance in both dry and wet seasons. Compared with other rices, it is subject to less attack by the stem borer *Chilo zaccanius.*

IR1416 is a high-tillering spreading-type semidwarf (75 – 90 cm) of intermediate growth duration (130–135 days). It has medium-long panicles and medium-slender grains (24 g/1,000-grain wt) that are more translucent and of better quality than those of IR5. In Liberia, IR1416 is especially preferred to IR5 because of its keeping quality after cooking. It has low levels of glume discoloration (dirty panicles), and good resistance to sheath blight, sheath rot, and leaf scald. IR1416 is moderately tolerant of iron toxicity, but susceptible to brown spot, caseworm, and rice yellow mottle virus. Blast did not attack it under the dryland, drought conditions at IITA that killed varieties such as IR5, BG90-2, and Brengut. In those trials, six major vertical genes, as indexed on japonica differentials, were present in the blast population.

In 1976. Liberia nominated IR1416 to the coordinated variety trials of the West Africa Rice Development Association (WARDA). It performed well under good management in Mauritania, Mali, Upper Volta, Sierra Leone, and Ivory Coast.

IR1416 is proposed for release in Liberia as Suakoko 12. It is considered most appropriate for West African paddy with good irrigation and with nontoxic soils — especially where current cultivars are subject to neck blast. It is used as a parent in IITA's hybridization program. ■

Performance of IR1416 and IR5 in yield trials in Liberian irrigated inland valley swamps, 1974–77.

Year	Site	Yield (t/ha) IR1416	Yield (t/ha) IR5	IR1416 yield (% of IR5)
Wet season, good management				
1974	Suakoko	6.6	4.9	+64
1975	Suakoko	6.1	4.7	+30
1976	Suakoko	4.4	3.7	+21
1977	Voinjama	5.9	5.5	+ 8
Mean		5.8	4.5	+32
Wet season, poor water control[a]				
1975	Suakoko	3.4	3.4	+ 1
1977	Suakoko	3.4	5.1	–34
1977	Kolahun	3.9	5.8	–33
1977	Zlehtown	3.8	4.4	–13
Mean		3.6	4.7	–26
Dry season				
1974	Suakoko	4.8	3.6	+32
1975	Foya	6.9	5.2	+33
1976	Suakoko	4.4	4.0	+10
1977	Suakoko	4.0	3.5	+15
Mean		5.0	4.1	+23

[a]Newly developed swamp, or land with imbalanced nutrition, or both.

Induction of monogenic recessive male sterility in IR36 by ethyleneimine treatment

R. J. Singh and H. Ikehashi, Plant Breeding Department, International Rice Research Institute

To facilitate rapid recombination breeding and to save labor in the hybridization program, attempts were made to induce monogenic recessive male sterility in IR36 by use of ethyleneimine, a chemical mutagen. Dried IR36 seeds were treated with ethyleneimine at various concentrations (0.2%, 0.4%, 0.8%, 1.2%, and 1.6%) for 1 hour and 3 hours. The 0.2%; concentration for 3 hours depressed germination by 69%; the 0.4% concentration for 1 hour depressed it by 30%. But the 0.2% for 1 hour gave 93% germination, similar to that of the control (99%). Seeds in other treatments did not germinate.

About 2,000 plants from treatments of 0.2% for 3 hours and 4% for 1 hour were planted in M_1. A single panicle was harvested from each M_1 plant. All M_1 plants produced M_2 pedigrees. Out of 1,954 M_2 lines of 12 plants each, 93 lines segregated for sterility and partial sterility. A single plant from each line was transferred from the field to the greenhouse for study of chromosomes, pollen fertility, and cross fertility of the female organ.

The meiotic pairing and pollen fertility studies of 93 M_2 lines revealed the following information.

Meiotic behavior	Pollen fertility range (%)	Lines (no.)
Reciproval trans-location	1.6–80.0	61
Triploid	0.9–2.1	2
Desynaptic plants	2.1–22.1	2
Normal meiosis	80.0	13
Meiosis not studied	33.0–89.0	6
Normal meiosis	0.0–4.0	4
Not identified		5
Total		93

Four male-sterile lines had excellent crossability with IR36. No seed set was observed after selfing but some seeds were obtained from sterile plants produced by outcrossing. All the M_3 plants were fertile. But when pollination

Segregation of four M_4 male-sterile lines. IRRI, 1978.

Designated male-sterile line	Pedigree	Fertile (no.)	Sterile (no.)	Total (no.)	(X^2) [a] 3:1
ms-a	E2-3-10	209	80	289	1.00
	E2-3-10	207	75	282	0.38
	E2-3-11	214	83	357	0.58
	E2-3-11	349	108	457	0.45
Total		1039	346	1385	0.00
ms-b	E2-538-6	199	69	268	0.08
ms-c	E6-953-10	196	58	254	0.64
ms-d	E6-1335-5	217	64	281	0.74

[a] X^2 = table value for a df (5%) = 3.84.

was controlled, the F_1 plants were completely fertile. That indicates the recessive nature of male sterility, which was also confirmed in the M_4, as all the four male-sterile lines segregated in a 3 – 1 ratio (see table).

Incomplete panicle exsertion was observed for lines ms-a, ms-b, and ms-d, but ms-c showed normal panicle exsertion. That indicates that spikelets of line ms-c have a greater chance than the three other male-sterile lines of receiving pollen from the neighboring fertile plants. A single panicle per male-sterile plant was harvested to study the amount of outcrossing in male-sterile lines. Outcrossing was maximum for ms-c (33.6%), followed by ms-d (32.5%), ms-b (29.8%), and ms-a (14.8%). ■

Isolation of tall and dwarf seedlings of rice

J. Begum, Rice Research Station, Chinsurah, West Bengal, India

In the segregating populations of dwarf-tall crosses, isolation of the dwarf seedlings from the talk in the nursery offers certain testing advantages. Failure to separate the dwarfs from the talls may ultimately result in extinction of the dwarf types or suppression of their performance. Therefore, preliminary tests were conducted to determine the association of certain morphological characters to aid in the selection of the dwarf types in the nursery. Eighty pure line rice varieties of diverse sources were tested during boro (summer).

The number of leaves at 25 days after sowing (X_2) and at 35 days (X_3), and seedling length at 25 days after sowing (Y_1) and at 35 days (Y_2) were recorded. X_2 and X_3 were correlated with mature plant height (X_1). A significant positive association between X_1 and seedling characters X_2, X_3, Y_1, Y_2 was found (see table). X_2 and X_3 were also highly significant and positively correlated with Y_1 and Y_2. In 1970, W. L. Chang reported that seedling length was positively correlated with plant height, especially during early growth.

The results indicated that the dwarf types will have shorter seedlings that produce fewer leaves. Therefore, the number of leaves and elongation rate of the seedlings should be considered when separating the dwarfs from the talls in the nursery.

Correlation *(r)* values between mature plant height (X_1) and number of seedling leaves (X_2 and X_3) and seedling length (Y_1 and Y_2). Chinsurah, West Bengal, India.

Characters	*r* value
X_1 X_2	0.9730**
X_1 X_3	0.9637**
X_1 Y_1	0.9792**
X_1 Y_2	0.9700**
X_2 Y_1	0.9891**
X_2 Y_2	0.9658**
X_3 Y_1	0.9531**
X_3 Y_2	0.9818**

**Significant at 1% level of probability.

Individuals, organizations, and media are invited to quote or reprint articles or excerpts from articles in the IRRN Duplicate prints of photos and illustrations are available to media on request from the office of Information Services, IRRI. Persons who wish additional details of information presented in IRRN should write directly to the authors.

Four new rice varieties released in Nepal

B. B. Shahi, national rice coordinator, National Rice Improvement Program, Parwanipur Agriculture Station, Birganj, Nepal

After intensive research on promising genotypes in Nepalese research stations and in farmers' fields for more than 4 years, the national seed committee has released 4 varieties for the tarai, inner tarai, and equivalent climatic regions of Nepal.

For the chaite dhan season (early crop, Mar-Jun)

1. *Laxami,* formerly IR2061-628-1-6-4-3, from the cross IR833-6-2-1-1//IR1561-149-1/IR1737. The line was introduced into Nepal through the International Rice Yield Nursery-Early (IRYN-E) in 1975. It matures in 111 days – one of the earliest cultivars released.

2. *Durga,* formerly IET2938 (Jaya//IR8/2*Latisail). Bred in India, the line was introduced into Nepal through the IRYN-Medium duration nursery in 1974.

For the barkhe dhan season (normal monsoon)

3. *Janaki,* formerly BG90-2 (Peta*3/TNl//Remadja) was developed in Sri Lanka and introduced into Nepal through the IRYN-M in 1975.

4. *Subitri,* formerly IR2071-124-6-4 (IR1561-228-l/IR1737//CR94-13), was introduced into Nepal through India's initial evaluation trial in 1975.

Yield performance at different Nepalese research stations, agronomic characteristics, and responses to diseases and insects of 4 new rice varieties in Nepal, 1978. [a]

	Laxami	Durga	Janaki	Sabitri	Panvanipur-1 (check)	Chandina (check)	Masuli (check)
				Mean yield (t/ha)			
Kankai	5183	5923	4323	3703	5736	4697	3121
Tarhara	6060	6284	5286	3918	6914	5990	3854
Janakpur	4128	5098	4717	4893	4585	4243	4797
Parwanipur	4585	4974	3883	3405	4362	3915	2548
Rampur	2800	3429	4001	4053	3949	3000	3164
Bhainva	4758	4477	3905	4196	2922	5430	3240
Nepalganj	5113	4696	5126	3722	5861	4708	4042
Av	4777	5016	4404	3995	4804	4794	3564
				Agronomic characteristics			
Days to heading	88	100	104	90	106	111	121
Days to maturity	111	128	134	120	135	140	150
Plant ht (cm)	93	91	92	80	98	94	120
Tillers (no.)	6.5	6.5	7.0	8.0	9.0	9.0	9.5
1,000 grain wt (g)	23	25	26	20	27	25	17
Milling recovery (%)	72.5	66.5	–	70	67	73	–
Head rice (%)	79.0	86.5	–	81.9	79.9	91.8	–
Protein (%)	6.9	1.3	–	7.0	5.5	8.0	–
Grain quality	Coarse	Medium	Coarse	Medium	Coarse	Medium	Medium fine
				Response to diseases [b] *and insects* [c]			
Blast	1	1	1–2	1–5	1–3	1–3	1–6
Bacterial blight	3–5	3–5	7–9	3	1–3	3–5	3–5
Brown spot	3	3	3	3	1–3	1–7	3–5
Sheath blight	–	MR	–	–	MS	–	–
Brown planthopper	MR	S	S	–	–	R	–
Green leafhopper	R	R	S	–	–	R	–
Gall midge	–	MR	–	–	MR	–	R

[a] Varieties Laxami and Durga were tested in Mar-Jun along with check varieties Parwanipur-1 and Chandina; Janaki and Sabitri were tested against Masuli (Mahsuli) during Jun–Nov, the normal season.
[b] On a scale of 1-9 of the 1976 Standard Evaluation System for Rice.
[c] MR = moderately resistant, S = susceptible, R = resistant.

Laxami and Durga yield better than the recommended varieties in the early season, and their early maturity leaves farmers enough time to grow a second crop. The two also have better resistance to insects and diseases than other recommended varieties. Durga and Sabitri have good eating quality and medium-fine grain. All four varieties have high response to fertilizer, lodging resistance, and improved plant type (see table).■

GENETIC EVALUATION AND UTILIZATION

Grain quality

Cooking characteristics of selected IR424 lines

A. K. Saha, K. Banu, Q. A. Haque, A. A. Miah, N. M. Miah, M. A. Hamid, A. C. Roy, and M. S. Ahmad, Bangladesh Rice Research Institute (BRRI), Joydebpur, Dacca, Bangladesh

Basmati rice is well known for grain and cooking qualities and for aroma. It is used in the preparation of delicacies on festive occasions and its long grain brings a special market price; however. it has poor plant type and yields low. Crosses were made during the mid-1960s at IRRI to improve its plant type and thus its yield potential, while keeping its other qualities intact.

From materials originally received from IRRI. 119 lines of the IR424 cross (Basmati 370*^{3}/TN1) were selected at BRRI. The lines were grown in observational trials in the 1978 boro (Dec-May) at BRRI. Fifteen lines were selected for their grain yield and cooking quality. Cooking quality was further evaluated on the basis of elongation ratio (av length of 10 randomly selected cooked grains to av length of 10 randomly selected uncooked grains). imbibition ratio (vol of cooked to vol of uncooked grains). visual scoring of cooked grains, and aroma.

Twenty-five polished grains were cooked for 7 minutes in 20 ml boiling water. The cooked grains were transferred to petri dishes and visually scored for uniformity of length and smoothness. The cooked samples were also checked for aroma. BR5, BR7, and Kataribhog were used as checks. BR5 has fine aromatic grains. BR7 has long nonaromatic grains; Kataribhog has long aromatic grains but unsatisfactory yield.

Most of the lines varied widely in the visual scores — only 15 were scored 3 to 5 and none were scored 1. Fifty lines scored 7 and 54 lines, 9. Variability was observed for all characters studied. The table lists 15 selections equivalent to or better than the standard checks. All of the selected lines had numerically higher elongation-ratio values than the checks. But 12 selections had similar or higher imbibition ratio values, and most were equivalent to the checks in visual scores. ■

Elongation ratio, imbibition ratio, and visual score of selected aromatic IR424 lines. Bangladesh Rice Research Institute, Joydebpur, Dacca, Bangladesh, 1978.

Pedigree	Elongation ratio	Imbibition ratio	Visual score[a]
IR424-2-1			
/J_1-30-6	2.00	3.98	3
/J_1-30-7	1.98	3.95	3
/J_1-30-8	1.88	3.76	3
/J_7-2-4	1.85	3.69	3
/J_7-2-5	1.75	3.77	3
/J_7-2-7	1.85	2.61	5
/J_7-2-9	1.85	3.69	3
/J_7-2-15	1.85	2.74	5
/J_7-4-11	1.76	2.52	5
/J_7-4-14	1.82	3.62	3
/J_7-4-15	2.00	4.31	3
/J_8-1-8	2.07	4.47	3
/J_8-l-9	2.00	3.98	3
/J_8-l-18	2.01	4.35	3
/J_8-7-14	1.88	4.07	3
BR5	1.70	3.58	3
BR7[b]	1.40	3.60	3
Kataribhog	1.67	4.18	3

[a]1 = All cooked grains smooth and uniform in length; 3 = 80% cooked grains smooth, uniform; 5 = 60% cooked grains smooth, uniform; 7 = 40% cooked grains smooth, uniform; 9 = 20% cooked grains smooth, uniform. [b]Nonaromatic.

Individuals, organizations, and media are invited to quote or reprint articles or excerpts from articles in the IRRN. Duplicate prints of photos and illustrations are available on request from the Office of Information Services, IRRI. Persons who wish additional details of information presented in IRRN should write directly to the authors.

