International Rice Research Newsletter

VOLUME 10 NUMBER 5 OCTOBER 1985

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

Contents

Guidelines and Style for IRRN Contributors

Articles for publication in the International Rice Research Newsletter (IRRN) should observe the following guidelines and style.

Guidelines

- Contributions should not exceed two pages of double-spaced typewritten text. Two figures (graphs, tables, or photos) may accompany each article. The editor will return articles that exceed space limitations.
- Contributions should be based on results of research on rice or on cropping patterns involving rice.
- Appropriate statistical analyses should be done.
- Announcements of the release of new rice varieties are encouraged.
- Pest survey data should be quantified. Give infection percentage, degree of severity, etc.

Style

- For measurements, use the International System. Avoid national units of measure (cavan, rai, etc.).
- Abbreviate names of standard units of measure when they follow a number. For example: 20 kg/ha, 2 h/d.
- Express yield data in tonnes per hectare (t/ha). With small-scale studies, use grams per pot (g/pot) or g/row.
- Express time, money, and common measures in number, even when the amount is less than 10. For example: 8 min, $2, 3 kg/ ha, 2-wk intervals.
- Write out numbers below 10 except in a series containing 10 or higher numbers. For example: six parts, seven tractors, four varieties. *But* There were 4 plots in India, 8 in Thailand, and 12 in Indonesia.
- Write out numbers that start sentences. For example: Sixty insects were put in each cage. Seventy-five percent of the yield increase is attributed to fertilizer.
- Place the name or denotation of chemicals or other measured materials near the unit of measure. For example: 60 kg N/ha, not 60 kg/ha N; 200 kg seed/ha, not 200 kg/ha seed.
- Use common names — not trade names — for chemicals.
- The US is the standard monetary unit in the IRRN. Data in other currencies should be converted to US.
- When using acronyms, spell each out at first mention and put the specific acronym in parentheses. After that, use the acronym throughout the paper. For example: The brown planthopper (BPH) is a well-known insect pest of rice. Three BPH biotypes have been observed in Asia.
- Abbreviate names of months to three letters: Jun, Apr, Sep.
- Define in the footnote or legend any nonstandard abbreviations or symbols used in a table or figure.
- Do not cite references or include a bibliography.

Genetic Evaluation and Utilization

OVERALL PROGRESS

Evaluation of new rices for kharif planting

K. Pushkaran, Agricultural Research Station, Mannuthy (P.O.) Trichur, Kerala; and M. J. Balakrishna Rao, Central Rice Research lnstitute (CRRI), Cuttack, Orissa, India

In low-lying, waterlogged aman areas, most farmers grow long-duration, tall, traditional rices during kharif. Seed is broadcast onto dry land that floods as the monsoon intensifies. Sometimes fields are flooded immediately after sowing or at early crop growth. Lack of suitable high-yielding varieties for these lands is a major constraint to increased production.

We evaluated 18 promising high yielding rices (16 semidwarf and *2* tall) developed at CRRI for their suitability for direct seeding in waterlogged areas and where there is early flooding. The rices had yielded well in transplanted conditions.

Dry seed was line sown at 60 kg/ ha with 20 cm between lines and 30-50-50 kg NPK; ha was applied basally. Two days after sowing, the field was submerged by heavy rains. Of the 18 varieties, 14 grew and yielded well (see table).

CR1017 yielded highest with 3.6 t/ha, followed by CRl0l0 and CRl0l8. CR1017 had maximum panicle-bearing tillers/m^2 and less sterility than other varieties. Lodging caused low yields of Safri-17/IR20-1, T412/IR20, and Waikoku/IR1014-211.

Yield and important ancillary characters of 14 rice cultivars, Orissa, India.

Culture	Plant ht (cm)	Grains (no. / panicle)	Sterility (%)	1,000-grain wt (g)	Av panicle-bearing tillers / m^2	Grain yield (t/ha)
CR1009 (Pankaj / Jaganath)	98	179	19	20	183	3.0
CR1010 (Pankaj / Japanath)	112	217	22	23	173	3.3
CRl0l1 (Pankaj / Jayanath)	101	122	11	22	159	2.2
CRl0l7 (Pankaj / Jaganath)	116	167	11	23	186	3.6
CR1018 (Pankaj / Japanath)	115	203	9	24	169	3.3
CR1013 (Jaganath natural cross)	113	137	14	20	169	2.8
CR1020 (CR70 / Pankaj)	112	152	23	28	137	2.4
T412 / IR20-3	119	123	12	11	144	1.5
T412 / IR20-8-2	116	124	17	11	122	1.5
T412 / IR20-18-2	114	151	9	15	142	2.1
T412 / IR20-194	115	154	13	11	147	1.7
T412 / IR2041-3	122	182	20	14	137	1.8
Safri-17 / IR20-1	137	145	25	19	167	1.2
Waikoku / IRl014-211	129	149	9	20	132	2.1