GENETIC EVALUATION AND UTILIZATION

Disease resistance

Rice cultures that are moderately resistant to Helminthosporiose

V. Mariappan, plant pathologist, and P. Durairaj, assistant plant pathologist, Tamil Nadu Agricultural University, Coimbatore 3, India

Helminthosporiose is widespread in Tamil Nadu. The disease affects the [rice crop at all growth stages; no cultivated variety is resistant or tolerant. The 540 IET entries received from the All India Coordinated Rice Improvement Project were screened for reaction to high pressure of helminthosporiose in a sernidry nursery. The entries were grown in 2 rows, 1 In long, surrounded by 1 row of the susceptible check Benibhog. At 45 days of age the plants were spray inoculated with a conidial suspension (concn of 40,000 spores/ml) of Helminthosporium oryzae that had been isolated from typical lesions. The disease incidence was scored on a 0-9 scale. Benibhog had a score of 9 (highly susceptible) and many entries scored from 5 to 7. Five entries — IET5870, IET5878, IET6515, IET6524, and IET6541 — were scored from 0 to 1. When tested in the laboratory under similar inoculum pressure, the cultures showed moderate resistance to the disease (score, lower than 3). ■

Resistance of cultivars to the rice leaf folder

S. K. Verma, P. K. Pathak, B. N. Singh, and M. N. Lal, G. B. Pant University of Agriculture and Technology, Pantnagar 263145, Uttar Pradesh, India

Eleven standard cultivars and four promising lines were evaluated for resistance to the rice leaf folder in a randomized block design replicated three times in a field trial in 1977 kharif. In the last week of August, when leaf folder incidence was at a peak, all the leaves and those infested on 15 hills/replication were counted and the percentage of infestation was recorded.

Infestation ranged from 13 to 63%; it was highest on Jaya and lowest on Prasad (see table). No cultivar was immune to leaf folder attack. ■

Susceptibility of rice cultivars to the rice leaf folder. Pantnagar, India.

Designation	Av infestation (%)
Jaya	63
IR8	61
Padma	57
UPR190D-17-1	55
IR20	52
UPRI73-23	49
UPR82-1-7	49
Cauvery	42
Bala	38
Saket-4	36
Tilak chandan (dwarf (mutant)	31
Ratna	30
Pusa 2-21	24
IR24	15
Prasad	13
CD at 5%	17.55

Straighthead disease of rice suspected in southern Thailand

Praphas Weerapat, rice breeder, Nakornsrithamaraj Rice Experiment Station, and Satian Promchainan, rice breeder, Rice Division, Department of Agriculture, Ministry of Agriculture and Cooperatives, Bangkok 9, Thailand

Severe symptoms similar to those of straighthead disease reported in the USA and Japan were observed in southern Thailand in 1977. The observations were made in an 80-ha area of lowland rice planted on sandy soil that was previously planted to upland crops in Ronphibool subprovince, Nakornsrithamaraj province. The rice plants were at the heading stage, The infected plants had normal vegetative growth but exhibited tillering at the upper nodes, poor exsertion, twisted spikelets, distorted hulls (in "parrot beak" shape), and high sterility.

To observe if varietal reactions to the disease differed, four replications of three recommended varieties, Nahng Prayah 132, RD13, and RD7, and of the local variety Khao Nang were randomly planted in the area in 1978 wet season. On the basis of the grain yield and the percentage of straighthead panicles, Khao Nang ang Nahng Prayah 132 were more tolerant of straighthead disease than RD7 and RD13 (see table). To the authors' knowledge, this is the first report of straighthead symptoms in Southeast Asia. ■

Percentage of affected panicles and grain yield of 4 varieties as a measure of damage from straighthead disease (av of 4 replications). Nakornsrithamaraj Rice Experiment Station, Thailand.

Variety	Straighthead panicles[a] (%)	Grain yield[a] (g/m^2)
Khao Nang	16 a	294 a
Nahng Prayah 132	39 b	161 b
RD13	63 c	148 b
RD7	63 c	98 b

[a] In a column, values followed by the same letter do not significantly differ at the 0.05% level.

Dirty panicle or glume discoloration of rice in Sierra Leone

S. A. Raymundo, plant pathologist, and S. N. Fomba, research assistant, Plant Pathology, Rice Research Station Rokupr, Sierra Leone, West Africa

The *dirty panicle* or *discolored glume* syndrome of rice is found in practically all rice ecologic zones in Sierra Leone. The disorder may be limited to individual grains, but in severe cases almost the entire panicles, including the rachises, become discolored. When the disease strikes, yield losses may reach 50%.

Some fungi associated with the disorder were identified by the Commonwealth Mycological Institute, U.K., and locally from seed samples from an upland area near Rokupr. They were: *Helminthosporium oryzae, Leptosphaeria* sp., *Phoma sorghina, Diplodiella oryzae, Alternaria* sp., and *Fusarium* sp. Rice bugs that feed on grain also predispose the glumes to fungal infection.

Screening tests to determine varietal reactions to grain and glume discoloration were conducted at a dryland site at Makassa, near the Rokupr Rice Research Station, in the 1977–78 wet season. Cultivars that had 10% or fewer affected grains were classed as resistant. They included IRAT8, M1069-1-2, M50-4-2-2, M133-6-1-2, IAC47, and LAC23. Cultivars with 25% or mure of their grains severely affected were classified as susceptible. They included IB96, IB100, Line 13d/R75 sel. 958, TOX C1-95-2-2-69-1, IAC5544, and Perola. ■

GENETIC EVALUATION AND UTILIZATION

Insect resistance

Field reaction of rice varieties to leaf folder at various nitrogen levels

G. S. Dhaliwal, H. N. Shahi, P. S. Gill, and M. S. Maskina, Punjab Agricultural University, Regional Rice Research Station, Kapurthala 144601, India

The rice leaf folder *Cnaphalocrocis medinalis,* previously a minor rice pest in the Punjab, has lately become serious. In 1978 kharif, 16 varieties were screened for reaction to leaf folder at 6 nitrogen levels in 3 nitrogen variety trials: NVT 1 (short-duration varieties, 110 – 120 days), NVT 2 (medium duration, 135 – 145 days), and NVT 3 (aromatic varieties, 120 – 140 days).

In NVT 1, leaf folder infestation increased with increasing nitrogen level. Infestation was maximum in variety PR422 and minimum in Palman 579. In NVT 3, infestation did not increase consistently with increased nitrogen level. Damage was maximum in PR299B and minimum in PR106. In NVT 3, leaf folder infestation was significantly lower in plots that received less nitrogen. PR476 had maximum insect damage and PR484, minimum. Leaf folders generally preferred fine-grained, scented varieties to short and medium-duration, nonaromatic varieties. ■

Incidence of rice leaf folder on varieties at various nitrogen levels. Kapurthala, India, 1978.

Variety	Leaf folder-damaged leaves[a] (no./ 10 hills)						
	0 kg N/ha	30 kg N/ha	60 kg N/ha	90 kg N/ha	120 kg N/ha	150 kg N/ha	Mean
NVT 1[b], short-duration varieties (110 – 120 days)							
PR103	10.7	12.3	11.0	11.7	13.0	14.1	12.2
PR404	9.3	9.3	9.1	10.7	15.7	18.3	12.2
PR405	1.7	12.3	8.0	11.3	15.1	11.3	12.1
PR406	9.0	10.3	14.1	12.3	12.3	18.3	12.8
PR422	9.3	10.1	12.0	15.0	16.1	16.0	13.3
Palman 519	12.3	4.1	9.3	10.3	12.0	12.3	10.2
Mean	9.1	9.9	10.1	11.9	14.2	16.2	12.1
NVT 2[c], medium-duration varieties (137 – 145 days)							
PR106	1.0	1.0	8.7	7.5	6.0	10.7	6.8
PR299 A	1.3	4.0	8.5	10.0	11.3	8.3	8.2
PR299B	8.0	8.1	8.3	9.3	1.3	13.1	9.2
PR504	9.1	9.3	5.3	8.7	8.1	8.7	8.4
Jaya	5.7	7.8	9.5	9.0	5.3	8.0	7.6
Mean	1.5	6.2	8.1	8.9	1.7	9.9	8 .0
NVT 3[d], aromatic varieties (120 – 140 days)							
PR214	11.0	14.3	28.1	33.1	38.0	42.3	28.0
PR431	10.7	12.0	23.1	21.1	34.1	41.3	25.0
PR416	18.0	21.3	21.0	29.0	32.3	41.1	28.2
PR484	10.3	14.0	11.1	19.0	34.1	39.3	22.5
Basmati 310	19.3	20.7	20.3	23.1	36.1	45.7	21.1
Mean	13.9	16.5	22.3	26.6	35.3	43.3	26.3

[a] Mean of 3 replications. Observations recorded 80 days after transplanting (DT).
[b] Plot size = 10.0 m^2, N applied in 3 equal splits at 4, 26, and 54 DT. Differences between varieties significant at 1%: LSD 0.05 = 3.1, LSD 0.01 = 4.4; between nitrogen levels, nonsignificant.
[c] Plot size = 12.5 m^2. N applied in 3 equal splits at 4, 26, and 53 DT. All factors nonsignificant.
[d] Plot size = 8.1 m^2. N applied in 3 equal splits at 5, 30, and 45 DT. Differences between varieties significant: LSD 0.05 = 3.8, LSD 0.01 = 5.5; between nitrogen levels, significant at 1%: LSD 0.05 = 5.5, LSD 0.01 = 7.3. Interaction nonsignificant.

Two different reactions of Rathu Heenati to the brown planthopper in Indonesia

Tatang S. and Agus S., Central Research Institute for Agriculture (CRIA), Sukamandi; and O. Mochida, Cooperative CRIA-IRRI Program, Sukamandi, Subang, West Java, Indonesia

The reactions of the variety Rathu Heenati to brown planthopper were checked seven times in the greenhouse and once in the paddy field at Sukamandi over a period of 3 years (see table).

Rathu Heenati gave two different reactions; one strain was resistant (scores, 0.2 – 0.9) in the greenhouse and the other was susceptible (8.6 – 8.9). Thus, scientists using Rathu Heenati as a resistant check should ensure that the seed is from the correct accession. ■

Reaction scores of Rathu Heenati to brown planthopper at Sukamandi, Indonesia, 1975–78.

Source	Time of check	Av score [a]	Tested in [b]
1st IRBPHN [c]	May 1975	8.9	GH
Breeding Dep., CRIA, Sukamandi	Jun 1976	0.4	GH
2d IRBPHN [c]	Dec 1976	8.5	GH
IRRI (acc. no. 11730)	Mar 1977	0.4	GH
3d IRBPHN [c]	Oct 1977	0.2	GH
Breeding Dep., CRIA,Sukamandi [d]	Jan 1978	8.5	GH
Breeding Dep., CRIA, Sukamandi [d]	Jan 1978	6.1	F
4th IRBPHN [c]	Dec 1978	0.9	GH

[a]1976 Standard Evaluation System for Rice (SES): 1 = little to no damage; 9 = plants dead.
[b]GH = greenhouse, F = field.
[c]International Rice Brown Planthopper Nursery.
[d]Seeds obtained from the same source.

Susceptibility of rice cultivars to paddy leaf miner

N. G. Patel, V. S. Patel, and J. F. Dodia, Main Rice Research Station, Gujarat Agricultural University (GAU), Nawagam 387540, Gujarat, India

The paddy leaf miner *Cerodontha oryzivora* sp. is a minor nursery pest that damages the anterior tips of leaves. But as agroecosystems change, it could become a major pest.

The maggot remains concealed and feeds on the internal leaf contents, leaving the epidermis intact. The damaged area appears papery with a maggot or pupa inside the infested streak.

An intensive survey was made in the 1978 monsoon season to gain basic information on leaf miner attack on different paddy cultivars. Seventeen paddy cultivars were grown at the Main Rice Research Station, GAU, Nawagam. From 75 to 100 plants were randomly selected from the plots and the percentage of leaves damaged by leaf miner was determined.

No cultivar was resistant (see table). Plant infestation ranged from 38 to 91%. On the basis of percentage of plants infested, early maturing cultivars were less susceptible than medium- and late-maturing rices. The trend was similar for leaf infestation, which ranged from 1.4 to 3.6% (except in Mochi Rice, which has few leaves). Medium- and late-maturing rices, except Salt Culture, also had higher infestation.

Although late-maturing varieties seemed more susceptible to leaf miner than early ones, results of studies conducted in 1976 by Upadhyay and associates did not reveal a correlation between crop maturity and leaf miner infestation level. ■

Relative susceptibility of paddy cultivars to paddy leaf miner. Gujarat, India, 1978 kharif.

Cultivar	Plants observed (no.)	Plants infested (%)	Leaves observed (no.)	Leaves infested (%)
Early-maturing				
Shukhvel 20	72	45.8	2697	1.6
118-1-5	77	63.6	240 3	3.6
GAUR1	82	59.8	3319	2.2
GTC	75	45.3	1741	2.2
Mochi Rice	96	61.5	748	11.2
GR3	79	38.0	289 1	1.4
Ratna	80	53.8	3259	1.6
Medium-maturing				
GAUR10	81	66.7	1954	3.6
GR11	82	58.5	1411	4.1
Late-maturing				
Jaya	75	90.7	1986	7.4
N19	85	77.6	1265	8.2
Salt Culture	94	52.1	2206	2.6
Pankhali 203	80	80.0	1366	6.1
J208	80	68.8	1606	4.1
Kamod 118	76	90.8	I449	8.1
Mahsuri	82	61.0	2521	2.3
GAUR100	86	53.5	1400	4.1

Mass rearing of the rice gall midge in the greenhouse in Indonesia

Arifin Kartohardjono, assistant entomologist, Department of Agriculture, Central Research Institute for Agriculture, Jalan Merdeka 99, Bogor, Indonesia

The rice gall midge *Orseolia oryzae* has been reared in the greenhouse at Bogor, Indonesia, since 1974. The rearing procedure is based on the biology of the

Number of gall midge adults collected per month in the greenhouse. Bogor, Indonesia, 1975–78.

Month	Gall midge adults (thousand)			
	1975	1976	1977	1978
Jan.	1.3	2.8	13.3	30.2
Feb	2.1	2.6	11.1	25.9
Mar	3.9	4.1	10.9	26.4
Apr	7.0	5.1	10.3	21.8
May	4.3	3.4	12.6	26.3
Jun	7.1	4.3	19.8	23.8
Jul	5.7	5.0	26.4	25.6
Aug	7.6	5.4	34.7	28.6
Sep	2.8	10.4	22.8	23.7
Oct	4.5	12.3	24.9	25.0
Nov	3.2	10.7	18.1	20.2
Dec	2.7	12.4	22.0	17.6
Av	4.4	6.5	18.9	24.6
Sex ratio (female: male):	1.7:1	1.4:1	1.4:1	1.4:1

insect and the stage when it feeds on plants.

Results of rearing are presented in the table. The average number of adults collected per month was 4,402 in 1975, 6,540 in 1976, 18,912 in 1977, and 24,594 in 1978. The insects are useful for continuity in mass rearing, varietal screening, and other gall midge experiments. ■

GENETIC EVALUATION AND UTILIZATION

Drought resistance

Screening for harvest index in upland rice in southwestern Nigeria

J. B. Oyedokun, Institute of Agricultural Research and Training, University of Ife, P.M.B. 5029, Moor Plantation, Ibadan, Nigeria

Yields of rainfed upland rice are low in the rain forest zone of southwestern Nigeria partly because farmers use OS6, a long-culmed, low-tillering. and lodging-susceptible cultivar that responds poorly to fertilizer nitrogen (N). Lodging adversely affects percentage of filled grains, a major yield component.

The selection criteria suggested for high-yielding, N-responsive semidwarf cultivars include harvest index, ratio of grain, and biological yield (excluding root weight).

Among the rice accessions screened in the greenhouse, 5 improved cultivars-TOS4164, TOS4172, TOS4632 (from the International Institute of Tropical Agriculture). IR30, and OS6 — were compared at 4 rates of N (0, 150, 300, and 450 ppm), replicated 3 times in 10-liter plastic pots that were watered once daily, without flooding. Data on soil water-holding capacity were not collected. Soil analysis before cropping indicated a pH of 6.7, 2.2% organic C, 0.17% total N, 6.7 kg available P/ha, and 238 kg available K/ha.

IR30 had the highest mean harvest Index (86.7%) and differed highly significantly from the other rices ($P < 0.01$) (see table). That implies that IR30 used a greater proportion of the nutrients in the production of grain than of straw. The other cultivars did not differ significantly. ■

Harvest indexes of 5 rice cultivars.[a] University of Ife, Ibadan, Nigeria.

Cultivars	Harvest index (%)				
	0 ppm N	150 ppm N	300 ppm N	450 ppm N	Mean
IR30	99.9	115.7	51.3	74.0	86.7 a
TOS4164	75.5	49.3	46.8	64.4	59.0 b
TOS4172	52.0	58.8	62.8	47.0	55.2 b
TOS4632	60.4	55.0	42.5	45.5	50.9 b
OS6	48.7	56.9	63.7	64.4	58.4 b

[a] Standard error = 13.0. Coefficient of variation = 21.0%. Means followed by the same letter are not significantly different at the 5% level.

GENETIC EVALUATION AND UTILIZATION

Adverse soils tolerance

IR42: a modern variety suited to the small rice farmer

F. N. Ponnamperuma, Soil Chemistry Department, International Rice Research Institute

Small farmers lack the resources to provide the water control and management inputs needed to extract the high yield potential of modern varieties. To benefit from the green revolution. they need varieties with built-in tolerance for adverse environmental factors, i.e., too little or too much water, diseases and insects, and nutrient deficiencies and soil toxicities. The Philippine-named IR42 is the closest we have to such a variety.

IR42 has good agronomic characteristics. It yields well at low levels of nitrogen and phosphorus fertilizers and has moderate tolerance for salinity, alkalinity, iron toxicity, excess organic matter, and zinc deficiency. It is resistant to rice tungro virus, grassy stunt, bacterial blight and blast, and has intermediate resistance to sheath blight and *Cercospora* leaf spot. It has resistance to biotypes 1 and 2 of

Performance of IR42 and of other IR varieties on 6 problem soils. Philippines, 1978 dry and wet seasons.

Problem	Variety	Rating[a]	Grain yield (t/ha)	Location
Salinity	IR42	MT	5.6	Sinacaban, Misamis Occidental
	IR4630-22	T	5.1	
Iron toxicity	IR42	MT	4.6	Malinao, Camarines Sur
	IR36	T	2.2	
Peat soil	IR42	MT	4.2	Colorado, Agusan del Norte
	IR34	T	2.4	
Nitrogen deficiency	IR42	–	4.6	IRRI
	IR34	–	1.2	
Phosphorus deficiency	IR42	MT	3.9	Pangil, Laguna
	IR20	T	4.2	
Zinc deficiency[b]	IR42	MT	5.4	Gen. Santos, South Cotabato
	IR34	T	5.0	

[a]MT = moderately tolerant, T = tolerant. [b]Partly corrected by zinc oxide dip.

the brown planthopper and moderate resistance to green leafhopper and yellow stem borer. It is resistant to gall midge in several states of India.

In field tests, IR42 outyielded most IRRI varieties and elite lines on nutrient-deficient or toxic wetland rice soils and responded well to moderate applications of nitrogen and phosphorus fertilizers.

Because it combines high yield potential with pest resistance and tolerance for nutrient deficiencies and soil toxicities (see table), IR42 may be a solution to the small rice farmer's problems. ■

GENETIC EVALUATION AND UTILIZATION

Deep water

Miniature deepwater tanks for screening chemicals against ufra

P. G. Cox, plant pathologist, and L. Rahman, scientific officer, Bangladesh Rice Research Institute (BRRI), Overseas Development Ministry Deep-water Rice Pest Management Project, Joydebpur, Dacca, Bangladesh

Miniature deepwater tanks can be made from plastic soil pipe, 10 cm (4 inches) in diameter, cut into 1-m lengths. The pipes are sealed at the bottom with polythene and mounted upright in large earthenware pots of soil (see figure). Such tanks were used to determine the dosage of carbofuran needed to control ufra disease of deepwater rice, caused by the stem nematode *Ditylenchus angustus,* after the appearance of symptoms in the vegetative phase.

Diseased tillers (those that exhibited early symptoms of attack, a faint chlorotic splash pattern on the young leaves) were transplanted from a field badly affected by ufra during August directly into the tubes at 3 tillers/tube. Furadan 3G was added to each tube at 1 of 5 rates (0, 1, 4, 7, 10 g), with 5 replications/rate, and the tubes were arranged in a 5 x 5 latin square. The water depth in each was maintained at 0.5 m. When the tubes were scored about 2 months later, symptoms were observed on 40% of the tillers in the control tubes, 35% in the tubes receiving 1 g of Furadan 3G, and none in the other tubes. The chemotherapeutic effect of carbofuran is between 1 and 4 g of 3G granules/tube.

Miniature deepwater tanks for screening against ufra disease. Bangladesh Rice Research Institute.

This simple technique may be adapted to screen many types of chemicals (applied as granule or foliar spray) for activity against ufra when the symptoms appear. It is superior to the use of inoculated tillers because the relationship between the nematode and its host develops under natural conditions until transplanting. It is also superior to field experimentation because reinfestation is completely excluded, the plot size can be reduced, and the number of replications can be increased correspondingly. ■

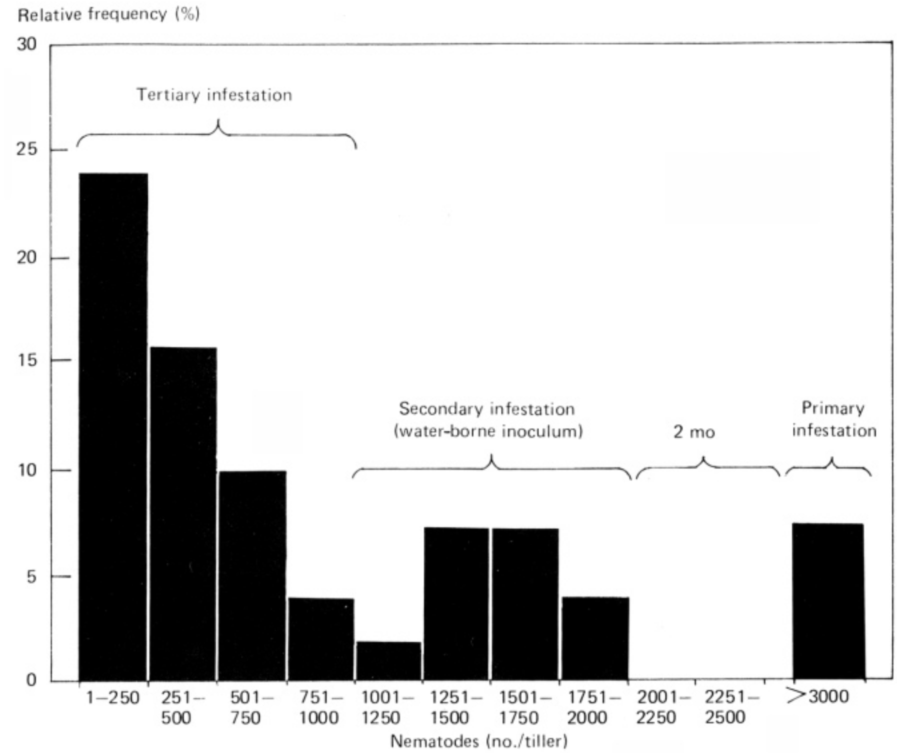
The ufra nematode population in deepwater rice in Bangladesh

P. G. Cox, plant pathologist, and L. Rahman, scientific officer, Bangladesh Rice Research Institute (BRRI)/Overseas Development Ministry Deepwater Pest Management Project, BRRI, Joydebpur, Dacca, Bangladesh

Ufra disease caused by the rice stem nematode *Ditylenchus angustus* devastates deepwater rice in southern Bangladesh. lnfested crop residues cause primary infestation and water-borne inocula, secondary infestation during the growing season. Distinction between the two kinds of infestations is necessary when investigating the effect of treatments during land preparation. An examination of the nematode population in individual tillers during the vegetative phase can help in making such distinctions.

To determine the relative frequency of nematodes per individual tillers, a random sample of 50 tillers was taken from a field badly affected by ufra in Comilla district. Each tiller was cut off just below the top node. then truncated 15 cm above the node. Each segment was cut into 0.5-cm pieces and placed in a 7-ml bijou bottle with 2 ml water. After 24 hours the nematodes extracted by the water were counted with a Peters' 1-ml counting slide.

Three distinct modes in frequency distribution were found; the high mode was not continuous with the remainder



The relative frequency of nematodes per tiller in a field in Comilla district, Bangladesh, 23 September 1978. Note: 16% of tillers were still not infested.

of the distribution (see figure). The crop is sown during the first rains. when no water stands in the fields. Nematodes have little chance of migrating from infested hills (primary infestation) to nearby hills until the floods arrive 6 to 8 weeks later. The gap in the distribution represents the 2-month lag before secondary infestation by water-borne inocula can begin. With the advent of floods, there is a burst of new infestation because the nematode population, although confined inside the primary infestation, has been growing. That accounts for the central mode in the population. Secondary infestation at initial flooding may cause the disease to spread over long distances. As the population continues to increase in primary and secondary infestations the nematodes spread through water, which accounts for the left-hand mode. This tertiary infestation consolidates the ufra patch.

If this Interpretation is correct, examination of the nematode population before panicle initiation will have several uses in ufra research: 1) to determine the inoculum source in experiments in farmers' fields (by presence or absence of the right-hand mode), 2) to distinguish between individual components of the nematode population growth rate, and particularly 3) to permit study of nematode population growth independently of the host's tillering behavior (by considering the rate at which the right-hand mode moves in that direction).■

Flowering and yield response of late-maturing varieties under normal and waterlogged conditions

V. N. Sahai, Sheela Ghosh, H. K. Suri, S. Saran, and M. S. Haque, Rajendra Agricultural University, Bihar Agricultural Research Institute, Mithapur, Patna 800001, India

Eighteen late-maturing varieties were tested under normal and waterlogged conditions (30–50 cm water depth) during 1977 kharif. The experiment was conducted in randomized blocks with 3 replications, fertilized with N, P_2O_5, and K_2O at 60-30-30 kg/ha.

Flowering was generally delayed under waterlogged conditions. The delay ranged from 1 to 11 days longer than under normal conditions (see table). Tiller number and yield were also reduced by waterlogging.

Only Panidhan 1, a selection of IR442, increased significantly in grain yield

Flowering and grain yield under normal and waterlogged conditions. Patna, India.

Designation	Parentage	Days (no.) to flowering		Yield (t/ha)	
		Normal	Water-logged	Normal	Water-logged
IET3235	IR8/SLO13	125	126	5.0	4.4
IET3236		124	126	4.3	4.0
IET3257	CR63-3218-1/Pankaj	120	121	4.7	4.3
IET3261	IR8/BJl//IR22	115	117	3.8	3.4
IET4084	IET728/CR1014	122	123	4.1	3.8
IET4086	CR36-48/CR70-80-2	108	119	4.1	3.8
IET4087	CR63-5218-l/Pankaj	115	118	3.4	2.8
IET5631	F1IR2042/CR94-13	122	124	4.5	3.8
IET5633		122	123	4.1	3.3
IET5638		114	115	4.5	3.8
IET5656	RPW6-13/Sona	117	118	4.1	3.6
IET5852	Pankaj/Jagannath	132	133	4.1	3.5
IET5853		131	133	4.9	4.3
IET5855	Sona/Mahsuri	125	126	4.4	3.8
Intan		122	125	2.6	2.4
Mahsuri		118	119	3.0	2.6
Pankaj		116	118	5.0	4.1
Panidhan-l	IR442 selection	102	104	2.0	2.3
C.D. at 5%				0.60	0.52

under waterlogging, possibly because of its intermediate plant height and ability to elongate with rising water.

IET3235, IET3257, IET5853, and Pankaj gave the highest yields under waterlogged conditions. IET3235 and Pankaj were also the highest yielders under normal water conditions.

GENETIC EVALUATION AND UTILIZATION

Cold tolerance

Highlights of the Korea-IRRI Collaborative Program on Rice Cold Tolerance

B. S. Vergara, J. K. Ahn, R. M. Visperas, G. S. Chung, and J. H. Lee

A collaborative Korea-IRRI program on rice cold tolerance was initiated in late 1977. The first experiments were conducted in 1978 at Chuncheon Branch, Crop Experiment Station, Office of Rural Development. This report highlights some of the experiments.

A total of 750 entries from the International Rice Cold Tolerance Nursery (IRCTN) and early generation breeding lines from Korea, Indonesia, and IRRI were subjected to continuously flowing cold water, 17 to 27°C, from the tillering stage until maturity. Varieties responded widely in tolerance. The best entries for each agronomic character follow:

Well-exserted panicles: Somewake, Oirase, Bandalbyeo, Thankote Marsi, IR5867-50-3-2-2-1, IR9202-22-3-2.

Short growth duration: Matsumae, China 1039, K140-52-3, Fuji 269, K39-'96-1-1-1-2.

Intermediate plant height: Firooz, HP46, Habiganj Boro II, IR2403-PLPB-7-2-1-3B. IR4097-P1P6-1B, IR4999-B-Jn2B, IR5086-P1P6-2B, IR5467-2-2-2, IR10212-12, Jaliya, MPR-1, Paro White, Thankote Marsi.

High spikelet fertility: IR9202-32-2-3, IR8460-7-2-1, IR5868-112-1-7-1-1, IR2403-PlpB-5-4-1B, IR9202-25-1-2, China 988 (HPU16), China 988-LS 13.