CD (5%) for comparison of yield = 0.267

Hang Feng, a new, short-statured keng rice grown near Shanghai

Cui Sho-Bai, Institute of Crop Breeding and Cultivation, Shanghai Academy of Agricultural Sciences, Shanghai, China

In Feb 1983, the Shanghai Municipal Crop Variety Examining and Approving Commission released Hang Feng. The variety is now grown on more than 20,000 ha around Shanghai. It was developed at the Institute of Crop Breeding and Cultivation of SAAS.

Hang Feng is short-statured with firm culms; strong, erect leaves and tight leaf sheaths; and good tillering and heading ability. It responds well to high N application and resists lodging. It is relatively tolerant of low temperature at meiosis and flowering. Leaves are light green and become yellowish-green during ripening. It has had few disease and insect problems. Yield is comparatively stable.

Hang Feng has superior grain quality and high milling percentage. Milled rice is broad, uniform, and white, with good flavor, suitable stickiness, good scent, and glossy appearance.

The variety is most commonly planted as a second crop (plant height 70-75 cm), although it also is single-cropped (plant height 85-90 cm). Second crop growth duration is 140 d. A single crop takes about 160 d. Hang Feng yields about 5 t/ha as a second crop and may yield 30% more in a single-cropping system.

Performance of BW rices in the midcountry wet zone of Sri Lanka

P. E. Peiris, Bombuwela Regional Agricultural Research Station, Sri Lanka; and Kalarunji Maheswaran, National Agricultural Research Institute, Guyana

We evaluated 5 short-duration (90-100 d) BW rices for performance in the Sri Lanka midcountry wet zone (MZ) at Peradeniya in Jul-Oct 1982. BW272-6B, BW288-2, BW293-2, BW267-3, and BW267-7 were developed by the Bombuwela Regional Agricultural Research Station (BRARS) for the low country wet zone, mainly the Kalutara Galle and Matara districts.

Plant height, 1,000-grain weight, yield, number of productive tillers, and panicle length in the MZ were compared with similar data from BRARS, where the varieties were grown in Apr-Jun 1982 (see table). Fertilizer doses were the same at both sites.

Peradeniya is 490 m above sea level and Bombuwela is 3 m above sea level. Average monthly temperature and rainfall at the sites are in the figure. The soil at Peradeniya is an alluvial gley.

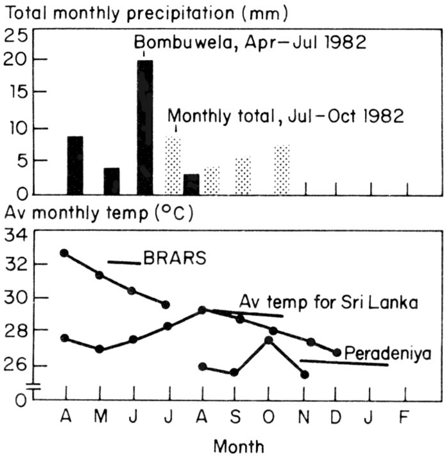
The varieties performed poorly in the MZ, and took longer to mature than at BRARS. BW272-6B, normally a 90-d variety, matured in 122 d. All the varieties retained their insect and diseases resistance. BW267-3 yielded highest at both sites.

The differences in yield and maturity may have been caused by differences in location, that could have attributed to differences in humidity, sunshine hours, rainfall, day-night temperature, and irrigation water quality.