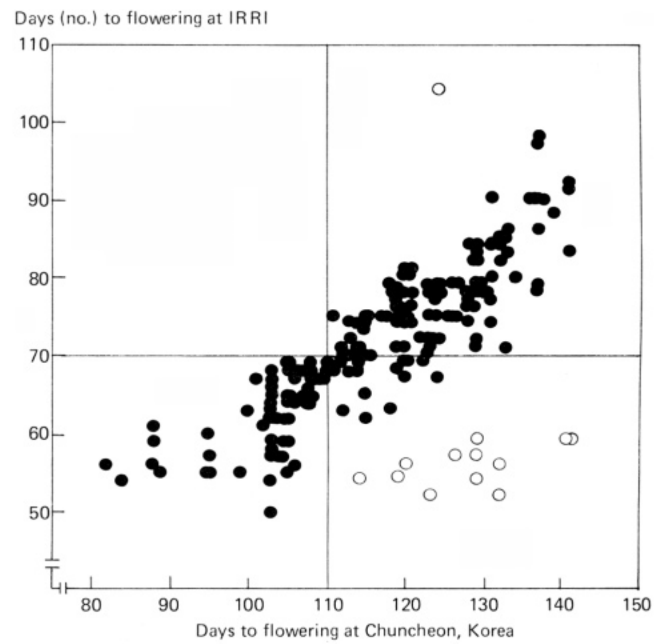
Good phenotypic acceptability at maturity: IR5867-50-3-2-2-2, IR7167-33-1-7-3, IR7167-33-2-3-3, IR7167-33-2-4-1, IR7167-33-2-4-3, IR7167-33-2-5-1, IR9202-22-3-2.

To identify extremely cold-tolerant parents for the breeding program. the best Korean and IRRI selections were subjected to 17°C water from tillering to maturity.

Naengdo 13 had excellent panicle exsertion. Fuji 269 and ARC6240 had the shortes growth duration. The tallest at flowering were Silewah, Heug dae gu. and Pho Kha. At harvest, Page Sampe Tuah had the most spikelets per panicle; ARC6000, the most spikelets per square meter; and Shoa-nan-tsan and ARC6000, the highest spikelet fertility.

The table, which gives the best donors from our tests, shows that many indicas are more cold tolerant than the japonicas.

The possibility of selecting early lines at Los Baños, Philippines, in the wet season, despite the high temperature, was tested by comparing the growth duration of the 219 entries in the 1978 IRCTN planted both at



Growth duration of 1978 IRCTN entries grown in Korea and IRRI

Varieties that were excellent in at least 3 plant characters desired in low-temperature areas. Korea-IRRI collaborative program, 1978.[a]

Agronomic character	ARC 6000	Leng Kwang	Stejaree 45	01 Byeo	Ggae Byeo	Shoa-Ga-Dau	Shoa-Nan-Tsan	HR 33
Good phenotypic acceptability	x	x	x	x			x	
Excellent panicle exsertion	x	x		x				
Optimum culm length		x			x	x	x	x
Earliness (days)	111	119	114	126	125	127	113	138
Stable growth duration	x			x	x	x		x
Good tillering	x	x						
Long panicles						x	x	x
High spikelet no./panicle					x			
High spikelet no./m^2	x	x	x				x	
High spikelet fertility	x	x	x	x			x	

[a] x = desired characteristic is present.

Los Baños and at Chuncheon (see figure).

Entries with long growth duration at Los Baños generally also had long growth duration at Chuncheon (see figure). But 12 entries had short growth duration at Los Baños and relatively long duration at Chuncheon, probably because they were photoperiod-sensitive and the days in Chuncheon were long.

Preliminary selection for early maturity can be done at Los Baños and entries which flower in more than 70 days can be removed.

Indica varieties in the lRRI germplasm collection with growth duration of 94 days or less at Los Baños were evaluated in Korea. Most of the 240 varieties tested had early growth duration but the long day lengths in Korea apparently delayed 8 photoperiod-sensitive varieties.

Hungarian 1 and Tinpakhia were the earliest, 20 days earlier than the short growth duration Josaengtongil at 21.2°C water temperature. ■

Pest management and control DISEASES

Fatty acid content of rice leaves affected by bronzing disease

Manjula Abeywickrama, Department of Biological Sciences, University of Sri Jayawardenapura, Sri Lanka

Iron toxicity or *bronzing* is a major physiological disease of rice in Sri Lanka's wet zone. Cytological changes in diseased leaves have shown that the accumulation of brown globules in chlorophyllous tissues is a characteristic associated with bronzing. The brown globules are weakly acidic.

This study showed that brown globules have an affinity to stains such as Sudan III, Sudan IV, and Nile Blue – an indication that the globules are fat or oil droplets. To further ascertain that the brown globules are oil, the fatty acid contents of diseased and of healthy leaves were quantitatively compared.

Plant materials of rice varieties BG34-8, BG11-11, IR2061-214-2-7-6-3, and H9 were analyzed. BG34-8 and H9 were grown in liquid culture; BG11-11 and IR2061-214-2-7-6-3 were obtained from the IRRI-Sri Lanka collaborative iron toxicity screening site at Padukka. To induce iron toxicity, ferrous sulfate was added to the culture medium. The varieties grown in the field were planted in replicates; disease incidence was observed only in some of the replicates. Leaf samples were collected from healthy and severely bronzed plants. Lipids extracted from the samples were processed and the methyl esters of fatty acids were analyzed by gas-liquid chromatography. All fatty acids were identified by retention times and peak enhancements with standard solutions. Fatty acid contents were calculated directly by the peak-area method (see table).

Total area of peaks obtained in leaves of healthy and diseased plants of four rice varieties. University of Sri Jayawardenapura, Sri Lanka, 1977.

Designation	Total area (mm^2) in	
	Healthy plants	Diseased plants
BG34-8	1457	2128
H9	2914	4022
BG11-11	1263	2097
IR2061-214-2-7-6-3	3432	4516

The carbon number of the fatty acid that were identified ranged from 6 to 20 and the C-20 acid was found only in the diseased condition. A two-way analysis of variance revealed highly significant fatty acid contents in the leaves of diseased plants and highly significant variations of the fatty acid contents of different rice varieties. ■

Suspected ragged stunt disease in India

A. Ghosh, B. T. John, and J. R. K. Rao, All India Coordinated Rice Improvement Project, Rajendranagar, Hyderabad 500030, Andhra Pradesh, India

Rice ragged stunt disease, first reported in the Philippines, was later found in various parts of Indonesia. The disease, which has been identified as caused by a virus, is transmitted by the brown planthopper *Nilaparvata lugens.*

Specimens showing the characteristic symptoms of the new disease were first seen at the Regional rice Research Station, Chiplima, in 1975 and later at the Central Rice Research Institute, Cuttack. In 1976 and 1977, plants with similar symptoms were again seen, but the incidence was low. Transmission studies are being attempted, and varieties from the germplasm bank will be screened to identify resistant donors. ■

A new type of malformation in rice

A. Panda, J. K. Roy, and R. N. Misra, Division of Genetics, Central Rice Research Institute (CRRI), Cuttack 6, India

A new type of rice malformation was observed in the germplasm maintenance plots at CRRI in 1978 kharif. Affected tillers produced bunches of leaves that appeared like a fan; the tillers remained in the vegetative stage (see photo). At later growth stages, the upper portions of the tillers swelled, giving a false impression of an enclosed panicle due to the merging of the upper internodes and consequent crowding of leaves, covered by the outer leaf sheaths. In a few cases, incompletely emerged panicles with discolored spikelets aborted. Because the affected tillers had more internodes (7–10), their height sometimes exceeded that of the unaffected tillers. In other cases, a large number of shorter affected tillers gave the plants a bushy appearance. The leaves and internodes of affected tillers were crinkled and often twisted. Nodal branching was frequent. But vigor was not reduced in the vegetative stage. The malformed tillers often dried about a month after the unaffected plants matured.

Examination of the incompletely emerged and discolored panicles showed

Affected tillers. The arrow points to leaves that have remained in the vegetative stage CRRI, India.

large numbers of nematodes inside the spikelets. No such nematodes were observed in affected tillers that remained in the vegetative stage. The primordial portions of affected tillers had one larva each of some insects. That symptom was not observed in gall midge-resistant varieties such as Ptb21 and Ptb18. Differences in varietal reaction to this malformation. as well as its cause, are being investigated. ■

Influence of nitrogen fertilization on development of sheath blight

S. Kannaiyan and N. N. Prasad, Microbiology Laboratory, Agriculture College, Annamalai University, Annamalai Nagar 608101, Tamil Nadu, India

Sheath blight disease of rice caused by *Rhizoctonia solani* is severe in several rice-growing districts of Tamil Nadu. A pot-culture experiment was carried out to determine the effect of nitrogen (N) fertilizer on disease development. Three plants of ADT31, which is susceptible to sheath blight, were raised in concrete pots in kuruvai (Jun-Sep). Levels of 0, 49, 99, 148, 198, and 247 kg N/ha (converted from kg/acre) were calculated and applied with urea. At all N levels, 62 kg P/ha as superphosphate and 62 kg K/ha as muriate of potash were applied. Half of the N was applied as basal, along with the P and K; and the remaining half was topdressed 25 days after transplanting. At the maximum-tillering phase, the crop was inoculated with the pathogen by the straw-bit method developed by Venkata Rao and Kannaiyan in 1973. The intensity of disease development was recorded using the Standard Evaluation System. Increased N level proportionately increased disease incidence (see table). Severe disease incidence at higher N levels reduced the grain yield considerably. ■

Effect of nitrogen on the incidence of sheath blight disease.[a] Tamil Nadu, India.

N level (kg/ha)	Mean disease index (%)	Increase (%) over control	Mean grain yield (g/pot)	Increase (+) or decrease (–) (%) over control
0	41	–	10.4	–
49	52	25	16.3	+56.7
99	62	52	14.5	+39.9
148	14	80	12.2	+16.8
198	83	103		10.8 + 4.0
241	88	113		10.2 – 1.9

[a] Disease: SE = 0.8746, CD = 2.64. Grain yield: SE = 0.6801, CD = 2.05. Significant at 1% level.

Rice ragged stunt disease in Orissa, India

D. Mishra, junior plant pathologist, All India Coordinated Rice Improvement Project, Regional Research Station, Chiplima, Sambalpur, Orissa, India

During 1977–78 kharif, a rice disease was observed, especially in late-planted rice, in the experimental fields of the Regional Research Station of Orissa University of Agriculture and Technology, Chiplima.

Diseased plants were stunted and leaves became ragged and serrated. Vein-swelling was marked on the outer surface of the leaf sheath. Flag leaves were small, twisted, and malformed. Panicle emergence was often incomplete and panicles bore mostly empty grains. Most of the tillers of the diseased plants were branched and produced many panicles. Flowering in diseased plants was delayed. Symptoms in the ratoons were similar.

Because the above symptoms are similar to those of rice ragged stunt disease, reported and described by K. C. Ling (IRRN 2(5):6–7, 1977). the disease is suspected to be ragged stunt, reported for the first time in Orissa.

Field observations on percentage of hills infected and percentage of tillers showing malformation and twisted leaves among 73 rice varieties from the National Screening Nursery were conducted in 1978 kharif. Infected hills varied from 0 to 90% among varieties; malformed tillers, from 0 to 61%. Highly infected varieties included RP884-33-6, OR34-21, OR27-7, IET1444, Benibhog, IR28, and Cauvery. IR36, Pankaja, OR117-4, and ADT31 showed no disease incidence. Transmission studies to confirm the disease are in progress. ■

Chemical control of sheath rot disease of rice

S. Kannaiyan, Plant Pathology Laboratory, Paddy Experiment Station, Tirur 602025, Chingleput district, Tamil Nadu, India

Sheath rot caused by *Acrocylindrium oryzae* is becoming serious in several high yielding rice cultivars. A pot-culture experiment on chemical control of sheath rot was conducted in pishanam (Jan-Apr) 1978, using the susceptible variety IR20. Eight fungicides – Hinosan EC, Kitazin EC, Benlate, Bavistin, Difolatan, Miltox, N.F. 48, and Daconil – at 0.2% concentrations were sprayed on the plants twice at 10-day intervals during the flowering stage. The disease incidence was recorded during harvest with the use of the 1976 Standard Evaluation System for Rice scale.

Plants treated with Benlate had only 6.3% disease incidence; plants treated with N.F. 48, 6.6%; and plants treated with Daconil, 6.8%. The unsprayed control had 41.4% incidence. Pots sprayed with Bavistin had 8.5% incidence; with Difolatan, 8.7%; with Kitazin, 10.6%; with Hinosan, 11.0%; and with Miltox, 13.9% — also lower than incidence in the control. ■

Control of sheath blight disease of rice

S. Kannaiyan and N. N. Prasad, Microbiology Laboratory, Agriculture College, Annamalai University, Annamalai Nagar 608101, Tamil Nadu, India

The rice variety ADT 31, which is susceptible to sheath blight caused by *Rhizoctonia solani,* was grown in concrete pots during kuruvai (Jun-Sep) 1977. At maximum-tillering stage the plants were inoculated with the pathogen by the straw-bit method developed by Venkata Rao and Kannaiyan in 1973. The test fungicides Bavistin, Kitazin, Hinosan, Benlate, Demosan, thiabendazole, Vitavax, Daconil, Brassicol, and wettable ceresan were used at 0.05, 0.1, and 0.2% levels. They were sprayed once at 12 hours after inoculation. The disease intensity was assessed with the 1976 Standard Evaluation System for Rice scale. Compared with the untreated control, all the fungicides effectively controlled the disease. Bavistin, Kitazin, Hinosan, Benlate, Demosan, and thiabendazole gave significant disease control (<75%). An increase in spray concentration of all fungicides lowered the disease index (see table). ■

Effect of fungicides on the control of sheath blight disease of rice. Tamil Nadu, India.

Fungicide	0.05% level		0.1% level		0.2% level	
	Mean disease index (%)	Reduction (%) over control	Mean disease index (%)	Reduction (%) over control	Mean disease index (%)	Reduction (%) over control
Bavistin	5.6	92.8	4.9	93.7	3.3	95.7
Kitazin	7.1	90.9	5.7	92.7	4.5	94.2
Hinosan	9.0	88.4	7.2	90.7	5.4	93.0
Benlate	12.2	84.3	9.1	88.3	7.5	90.3
Demosan	13.2	83.0	10.1	87.0	7.0	91.0
Thiabendazole	17.9	77.0	14.4	81.5	12.1	84.5
Vitavax	24.1	69.1	18.4	76.4	16.0	79.5
Daconil	26.2	66.4	22.1	70.9	17.9	77.0
Brassicol	30.3	61.5	25.8	66.9	23.2	70.2
Wettable ceresan	64.2	17.7	58.8	24.7	52.0	33.4
Control	78.1	–	78.1	–	78.1	–

Treatments: S.E. = 0.4262, S.E.D. = 0.6028, C.D. = 1.23.
Concentrations: S.E. = 0.2335, S.E.D. = 0.3302, C.D. = 0.67
Treatments x concentrations: S.E. = 0.6028, S.E.D. = 0.8524, C.D. = 1.74. Significant at 1% level.

Reaction of some common weeds in Sri Lankan rice fields to *Corticium sasakii*

J. M. R. S. Bandara, lecturer, Plant Pathology, and V. Nadaraja, Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Sheath blight is a common rice disease in the wet zone of Sri Lanka. The degree of infection varies with region and season. But the fungus appears to survive continuously from season to season through an alternate host or in rice stubble of infected fields.

Two virulent isolates of *Corticium sasakii,* PI 1 and PI 2, were used to test the ability to infect several weeds common in rice fields. Eight species of weeds were grown in the greenhouse at 23-79°C. After 7 weeks *C. sasakii* inoculum grown in sterilized rice seeds was incorporated into the plants' substrate. The pathogenicity of the two isolates to the weeds is summarized in the table.

All the weeds tested. except *Eriocaulon* species and *Monochoria vaginalis,* were susceptible to sheath blight and showed spreading lesions. Symptoms were similar to those on rice plants. Spots that originated at soil level were irregular and pale green. They turned off-color and spread further upward along the stem. In *Echinochloa,* the sheath appeared water-soaked and wrinkled. The *Echinochloa* species were

Reactions of some common weeds[a] in rice fields to sheath blight fungus. Peradeniya, Sri Lanka.

Host	Days before lesion development		Mean lesion length (mm) after 2 wk		Disease incidence[b]
	PI 1	PI 2	PI 1	PI 2	(%)
Echinochloa crusgalli	5	7	8	6.2	30.8
Echinochloa colonum	5	6	8	5.5	30.0
Fimbristylis miliacea	7	8	5.2	3.0	20.0
Fimbristylis littoralis	7	7	6	2.8	16.9
Cyperus difformis	9	13	1.8	1	0.7
Eriocaulon species	–	–	–	–	–
Monochoria vaginalis	–	–	–	–	–

[a] Mean of 12 plants. [b] 2 wk after inoculation.

more susceptible to infection than the other species tested; they were also morphologically similar to the rice plant.

Since the weeds are found growing in rice fields throughout the year, the fungus *C. sasakii* probably overwinters on them. The weed populations on bunds and hedges during the period of cultural operations would facilitate the pathogen's survival and help continue the disease cycle. The cycle could be easily interrupted by cleaning the bunds and eliminating graminaceous weeds. particularly *Echinochloa* species. ■

National symposium on sheath blight and blast in Madras, India

K. Manibhushan Rao, convener, Centre for Advanced Studies in Botany, University ofMadras, Madras 600 005, India

Active rice research workers met at a 1-day symposium on the present understanding of sheath blight and blast diseases of rice at the Centre of Advanced Study in Botany, University of Madras, on 9 February 1979. The purpose was to review and discuss in depth the latest findings on the two important rice diseases.

Prof. A. Mahadevan, Centre director, welcomed the participants and observers. Dr. N. Parthasarathy, former director, Central Rice Research Institute (CRRI), Cuttack, presided, and H. K. Pande, CRRI director, delivered the keynote address.

Dr. Parthasarathy traced the history of rice and its pathology. Dr. Pande stressed the water technological aspects in augmenting yield. Two sessions were devoted to sheath blight and one to blast.

Dr. V. T. John presented an account of genetic resistance and chemical control of rice diseases. He suggested the use of artificially inoculated Typha-leaf bits as an alternate source of field inoculum for varietal screening against sheath blight. Most workers in screening trials use the stem-tape inoculation technique developed by Amin in 1975. Although cumbersome, the technique gives consistent results. Dr. John reported that such cultivars as ARC15672, ARC18275, ARC18545, Ramedja, CET5656, and CET5952 are resistant. But it was suggested that they be listcd as tolerant because no immune variety has been identified so far and the reactions of the cultivars vary from season to season. A fundamental paper on histopathological studies was presented by Dr. Manibhushan Rao. Fungi penetrate the host tissue through infectious lobate hyphae or by direct penetration through natural openings. The attraction toward somata-stomatal tropism caused a fivefold increase in penetration in susceptible cultivars.

A general account of the Indian work on sheath blight was reviewed by Dr. Premalata Dath. Her report that a phyllophane bacterium effectively inhibited the sheath blight parasite generated much interest. The subject should be further investigated. Kannaiyan and Prasad reported on soil amendments with neem cake and effective disease control. They also presented a comprehensive account of the physiology and host range of the pathogen. Sheath blight incidence at Maruteru was reported by Koteswara Rao, who suggested that intensive investigations on its control be started.

On blast, Dr. Sridhar stressed the role in resistance of antimicrobial substances (prohibitins) formed before infection and of those that increase in quantity after infection (phytoalexins). Little is known about phytoalexin production in rice. The question of considering as phytoalexins nomilactones A and B produced in rice leaves after blast infection was discussed in depth. Venkata Rao indicated that in 6 years of screening trials on blast conducted at Nellore, no correlation between leaf and neck blast incidence was found. Dr. John presented a general account of blast disease, emphasizing varietal resistance and fertilizer application.

Dr. Chakrabarthi closed the symposium with a special lecture on the perpetuation and spread of blast.

The participants repeatedly stressed that sheath blight has become significant in many rice-growing tracts. Conditions that predispose the sheath blight pathogen should be investigated. A clear understanding of the host-pathogen interaction is lacking. Further work on the influence of cultural and environmental factors and of soil conditions on varietal resistance is needed.

The variability of *Pyricularia oryzae,* the causal organism of rice blast disease, is to be studied in detail. Genetic and cytologic investigations of the pathogen as well as epidemiologic studies including forecasting and warning systems should be made. A large-scale search for chemicals that induce systemic disease resistance in plants will be conducted. ■

Bleaching powder for bacterial blight control

A. Palaniswami and N. Jaleel Ahmed, All India Coordinated Rice Improvement Project, Aduthurai 612101, Tamil Nadu, India

An attempt to control bacterial blight of rice with stable bleaching powder (SBP) containing 35% chlorine was made at Aduthurai, Tamil Nadu, in 1078 kuruvai. The chemical was mixed with dry sand in a 4–1 ratio. The disease was assessed on variety TN1 in 5 hills/plot at the maximum tillering stage, the shoot blade stage, and 10 days after 50% flowering.

No disease was observed in the first two stages.

Disease incidence was not checked significantly when SBP was applied to the soil in a wet seedbed at 24 hours

Effect of stable bleaching powder (SBP) on bacterial blight control. Tamil Nadu, India.

Application of SBP at	Mean disease index (%)	Yield (t/ha)
5 ppm to soil 24 hours before seeding	54	1.1
30 ppm to nursery 24 hours before uprooting seedlings	47	0.8
5 ppm to seedbed, 30 ppm to nursery, and 50 ppm at panicle initiation	52	0.6
30 ppm to nursery and 50 ppm at panicle initiation	41	0.6
Control (untreated)	55	0.9

before seeding or at 24 hours before uprooting seedlings, or to the plants at the panicle initiation stage (see table). Application of SBP 24 hours before the uprooting of seedlings delayed seedling establishment by 10 to 12 days. Its application to the standing crop caused severe foliar damage due to phytotoxicity, and sharply reduced yields. ■

Sheath blight incidence in weed hosts

S. Kannaiyan and N. N. Prasad, Microbiology Laboratory, Agriculture College, Annamalai University, Annamalainagar 608101, Tamil Nadu, India

The natural occurrence of sheath blight of rice caused by *Rhizoctonia solani* in 21 weed hosts was recorded in both kuruvai (Jun–Sep) and thaladi (Oct–Jan). The pathogen from diseased weed hosts in rice field bunds was isolated in rice agar medium and used to inoculate the susceptible variety ADT31. The development of symptoms was observed and the pathogen's identity confirmed.

Sheath blight occurred severely in *Eriochloa procera, Andropogon asper, Cynodon dactylon,* and *Ischaemum indicum* (see table). That indicates that the pathogen can perpetuate itself in weed hosts during the off-season. ■

Perpetuation of *R. solani* in weed hosts. Tamil Nadu, India.

Weed host	Family	Disease reaction[a]
Commelina diffusa Burm. f.	Commelinaceae	+
Chionachne koenigii (Spreng.) Thw.	Gramineae	+
Cyperus rotundus L.	Cyperaceae	+
Digitaria longiflora (Retz.) Pers	Gramineae	+
Merremia emarginata (Burm. f.) Hall. f.	Convolvulaceae	+
Panicum repens L.	Gramineae	+
Paspalum scrobiculatum L.	”	+
Digitaria adscendens (H.B.K.) Henr.	”	+
Chloris barbata Sw.	”	+
Paspalidium flavidum (Retz.) A. Camus	”	++
Brachiaria mutica (Forsk.) Stapf	”	++
Fimbristylis ovata (Burm. f.) Kern	Cyperaceae	++
Desmodium triflorum (L.) DC.	Papilionaceae	+++
Imperata cylindrica (L.) Beauv.	Gramineae	+++
Urochloa panicoides Beauv.	”	+++
Alysicarpus monilifer Dc.	Papilionaceae	+++
Dichanthium caricosum (L.) A. Camus	Gramineae	+++
Eriochloa procera (Retz.) C.E. Hubb	”	++++
Andropogan asper Heyne	”	++++
Cynodon dactylon (L.) Pers.	”	++++
Ischaemum indicum (Houtt.) Merrill	”	++++

[a]+ to ++++ = increasing intensity of disease reaction.

Carbendazim controls rice blast

V. P. Sukumara Dev, assistant professor, Plant Pathology Division, Rice Research Station, Pattambi, Kerala, India

The systemic fungicide Bavistin 50 WP (carbendazim) and six other fungicidal chemicals were tested for control of rice blast disease in the variety Pusa 2-21. The field trials lasted for three seasons at the Pattambi Rice Research Station.

The fungicides were sprayed 4 times at 2-week intervals starting at 14 days after transplanting. Neck blast counts were taken 10 days after the last spraying. The percentages of affected panicles were based on random observations of all tillers in 60 hills/plot.

Carbendazim gave the maximum reduction in neck blast and increase in grain yield, followed by Hinosan and IBP (see table). ■

Control of rice blast by carbendazim (Bavistin 50 WP), Rice Research Station, Pattambi, Kerala, India.

Treatment[a]	Dose/ha	1976–77 rabi		1977–78 Kharif		1977–78 Rabi	
		Neck blast (%)	Yield (t/ha)	Neck blast (%)	Yield (t/ha)	Neck blast (%)	Yield (t/ha)
Hinosan 50 EC	0.5 liter	37	1.2	64	2.6	26	2.3
Dithane-Z-78	2.0 kg	54	0.9	66	2.4	33	2.1
Dithane-M-45	2.0 kg	53	0.9	68	2.4	28	2.1
Difolatan	1.5 kg	52	0.9	70	2.4	33	2.1
Fytolan	2.0 kg	45	1.0	75	2.4	28	2.1
Bavistin 50 WP (carbendazim)	0.5 kg	21	1.2	45	2.9	14	2.5
Kitazin 48 EC	1.0 liter	42	1.1	66	2.4	27	2.2
Control		57	0.8	86	2.1	47	1.9
CD (0.05)		(7.74)	n.s.	(21.09)	0.392	(6.16)	n.s.

[a]EC = emulsifiable concentrate, WP = wettable powder.

Identification of strains of Corticium sasakii in India

A. K. Roy, Indian Council for Agricultural Research Complex Scheme, Assam Agricultural University, Diphu 782460, Assam, India

Two isolates of *Corticium sasakii* – the sheath blight fungus – from rice (designated R) and from *Brassica campestris* var. cunifolia (designated B) with apparently different pathogenicity were studied at the Mycology Research Laboratory, Assam Agricultural University, Jorhat. At 14°C, the isolates on potato dextrose agar did not differ in growth rates, but at 21 and 36°C, they behaved differently. While the growth of R was greater at 21 than at 36°C, that of B did not differ at the 2 temperatures. B had a higher pH requirement than R. But when tested by the poisoned food technique the isolates did not differ in reaction to two potential fungicides, methyl benzimidazole carbamate (MBC) and methoxyethyl mercury chloride (MEMC). MBC was more effective on both isolates.

No appreciable differences in pathogenicity could be found between the isolates on soybean (highly susceptible to both), *Imperata cylindrica, Saccharum spontaneum,* and water hyacinth (less susceptible to both). But on *Colocasia antiquorum,* R did not incite infection and B was virulent. Pusa 2-21 was highly susceptible to both isolates, but only B was virulent on IR8, IET3267, and RP4-41. It was concluded that the isolates constituted distinct strains. ■

Pest management and control INSECTS

New record of a rice leaf miner, *Pseudonapomyza asiatica* Spencer (Diptera: Agromyzidae), in the Philippines

A. T. Barrion, research assistant, and J. A. Litsinger, associate entomologist, Entomology Department, Cropping Systems Program, International Rice Research Institute

Observations on rice seedlings in Iloilo, Pangasinan, and Laguna provinces, Philippines, in 1977 and 1978 revealed the presence of an unknown leaf miner. The same leaf miner attacked both transplanted and direct-seeded rice.

The mines (10–42 mm long, and 1–4 mm wide) run parallel to the leaf blade and usually occur at the apices. Each dissected leaf mine had a single white larva 0.80 to 2.00 mm long. The larva pupated within the mine, protected by the upper and lower epidermis of the leaf. The puparium, 1.35 mm long and 0.65 mm wide, appears mat, and each segment boundary is marked by 4 or 5 rows of irregularly placed spines. The puparium is generally glued firmly within the mine. Adult flies that emerged from infested leaves bearing pupae were identified as *Pseudonapomyza asiatica* Spencer by Dr. M. Sasakawa of Kyoto Prefectural University, Japan. The adults can be distinguished from related species by the bluntly angulate third antennal segment, mat mesonotum, grayish orbits, black lateral sides of thorax, largely colorless M_{1+2} and M_{3+4}, and the squamae and fringe are conspicuously silvery white.

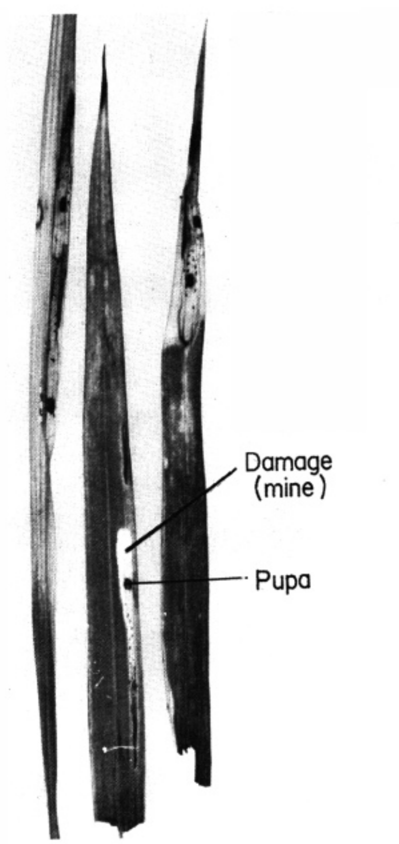
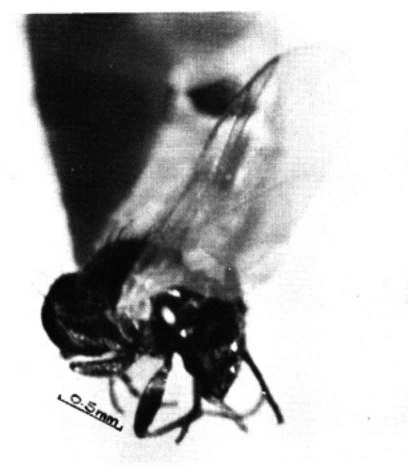


Photo 1. Rice leaves with damage (mines) and pupae of *P. asiatica.*

Photo 2. Adult fly of *P. asiatica.*



P. asiatica is widely distributed in Asia but this is the first account of its being a rice pest in the Philippines. Another host, *Cynodon dactylon,* was reported in Singapore in 1961. *Pseudonapomyza atra* has been mentioned as a leaf miner on rice in India and Taiwan, but according to taxonomists it is distributed in the temperate regions of North America and Europe. Therefore, the early records of *P. atra* in Asia probably referred to *P. asiatica.* ■

Spiders check planthopper population

M. J. Thomas, K. Balakrishna Pillai, K. V. Mammen, and N. R. Nair, Rice Research Station, Moncompu, Kerala, India

Spiders of different families have been reported to prey on the brown planthopper (BPH). Large numbers of spiders (av 2/hill) are seen on the rice crop, especially during later growth stages, near Kuttanadu, Kerala, where the BPH has become endemic. During a severe BPH incidence in the main punja season (Oct–Feb) field plots were treated with six insecticides. Six days after treatment, the populations of both BPH and spiders were lower than those in the untreated plots. Fifteen days after treatment the populations increased and the effect of insecticide treatment was not significant. During the next crop season (Apr–Sep), when insecticide application was negligible, the spider populations were high and the BPH population low.

These observations suggest that spiders are potential natural enemies of the BPH and that they can keep its population well below the economic threshold.

Based on field cage trials, seven spider species were found to be efficient predators: *Lucosa* sp., *Pholcys* sp., *Marpissa mandali* Tikader, *Tetragnatha* sp., *Linyphia* sp., *Oxyopes sakuntalae* Tikader, and *Argiope undulata* Thorell. Their feeding potential is being investigated. ■

Natural biological suppression agents of rice pests in the eastern plains of Colombia

John C. Brooks, Peace Corps volunteer, Instituto Colombiano Agropecuario (ICA), Entomologia, A. A. 233, Palmira, Valle, Colombia

The ecology of paddy rice pests was investigated during three successive growing semesters in 1977-78 at the La Libertad experiment station, Villavicencio, Meta. Control measures were not necessary because each potential economic pest was suppressed by natural enemies.

Trichogramma sp. or *Telenomus* sp. parasitized >95% of the eggs of the sugarcane stem borer *Diatraea saccharalis F.* The larval parasitoid *Agathis stigmaterus* Cresson was active in the plots each season. Borer damage never exceeded 3%, the level along borders.

During each crop unidentified epizootics of entomopathogens suppressed populations of leafhopper, mainly *Hortensia similis* (Walker) and *Draeculacephala clypeata* Osborn, by 70 to 95% (field estimate). Those species never caused an economic level of damage. The defoliators *Spodoptera* spp. and *Panoquina* spp. were effectively suppressed by fungal epizootics of *Paecilomyces tenuipes* (Peck) Samson (identified by R. A. Humber, Boyce Thompson Institute, Ithaca, N.Y., USA). Estimates of successful field infection rates ranged from 95 to 99% during each crop, which apparently was sufficient to maintain the species at lower than economic levels. Various tachnids parasitized the Pentatomid species. The rice water weevil *Lissorhoptrus oryzophilus* Kuschel (considered the Legion's major rice pest) was absent from the experimental plots.

No pest control measures were necessary because of the natural suppression complexes in the fields during the three rice crops.

Noe Arias, Practico, ICA, La Libertad, Villavicencio, collected *Diatraea* eggs and did most of the laboratory parasite counts. ■

Field efficacy of a fungus, a bacterium, and organic insecticides against rice pests

P. Narayanasamy and P. Baskaran, Plant Protection Laboratory, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India

The successful control of vegetable pests with low doses of organic insecticides and entomogenous organisms has encouraged the testing of such combinations against rice insect pests.

A field trial was established to determine the performance of white halo fungus (*Cephalosporium lecanii* Zimm.), a bacterium (*Bacillus thuringiensis* var. *alesti* Berliner Dipel), and of the two with dichlorvos or phosalone.

Phosalone reduced rice borer incidence slightly. Neither the fungus nor the bacterium reduced incidence of whorl maggot, stem borer, or leaf folder.

Effect of combinations of insect pathogens and insecticides on the incidence of rice insect pests. Tamil Nadu, India.

Treatment	Damage[a] (%) Whorl maggot	Stem borer	Leaf roller	Yield (t/ha)
Fungus (16 x 10^4 spores/ml)	12.6 d	11.9 b	0.6 c	2.9
Fungus + phosalone (16 x 10^4 spores/ml) (1.42 ml/liter)	11.6 c	13.3 c	0.3 ab	3.1
Fungus + dichlorvos (16 x 10^4 spores/ml) (2 ml/liter)	10.9 b	11.7 b	0.4 bc	3.2
Dipel (5.5 g/liter)	11.6 c	11.3 b	0.5 bc	3.2
Dipel + phosalone (2.75 g/liter) (1.42 ml/liter)	13.1 d	11.6 b	1.4 e	3.2
Dipel + dichlorvos (2.75 g/liter) (2 ml/liter)	11.9 c	12.4 b	0.2 ab	2.9
Phosalone (2.85 ml/liter)	10.3 a	8.6 a	0.5 c	3.3
Dichlorvos (4 ml/liter)	11.7 c	9.6 a	0.1 a	3.4
Phosalone + dichlorvos (1.42 ml/liter) (2 ml/liter)	11.4 bc	11.6 b	0.2 ab	3.2
Untreated control	11.9 d	12.4 c	0.4 d	2.3
Significance	*	*	*	n.s.
CD at 5% level	0.5	1.2	0.25	

[a] Mean values with the same letter are not significantly different from each other.

Ovicidal and larvicidal activity of some insecticides on leaf folder

S. L. Valencia and E. A. Heinrichs, Entomology Department, International Rice Research Institute

Four insecticides — methyl parathion, triazophos, methomyl, and carbofuran — at 0.04% concentration were tested on eggs and freshly hatched larvae of the leaf folder *Cnaphalocrosis medinalis.* Two-day-old eggs of leaf folder from the greenhouse culture were dipped in the prepared insecticidal solutions for 1 minute. The control was eggs dipped in water. Both treated and untreated eggs were placed in petri dishes lined with moistened filter paper and were observed daily. Three days after the treatment, the control eggs hatched. Most treated eggs did not hatch although embryonic development was completed (see table). Some eggs treated with methomyl hatched but the larvae were weak and died within minutes. In an earlier study ovicidal activity of carbofuran and triazophos against the brown planthopper was high while methomyl and methyl parathion were ineffective ovicides.

Solutions of the same insecticides and concentrations were tested for larvicidal activity by spraying on 25-day-old TN1 seedlings. One day after treatment, leaves were cut from the seedlings placed in petri dishes with moistened filter paper, and infested with 10 freshly hatched larvae. Forty-eight hours later, living and dead larvae were counted. All larvae on the treated leaves were dead, but those on the control were alive and active (see table). ■

Activity of certain insecticides at 0.04% concentration on the eggs and larvae of rice leaf folder.[a] IRRI laboratory, 1979.

Insecticide	Eggs hatched (%)	Larval mortality (%)
Methyl parathion	0	100
Carbofuran	0	100
Triazophos	0	100
Methomyl	17.5	100
Control	100.0	0

[a]AV of 4 replications.

Occurrence of brown and whitebacked planthoppers in Uttar Pradesh, India

S. K. Verma, P. K. Pathak, B. N. Singh, and M. N. Lal, G. B. Pant University of Agriculture and Technology, Pantnagar 263145, India

The presence of brown planthopper (BPH) in Uttar Pradesh was first noticed during 1969 kharif at Pantnagar University farms. Since then, it has infested the crop regularly, except in 1970 when the crop was free of attack. High incidence in most of the years resulted in typical hopperburn.

During a survey in 1977 kharif, BPH was widespread throughout the state. In some places, particularly the *tarai* region, where the farmers usually grow high yielding varieties with high doses of fertilizers, the attack produced hopperburn at the boot-leaf to hard dough stage of the crop. Varieties Jaya, IR8, IR24, Saket 4, Pusa 2.21, Ratna, and Bala were severely damaged and the BPH populations ranged from 100 to 1,000 per hill in the hopperburned plots. The weather was warm and humid and the fields had standing irrigated water.

The whitebacked planthopper *Sogatella furcifera* has also attacked the crop regularly since 1969. However, the degree of infestation varies. Infestation was severe only in 1972 and 1977, when typical hopperburn occurred during the late tillering phase of the crop. In a 1972 trial, the control of the pest resulted in 99% increase in yield. Under field conditions IR20 (in 1972) RP633-510-1-3-4-1, and IR36 (in 1977) showed some resistance. ■

Effects of biocides on brown planthopper adults on rice

P. R. M. Rao and P. S. Prakusa Kao, Central Rice Research Institute (CRRI), Cuttack, India

The brown planthopper (BPH) attacks high yielding rices, particularly at the ripening stage. Chemical control of BPH at crop maturity is hazardous because of the possibility of toxic residues in the grain and straw. Therefore, BPH control through the use of the biocides *Bacillus thuringiensis* (Thuricide HP), and aqueous extracts of leaves of neem *Azadarachta indica* and *Eclipta alba* (a weed) was explored at CRRI.

Thirty-day-old TN1 seedlings were transplanted in earthenware pots (15-cm diam). At 40 days, the plants were sprayed with the biocides with a fine atomizer until the runoff stage. The sprayed plants were allowed to dry naturally for 1 hour, then 10 BPH adults were caged in each pot. The treatments were replicated four times with untreated plants as the control. Mortality counts were taken 24 and 48 hours after insect release.

All doses of Thuricide gave 100% BPH mortality (see table). Insect mortality was considerable with both root and shoot extracts of *E. alba* and with neem extracts acquired by different methods. ■

Effectiveness of three biological formulations on brown planthopper adults[a]. Central Rice Research Institute, Cuttack, India, 11 - 13 April 1977.

Treatments	Mortality (corrected to 1%) at 24 h	Mortality (corrected to 1%) at 48 h
Thuricide HP		
0.25 kg/100 liters water	100	100
0.50 kg/100 liters water	100	100
0.75 kg/100 liters water	100	100
1.0 kg/ 100 liters water	100	100
Aqueous extract of Eclipta alba		
Extract of root portion	52	70
Extract of shoot portion	35	70
Aqueous extract of neem		
Hot water neem leaf extract	60	100
Neem leaf extract (1st fraction)	42	62
Neem leaf extract (2d fraction)	30	55
Mortality (%) in control	0	0

[a]Av of 4 replications. Max temp = 34.4°C; min temp = 22.2°C; mean max temp = 33.7°C; mean min temp = 24.°C; mean relative humidity = 74%.

Leaf folder outbreak in tarai and hill regions of Uttar Pradesh, India

S. K. Verma, P. K. Pathak, B. N. Singh, and M. N. Lal, G. B. Pant University of Agriculture and Technology, Pantnagar 263145, India

The leaf folder *Cnaphalocrosis medinalis* Guenee is becoming a common rice pest. The insect's first outbreak in Uttar Pradesh occurred in 1977 kharif at the Pantnagar University farms. A survey in September 1977 showed high populations of the pest not only in the tarai but also in the hilly regions (up to 1.500 m altitude).

As much as 60% of the rice leaves was damaged at the University farms and in some farmers' fields. The population began to appear in the field in July and remained until October. producing four or five generations. The early sown and upland crops suffered heavily.

Ekalux 25 EC sprayed at 0.5 kg a.i./ha gave good field control. ■

Whorl maggot damage on flag leaf

S. K. Basu, entomologist, Rice Production Training Institute (RPTI), Hindustan Fertilizer Corporation Ltd, Fertilizer Promotion and Agricultural Research Division, Durgapur 713212, India

Whorl maggot *Hydrellia* sp. regularly damages rice at the RPTI farm throughout the year. It often attacks the entire crop at the seedling stage.

Recently a late-sown 1978 kharif crop of the variety Jaya was attacked after the heading stage. Small punctures appeared in the middle of the flag leaf and its margin was sometimes discolored. On a few plants, the second and third leaves were also damaged. ■

Evaluation of insecticides for gall midge control

B. C. Shukla, S. K. Shrivastava, P. D. Deshmukh, D. J. Pophali, U. K. Kaushik, G. A. Gangrade, and G. L. Patidar, Operational Research Project on Integrated Control of Rice Pests, College of Agriculture, Raipur, India

Large strips of Ratna that had been transplanted on 3 August 1978 were treated on 8 and 24 September with several insecticides and formulations.

At harvest observations were made on two 1- × 1-m plots in each treatment to determine the percentages of silver shoots and the yield (see table). Percent silver shoots was lowest and yield highest in the granular treatment of quinalphos. ■

Percentage of silver shoots and panicles, and yield of Ratna treated with various insecticides. Raipur, India, 1978.

Treatment	Dosage	Silver shoots (%)	Yield (t/ha)
Quinalphos 5G	1 kg a.i./ha	32.0	2.7
Phorate 10G	1 kg a.i./ha	36.0	2.0
Carbofuran 3G	1 kg a.i./ha	36.7	1.8
Malathion 50EC	0.05% concn	47.6	1.6
Sevimol[a] 40EC	0.05% concn	41.0	2.0
Phosalone 35 EC	0.05% concn	48.3	1.9
Monocrotophos 40 EC	0.05% concn	56.8	1.8
Phosphamidon 100EC	0.05% concn	33.9	1.6
Quinalphos 30EC	0.05% concn	40.2	1.5
BHC 10% dust	25 kg/ha	41.4	1.5
Untreated control	–	69.0	1.5

[a] Carbaryl in molasses.

Biological studies of the population dynamics of rice brown planthopper and green leafhopper

P. Narayanasamy, B. Balusubramanian, and P. Baskaran, Plant Protection Laboratory, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India

The influence of weather factors on the field populations of rice brown planthopper (BPH) and green leafhopper (GLH) was studied.

GLH populations increased at both higher maximum and minimum temperatures (see table). BPH populations decreased at both high temperatures and lower minimum temperatures. GLH populations were higher at lower humidity levels. but BPH populations were positively correlated with higher humidity. No direct relationship between the amount of rainfall and GLH incidence was found. But the BPH population peaked at no or low rainfall (6-10 mm) and declined when rainfall exceeded 10 mm.

Correlation between weather elements and the incidence of rice green leafhoppers and brown planthoppers, Annamalainagar, India.[a]

Weather element	Green leafhopper		Brown planthopper (short-term season)
	Short term (Jul–Sep)	2d season (Nov–Jan)	
Max temp	+0.7166**	+0.5030*	–0.8122**
Min temp	–0.6922**	–0.5021*	+0.9122**
Humidity	–0.7022**	–0.7790**	+0.5610**
Rainfall	0.0056 ns	1.1450 ns	–0.7101**
Sunshine	+0.6328*	+0.7516**	–0.6222**

[a] * Significant at 5% level. ** Significant at 1% level. ns = not significant.

The GLH population was higher with more bright sunshine (3 8 hours) and decreased with fewer hours of sunshine. The BPH population increased with fewer bright-sunshine hours. ■

Rice leaf folder attacks in India

P. B. Chatterjee, Operational Research Project on Integrated Control of Rice Pests, Pandua 712149, Hooghly, India

The rice leaf folder *Cnaphalocrosis medinalis* (Lepidoptera: Pyralidae), normally a minor rice pest, occurred in epidemic proportions in 1978 on upland, drilled autumn rice (aus) in Coochbehar and Jalpaiguri, two rice-growing districts of North Bengal, India. Most areas of maximum infestation were on the peripheral regions of forest reserves and on plains near the foothills of the sub-Himalayan ranges. In aus rice, which is generally sown in March or April and harvested in July or August, the infestation was first noticed in the last week of April; incidence peaked in the second week of May. The insect spread to about 22,000 ha. Where infestation was severe, the rice plants (almost entirely rainfed) withered completely. Coochbehar and Jalpaiguri receive an average annual precipitation of' about 3,200 mm. Rainfall averages 50, 130, and 400 mm in March. April, and May. But in 1978. it averaged 3.2, 100.2, and 295 mm. The attack was confined mostly to the late-sown crop. But the infestation subsided with the onset of late May rains. ■

Performance of sprayers and influence of water volumes in insecticidal control of rice ear-cutting caterpillar

R. K. Patel, Department of Entomology, J. N. Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

A field experiment was conducted to test the performance of sprayers and the influence of water volumes in control of the rice ear-cutting caterpillar *Mythimna separata* Walk in paddy at Varansai in 1976-77. The ground sprayers evaluated were mist-blower, hand-compression, foot, and knapsack sprayers. The volumes tested were 50, 75, and 100 liters/ha applied by the low-volume sprayer (mist blower), and 500, 750, and 1000 liters/ha with each high-volume sprayer (hand-compression, foot, and knapsack). For convenience, the volumes were categorized as low, medium, and high. The fixed dose of the insecticide, fenitrothion as Sumithion 500 E at 1.0 kg a.i./ha mixed in varying water volumes, was applied by each sprayer on 11 October 1976 at the grain-formation stage of the variety Saken. The 12 treatments and control were replicated 3 times in a factorial randomized design. Insecticide was applied only once.

Equal and uniform application of the insecticidal fluid was ensured by adjustment of the operator's speed and timing. At spraying time the larvae were at the 4th- to 5th-instar stage. The performance of sprayers and the influence of water volumes were evaluated on the basis of larvae reduction.

The hand-compression spray equipment was significantly superior in reduction of larvae (95%) compared with the mist-blower (56%). The lever-operated knapsack sprayer and the foot sprayer performed equally well in pest control. Low water volume gave 83% control and medium volume, 83%. The high-volume treatment gave 68% larvae reduction. The average effect of treatment combinations was significantly higher than that of the control. ■

Effectiveness of foliar spray insecticides in brown planthopper control in Thailand

Thamnoon Bhudhasamai, Suchin Chandarasaard, Supanee Pimsaman, and Sanor Buranapawang, Rice Insect Pest Branch, Entomology and Zoology Division, Department of Agriculture, Bangkhen, Bangkok 9, Thailand

Six insecticides were tested in the 1977 dry season in central Thailand. The experiment was in a randomized complete block design with 7 treatments and 4 replications. The 5- x 6-m^2 plots were planted to the variety RD1. Insecticides were applied by knapsack sprayers at a concentration of 0.1% active ingredient at 40, 50, and 70 days after transplanting. Brown planthopper (BPH) populations were collected by a D-vac suction machine 1 day before and 1 day after spraying.

BPH populations after the first insecticide application differed significantly between treatments (see table). The most effective insecticides were carbofuran, MIPC, MTMC, BPMC, monocrotophos, and carbaryl. Results of the second and third applications were similar to those of the first.

Carbofuran gave the highest grain yield, followed by monocrotophos. Carbaryl gave lower yields than MIPC, MTMC, or BPMC. ■

Effectiveness of insecticides applied as foliar sprays against the brown planthopper (BPH) in central Thailand, 1977.

Treatment[a]	Formulation	BPH population[b]						Yield (t/ha)
		1st application (40DT)		2nd application (50DT)		3d application (70DT)		
		DBT	DAT	DBT	DAT	DBT	DAT	
Carbofuran	2F	1,271 a	15 a	144 a	19 a	149 ab	3 a	1.7 a
MIPC	50 WP	1,155 a	43 a	579 b	52 a	89 a	1 a	0.9 bc
MTMC	50 WP	1,875 bc	38 a	51 a	21 a	94 a	1 a	1.1 b
BPMC	50 WP	1,595 b	16 a	142 a	26 a	108 a	2 a	1.0 b
Monocrotophos	56 WSC	1,365 ab	413 b	195 b	185 b	214 bc	5 ab	1.3 ab
Carbaryl	85 WP	1,909 c	41 a	336 b	217 b	374 c	13 b	0.7 c
Control	–	2,184 d	1,215 c	751 b	1,229 c	417 c	154 c	0.2 d

[a]Applied at 0.1% concentration.
[b]Adults and nymphs from 4 replications.
DT = days after transplanting, DBT = days before treatment, DAT = days after treatment.
Means in a column followed by the same letter are not significantly different at the 5% level.

Soil and crop management

An easy mass-multiplication method for blue-green algae

S. Srinivasan, Paddy Experiment Station, Aduthurai 612101, Tamil Nadu, India

Commendable field experiments on the use of blue-green algae (equal to 25–30 kg N/ha) for higher rice yields have been conducted in various agroclimatic regions of India. Once the yield-increasing effects of algal inoculation are better recognized, large-scale production of algal inoculum becomes important — at least in areas with favorable conditions. Until now, algae have been multiplied in concrete tanks or metal troughs. which require high initial expenditures that marginal farmers cannot afford.

Because the merit of such a device lies in the farmers' adoption of methods of preparing their own inoculum, experiments were conducted at the Paddy Experiment Station, Aduthurai, to develop a suitable multiplication technique. In 1978 a simple and easy method for mass multiplication of blue-green algae was standardized by incubating the algae in the rice field with water. Farmers can adopt the simple method with no financial outlay. The stages of algal multiplication in the field are listed below:

1. Mark the area required for mass multiplication in the rice field.
2. Maintain a water depth of 2.5 cm.
3. Apply 2 kg superphosphate/40 m^2.
4. To control daphnids, snails, and mosquitoes apply 250 g of carbofuran 3% G or Ekalux 5% G/ 40 m^2.
5. If blue-green algae have been applied to the field earlier, a fresh application of algal inoculum is not necessary. Instead, apply a composite algae culture at 5 kg/ 40 m^2.
6. In clay soil a thick mat of blue-green algae will form in 2 weeks. That is the harvesting stage (in sandy soil it takes 3–4 weeks).
7. Remove the thick algal mat floating on the water surface and dry it in the sun by spreading it over a thin layer of powdered soil on a threshing floor.
8. Apply superphosphate and pesticide after each harvest to encourage subsequent harvests in 10–15 days. Blue-green algae inoculum need not be added for subsequent harvests.

Cost[a] of production per kg of blue-green algae. Tamil Nadu, India.

Harvests (no.)	Cost of production/ 40 m^2 (US $)	Cost/kg (US $)	
		Min yield	Max yield
1	2.50	0.16	0.07
2	3.10	0.10	0.04
3	3.69	0.08	0.03
4	4.29	0.07	0.03
5	4.89	0.06	0.03
6	5.48	0.06	0.03
7	6.08	0.05	0.03
8	6.68	0.05	0.02
9	7.27	0.05	0.02
10	1.87	0.05	0.02

[a]Cost of blue-green algae inoculum = US$1.90, cost of superphosphate = US$0.15, and cost of carbofuran = US$0.44. US$1 = Rs57.88.

Average yields of well-dried blue-green algae range from 16–35 kg/40 m^2 per harvest. The costs of producing blue-green algae are in the table.

The Tamil Nadu Department of Agriculture launched a massive program to multiply blue-green algae at state seed farms, experiment stations, and in leading farmers' fields to meet farm requirements in 1978–79. ■

Twenty-two participants in first INSFFER training program at IRRI

The first International Network for Soil Fertility and Fertilizer Evaluation in Rice (INSFFER) training program began at IRRI 1 February 1979 and ended 30 May. The 22 participants were from Bangladesh, Egypt, Indonesia, Korea, Nepal, Philippines, Sri Lanka, and Thailand (see photo). The training course was jointly sponsored by IRRI and the International Fertilizer Development Center (IFDC), Muscle Shoals, Alabama, USA.

The purpose is to strengthen the capabilities of researchers and technicians who participate in the INSFFER research program. The trainees examine the latest information, both theoretical and practical, on soils, fertilizers, and experimental techniques. The course includes lectures on all aspects of soils, and on agronomic and plant protection practices necessary for successful rice culture. The instructors are from the staffs of the University of the Philippines at Los Baños, IFDC, and IRRI.

The program began with participation in the 2-week Rice Production Training Course. The participants then conducted actual fertilizer experiments and spent 1 week on the study of azolla under Dr. I. Watanabe and the IRRI soil

Participants in the 1979 INSFFER training program checking their fertilizer experiments on the IRRI farm. ***Standing left to right:*** L. E. Nelson, visiting IRRI scientist, trainees D. B. B. Choudary, C. D. Reddy, R. C. Gautam, S. S. R. K. Raju, and C. R. Padalia from India; Somjit Khontasuvon, Thailand; Sonia M. Salguero, Philippines; Virgilius Hendrik, Harmastini Sukiman, Indonesia; and Hidayat Akhmad, Indonesia; Myeong Gu Lee, Korea; Tadjudin Surawinata, Indonesia; and IRRI training assistant R. Rosales.
Front row: Murshidul Kabir, Bangladesh; Kasemsri Subsorn, Thailand, P. K. Nayar, India; S. A. Ghanem, Egypt; Shanti Bhattarai, Nepal; Norma G. Gonzaga, Philippines; A. K. M. Rahman, Bangladesh; Hansa Khunathai, Thailand; Nirmala Gunapala, Sri Lanka; and Nipansri Kimthong, Thailand.

microbiology staff. The participants visited outlying fertilizer experiments and rice-growing areas in the Philippines.

Candidates for INSFFER training are carefully selected. Only highly motivated and active soil scientists with a B.S. degree or its equivalent, leadership potential, and a knack for hard work can quality.

The training program was developed by a committe composed of Dr. E.T. Craswell, Dr. J. T. Cope. and Dr. L. E. Nelson, chairman. Mr. Rogelio Rosales was training assistant in charge of the program. ■

Algae multiplication and fertilizer practices

S. Srinivasan, assistant plant pathologist, Paddy Experiment Station, Aduthurai, Tamil Nadu, India

Blue-green algae were inoculated in bulk fields of the Aduthurai Paddy Experiment Station in 1976 and 1977. Spread of the algae to all of the farm's wetland fields, including experimental areas, necessitated algae control, particularly in manurial experiments.

Blue-green algae were found embedded in plots of the 40th crop of the permanent manurial experiments 7 days after transplanting in 1978 kharif. Because the treatments included applications of both organic and inorganic forms of nitrogen, as well as many combinations of phosphorus, potassium, and lime (L), separate estimates of the algae's spread in various plots were made to determine the conditions of relative adaptation.

Mean algae yield at Aduthurai, Tamil Nadu, India.[a]

Main plots	Algae yield (kg/28 m^2 plot)								
	0	P	K	L	PK	PL	KL	PKL	Mean
Control	0.8	5.4	2.4	0.8	6.0	3.3	2.0	4.1	3.1
Ammonium sulfate	0.7	3.0	0.5	0.3	3.0	0.5	0.4	2.2	1.4
Compost	2.2	5.9	7.4	0.9	4.8	3.8	1.5	4.3	3.2
Farmyard manure	1.9	4.5	1.7	1.2	4.0	2.8	1.9	3.7	2.7
Green leaf	1.2	5.5	1.3	0.8	5.5	4.2	1.1	3.9	2.9
Mean	1.4	4.8	1.6	0.8	4.6	3.0	1.4	3.6	

[a]P = phosphorus, K = potassium, L = lime. C.D. for main treatment, 0.72 kg; C.D. for subtreatment, 1.34 kg; interaction, N.S.

Algae were harvested from each plot 15 days after planting, and yields were analyzed.

Among the main treatments, the plot that received ammonium sulfate gave the lowest yields (see table). In 1978, Venkataraman observed that nitrogen application immobilizes P in the soil. Possibly, algae grew poorly because only a negligible quantity of P was available in the plots fertilized with ammonium sulfate. The absence of readily available nitrogen in the other treatments caused higher P availability to the algae and. consequently, significantly higher algae yields.

The algae yields from P, PK, PKL, and PL were superior to those from O, K, KL, and L. That suggests that on this soil K and L influence algae yield only when phosphorus is applied. Thus, for successful multiplication. the phosphorus requirements of the algae must be met. ■

Environment and its influence

Rice fertilizer made of hydrolysis lignin

N. Alyoshin, junior researcher; E. Avakyan, biological sciences candidate; E. Alyoshin, doctor of biological sciences; Laboratory of Rice Physiology, Department of Plant Physiology and Biochemistry, Kuban Agricultural Institute, 350044, Krasnodar, Kalinina 13, USSR

Industries in the USSR produce 800,000 t of hydrolysis lignin/year. Of that, 520,000 t are not used and are wasted, polluting the environment. The All-union Research Institute of Hydrolysis in Leningrad produces fertilizer from it. The lignin-stimulating fertilizer (LSF) (which can be made of rice husks) is the product of the Andijan Hydrolysis Plant in the Uzbek SSR. It consists of nine parts hydrolysis lignin and one part ammoniac salts of polycarbonic acids. These salts, the active part of LSF, can be recovered after the lignin is hydrolyzed with nitric acid (HNO_3) and the product is reduced with ammonia (NH_3).

Changes in nucleic acid metabolism in rice apexes due to the effects of lignin-stimulating fertilizer (LSF). Kuhan Agricultural Institute, Krasnodar, USSR, 1974–78.

Leaf no.	RNA-DNA ratio in apexes			
	Without LSF	0.5 t LSF/ha	2.5 t LSF/ha	12.5 t LSF/ha
Leaf without blade	3.2	4.6	4.1	3.5
1	2.1	4.3	4.2	3.9
3	2.1	4.5	4.5	4.4
4	2.0	5.0	4.8	4.5
5	1.3	5.6	5.0	4.3
7	2.8	5.9	4.8	3.8
9	3.4	5.7	4.5	3.4
11	3.5	5.1	4.2	3.2

(Data after statistical analysis)

In laboratory experiments from 1974 through 1978. rice yields increased by 10% (from 5.5 to 6.1 t/ha) when 0.4 t LSF/ha was applied before sowing. The increase resulted from the active tillering brought about by the changes in nucleic acid metabolism in rice apexes (see table). The LSF decreases the activity of endogenous rice gibberellins and the silica (SiO_2) content of the straw. The latter can cause rice lodging.

Constraints to high yields

Farmers' perceptions of constraints to high yields in wetland paddy

P. B. Chatterjee, A. K. Maitra, M. K. Sarkar, and Subir Dutta, Operational Research Project on Integrated Control of Rice Pests, Pandua, Hooghly, West Bengal, India

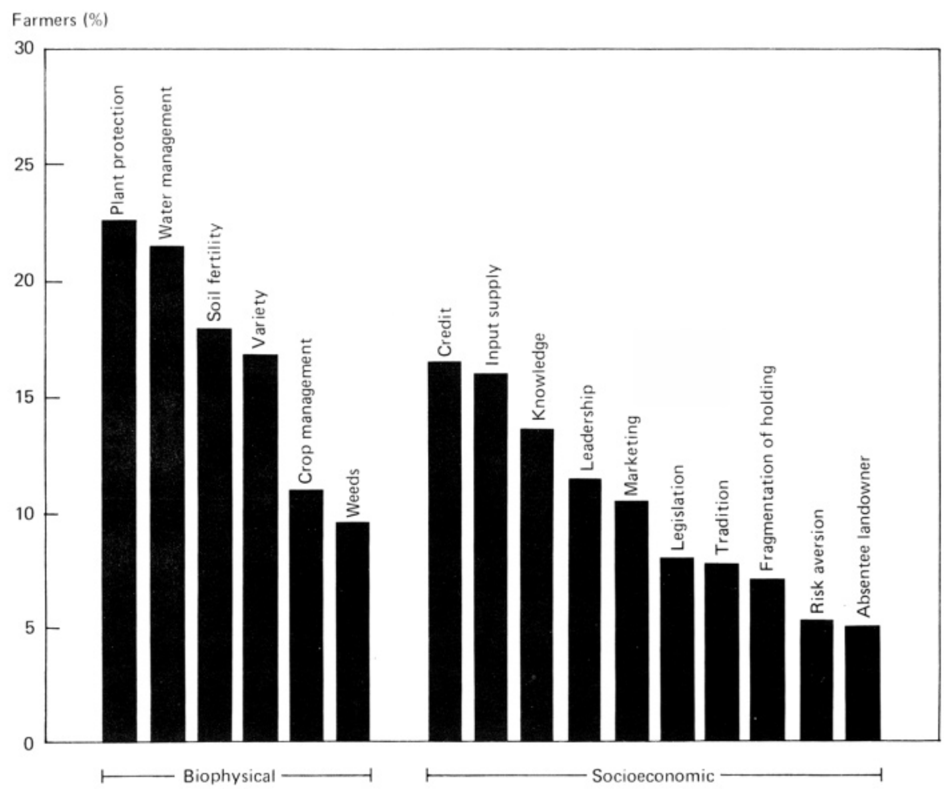
A study was conducted to determine farmers' perceptions of the relative contribution of socioeconomic and biologic constraints to high yields in kharif or wetland paddy. Among the biophysical constraints considered were water management, situation-specific rice varieties, weed control, insect and disease incidence, problem soils, soil fertility, and cultural management. Socioeconomic constraints were knowledge, institutional credit, absentee land-ownership, the sharecropping system, village leadership, input availability, marketing of farm produce, adequate legislation, fragmentation of holding, farming tradition, and risk aversion.

Stratified random samples were taken in 14 villages. The farmers were thoroughly briefed on the significance of the constraints and asked to rate their perceptions of each. A total of 189 marginal, small, and large farmers tilled in score sheets, which were tabulated. Score values on individual constraints were obtained by multiplying the rank marked by the farmers by the frequency. The ranking of each constraint was obtained in terms of percentage from the total rank score given by the farmers against the biophysical and socioeconomic constraints. The data are presented in the table; yield constraints (%) in kharif rice are in the figure. ■

Farmers' ranking of biophysical and socioeconomic constraints. West Bengal, India.

Constraint	All farmers' rank (n = 189)	Rank given by		
		Marginal farmers [a] (n = 139)	Small farmers [b] (n = 38)	Large farmers [c] (n = 12)
Biophysical				
Insect pests and diseases	1	1	2	2
Water management	2	2	1	1
Soil and fertility	3	3	4	3
Situation-specific rice varieties	4	4	3	4
Cultural management	5	5	5	5
Weed control	6	6	6	6
Socioeconomic				
Institutional credit	1	1	2	1
Input availability	2	2	1	2
Knowledge	3	3	4	3
Village leadership	4	4	5	4
Marketing of farm produce	5	5	3	5
Legislation safeguarding farmers' interest	6	7	6	6
Tradition	7	6	7	7
Fragmentation of landholding	8	8	8	8
Risk aversion	9	10	9	9
Absentee landowner	10	9	10	10

[a] Holding as much as 1 ha of land. [b] Holding from 1 to 2 ha [c] Holding more than 2 ha.



Proportion (%) of farmers mentioning biophysical and socioeconomic constraints on kharif rice, West Bengal, India.

Rice-based cropping systems

Insect-suppressing effect of rice stubble height, tillage practices, and straw mulch in a wetland rice-cowpea cropping pattern

Ruhendi, research scholar, Central Research Institute for Agriculture, Bogor, Indonesia, and J. A. Litsinger, associate entomologist, Cropping Systems Program, International Rice Research Institute

In the Philippines, wetland rice farmers with no irrigation establish cowpeas by zero tillage (broadcasting seed into recently harvested rice fields) to exploit residual soil moisture for seed germination. When traditional rice varieties are grown in the rainfed areas, the stubble after harvest is tall (30–60 cm). With the short-statured, improved varieties, the stubble is much shorter (10–30 cm).

We tested the effect of rice stubble height (2, 15, 30, 45, and 60 cm) of transplanted IR36 (25- × 25-cm spacing) on preflowering cowpea insect pests at IRRI under 2 tillage systems: 1) dibbling seed to stimulate zero tillage, and 2) a minimum tillage method of opening furrows between alternate rows of rice stubble with a plow. We compared the two systems and their stubble heights, with stubbleless high tillage (plowed and harrowed twice) with and without rice straw mulch.

Because we were concerned only with pest infestation at the preflowering period of cowpea, all plots received equal postflowering insecticide protection, but only half of each main plot received preflowering protection.

Three preflowering cowpea insect pests were evident during the trial (see table). In addition to bean fly *Ophiomyia phaseoli,* the leafbud-feeding thrips *Thrips palmi* and the leafhopper *Empoasca biguttula* attacked the young plants. All three pests caused plant stunting, and reduced the number of pods per plant. The thrips invasion was unexpected — thrips is a newly recorded cowpea pest in the Philippines. Thrips migrated into the IRRI farm from nearby watermelon fields in the surrounding Laguna area. Unfortunately the preflowering insecticide (carbofuran seed treatment) did not affect the thrips.

Pest incidence was highest in the high-tillage plots without stubble or mulch. The presence of rice straw mulch dramatically suppressed the leafhopper and thrips populations. We suspect that the mulch interfered with the visual host-searching responses of the pests during the colonization. Bare ground evidently highlights the cowpea plants, but mulch is either repellant or unattractive.

The erect rice stubble reduced the number of all three pests. This camouflaging effect was more pronounced in those plots with tall stubble, particularly within the 15- to 30-cm range. Responses did not differ significantly beyond 30 cm.

Differences in bean fly and thrips responses between the zero- and minimum-tillage plots were significant within the 2-cm stubble height. The minimum-tillage plow furrows reduced stubble density by opening bare soil. Pest reaction was similar to that to high tillage. But that effect was nullified at stubble heights of 15 cm or more.

Rice stubble height beyond 30 cm adversely affected cowpea yield. Plants in the 45- and 60-cm stubble became etiolated and set few pods. There were differences in yield potential between the various tillage systems as shown in the preflowering insecticide protected plots. The lowest yield was in the minimum-tillage plot with 2-cm stubble and the highest was in the zero-tillage plot with 15-cm stubble.

There was also evidence of differential responses in plant tolerance for high insect pressure among the tillage systems. High tillage with or without mulch suffered greater yield losses than minimum tillage at 2-cm stubble height

Effect of rice stubble management and tillage systems on preflowering insect pests of cowpea established after flooded rice.[a] IRRI, 1978.

Rice stubble	Tillage	Insects[b] (no./15 plants)			Yield[c] (kg/ha)	
		Bean fly[c] larvae + pupae 13 DE	Thrips[c] 20 DE	Empoasca[c] 20 DE	Preflowering insecticide[d]	No preflowering insecticide
None	Plowed and harrowed twice	17 a	83 a	36 b	687 bc	316 e
Mulch	Plowed and harrowed twice	15 a	8 b	13 c	571 cd	354 e
2-cm high	Furrows plowed between rice rows	15 a	82 a	83 a	480 d	532 d
2-cm high	Dibbling in rows	12 b	9 b	53 ab	775 b	515 cd
15-cm high	Furrows plowed between rice rows	9 bc	6 b	13 c	815 b	621 c
15-cm high	Dibbling in rows	8 bc	15 b	9 cd	994 a	799 b
30-cm high	Furrows plowed between rice rows	6 c	1 b	6 cd	626 c	360 e
30-cm high	Dibbling in rows	5 c	1 b	2 d	964 a	525 d

[a]Av of 3 replicates. IR36 transplanted at 25 × 25 cm. [b]Without insecticide. DE = days after emergence. [c]Means followed by a common letter are not significantly different at the 5% level. [d]1% wt/wt carbofuran seed treatment, 0.5 kg sprays of active ingredient (a.i.) monocrotophos/ha and 1.0 kg a.i. carbaryl/ha. All plots received a similar postflowering protection: sprays of 1.0 kg a.i. monocrotophos/ha at 35 and 45 DE.

with and without preflowering insecticide protection.

We conclude that the 15-cm stubble height is optimal for both yield potential and pest-suppressing effects, and is suitable for either zero or minimum tillage. Erect rice stubble is an effective cultural control of early-season insect pests, and any new tillage practice or crop-establishment method should be designed to leave erect stubble in the fields to retain this inexpensive insect control method without sacrificing yield potential. ■

Participants in IRRI Cropping Systems Training Program

The 6-month IRRI cropping systems training program is designed to familiarize participants with the methodology developed for site-related research for the introduction of additional crops and new technology into rice-based cropping systems. Procedures for defining and describing an area's physical and socioeconomic environment are developed so that appropriate research can be conducted there. The latest methods for the development of management technology for rice-based cropping patterns and their evaluation in farm trials are identified and discussed.

The trainees design and manage field research trials on major upland crops, perform various cultural and production operations, and interpret and present their results. The photo shows participants of the course completed on 16 March 1979. ■

Participants in the IRRI six-month cropping systems training program, 25 September 1978–16 March 1979. ***Front row (left to right):*** Wayan Sudana (Indonesia); H. R. M. Mostafa Anwar (Bangladesh); Md. Abdul Ahad (Bangladesh); Ivan D. Simbolon (Indonesia); Dr. L. D Haws (Crop Production Specialist and Head, RPTR); Dr. N. C. Brady (Director General, IRRI); Noemi M. Yapit (Overall Training Coordinator. RPTR); Dr. M. D. Pathak (Director, Research Coordination and Training, IRRI); Syafrida (Indonesia); Prissana Vachiraddanupap (Thailand), Mauliana Sibarani (Indonesia).
Second row (left to right): Goh Seng Cheng (Malaysia); Oscar Garcia (RPTR Staff); Domingo L. Simbillo (Philippines); Md. Akhter Hossain Khan (Bangladesh): Rumansyah Icin (Indonesia); Abdul Salam Wahid (Indonesia); Tito Z. Arevalo (Philippines).
Third row (left to right): Alfredo A. Domingo (RPTR Staff); Nyoman Winarta (Indonesia); Kanaganayagam Nagalingam (Sri Lanka), Johari Sasa (Indonesia); Ernesto G. Perez (Training Coordinator, RPTR); Isagani O. Herrera (Philippines); Dedchao Kraisorakul (Thailand); Somporn Lewchalermvongs (Thailand); Md. Rais Uddin Akanda (Bangladesh); Zaeny D. Suryanata (Indonesia); Bishnu Kafle (Nepal); Awadh Kishor Deo (Nepal); Mohd. Nizam Khamis (Malaysia).
Fourth row (left to right): Rizalino T. Dilag, Jr. (RPTR Staff); Victor M. Macalinga (RPTR Staff); Regal M. Aseron (RPTR Staff); Rex B. Alocilja (RPTR Staff); Emerito V. Tipa (RPTR Staff); William V. Barsana (RPTR Staff); Samer Jullavanich (Thailand); Vinich Sereeprasert (Thailand); Sanong Kuantharvon (Thailand); Joseph Handoko (Indonesia); K. Don Walter (Sri Lanka); Ahmad Bin Selamat (Malaysia); Ananto Dlasto Wijoyo (Indonesia); Murani Mirza (Indonesia).
Not in the picture: Sunarsedyono (Indonesia); Conrado R. Nora (RPTR Staff); and Rodolfo Salcedo (RPTR Staff).

Announcements

IRRI research paper series available on request

The IRRI Research Paper Series (IRPS) is a vehicle for timely publication of research findings, by IRRI and associated scientists, that have significant value for researchers working on rice or rice-based cropping systems. The papers go regularly to libraries and certain institutions who request to be added to the IRPS mailing list. Individuals may request *one* or *two selected papers only* (see box for recent titles). Write to: Office of Information Services, International Rice Research Institute, Box 933, Manila, Philippines. ■

Recent titles in the International Rice Research Paper Series.

Series no.	Title
21	Sulfur nutrition of wetland rice
22	Land preparation and crop establishment for rainfed and lowland rice
23	Genetic interrelationships of improved rice varieties in Asia
24	Barriers to efficient capital investment in Asian agriculture
25	Barriers to increased rice production in eastern India
26	Rainfed lowland rice as a research priority – an economist's view
27	Rice leaf folder: mass rearing and a proposal for screening for varietal resistance in the greenhouse
28	Measuring the economic benefits of new technologies to small rice farmers
29	An analysis of the labor-intensive continuous rice production system at IRRI

ANNOUNCEMENT FOR IRRN

The Office of Information Services is currently updating the mailing list for publications such as the IRRN. If the IRRN is regularly mailed to you, *you will soon receive a mailing list survey form.* If you wish to remain on the mailing list, please fill out the form completely and return it by AIR MAIL to IRRI. If you do not receive a survey form, please let us know so that your name will not be inadvertently dropped from the list. Thank you.

The International Rice Research Institute
P.O. Box 933, Manila, Philippines

ISSN 0115–0944