Performance of BW rices at Peradeniya and BRARKS. [a]

Variety	Plant ht (cm)		Productive tillers (no.)		Panicle length (cm)		1000-grain wt (g)		Grain wt per plant	
	P	B	P	B	P	B	P	B	P	B
BW 272-6B	102.8	100.5	2.4	5.0	25.6	26.36	16.1	16.7	4.02	5.75
BW 288-2	52.3	66.51	3.3	4.0	16.1	20.4	27.7	29.8	4.78	8.60
BW 293-2	59.0	66.01	1.9	3.0	9.5	22.8	27.2	30.0	3.21	7.80
BW 267-3	75.8	77.09	2.1	5.0	22.1	20.08	30.1	30.6	4.49	9.20
BW 266-7	94.0	81.56	2.2	4.0	21.8	21.71	25.4	25.8	2.03	5.68

[a] P = av of 60 plants (20/replication) were analyzed at Peradeniya. B = data obtained from BRARS.



Monthly precipitation and temperature in Bomhuwela and Paradeniya, Sri Lanka. 1982.

Manhar, high yielding, early maturing rice for the irrigated plains of Uttar Pradesh

M.P. Pandry, S.C. Mani, H. Singh, J.P. Singh, and S. Singh, Plant Breeding Department, G. B. Pant University of Agriculture and Technology, Pantnagar 263145, Uttar Pradesh, India

Manhar (UPR103-44-2) was developed using the pedigree method after hybridization of IR24 and Cauvery. It is a semidwarf that matures in 123 d, and is suitable for the irrigated plains of Uttar Pradesh.

Table 1. Mean performance of Manhar in trials in Uttar Pradesh, India.

Trial [a]	Year	Mean yield (t/ha): Manhar	Saket 4 (check)	Prasad (check)	Increase [b] (%) over check
VT-Early	1980	5.1	4.3	4.2	18
VT-Early	1981	4.5	–	4.3	3
VT-Early	1982	4.9	–	4.1	20
VT-Early	1983	4.6	–	4.3	5
VT-Early	1984	4.8	–	4.4	10
SVT-Early	1982	4.8	3.9	–	22
SVT-Early	1983	4.3	3.7	–	15
SVT-Early	1984	3.7	3.2	–	18
PVT-2 (AICRIP)	1982	4.9	3.3	Ratna	49
PTV-2 (AICRIP)	1983	3.1	2.3	Rasi	34
Mean		4.6	3.9	4.2	
Sites (no.)		61	29	33	

[a] VT = Varietal Trials, SVT = Standard Varietal Trials, PVT = All India Coordinated Trials. [b] Mean of 17% over Saket 4, 8% over Prasad.

Table 2. Distinguishing morphological characters Manhar, Uttar Pradesh, India.

Character	Particulars
Height	88 cm
Seedling vigor	Good
Lodging	Resistant
Plant type	Dwarf, ideal
Leaf sheath	Green
Tillering	Good (14 tillers/plant)
Position of flag leaf	Erect
Photoperiod sensitivity	Photoperiod insensitive
Panicle length	21 cm
Apiculus	Green
Duration	120 d from seed to seed
No. of grains/panicle	165
1,000 grain weight	19.9 g
Grain type	Long slender
Cooking quality	Good

Manhar yielded consistently more than Saket 4 and Prasad in kharif Varietal Trials-Early, Standard Varietal Trials-Early, and All India Coordinated trials throughout Uttar Pradesh (Table 1). Manhar yielded 17% higher than Saket 4 and 8% higher than Prasad. With optimum agronomic management, it yielded 6 t/ha at Pantnagar in 1983.

Manhar is moderately resistant to bacterial leaf blight and has field tolerance to whitebacked planthopper. Its grain is long and slender with good cooking quality. Table 2 gives distinguishing morphological characteristics.

The International Rice Research Newsletter (IRRN) invites all scientists to contribute concise summaries of significant rice research for publication. Contributions should be limited to one or two pages and no more than two short tables, figures, or photographs. Contributions are subject to editing and abridgment to meet space limitations. Authors will be identified by name, title, and research organization.

HPU8020, a promising mutant rice

K. D. Sharma, R. P. Kaushik, and S. L. Sharma, Plant Breeding Department, Himachal Pradesh Agricultural University, Palampur 176062, Himachal Pradesh, India

HPU8020 was isolated 1973 from Bala, an early-maturing rice that was treated with 20 Kr gamma rays. HPU8020 matures 10-13 d later than Bala. Unlike Bala, it has synchronous tillering and anthocyanin pigmentation at the plant base.

HPU8020 has significantly greater plant height, panicles/plant, panicle length, panicle weight, and 1,000-grain weight, and yields more than Bala (Table 1). Although it matures later, it has higher plant efficiency than its parent. HPU8020 has short, bold grains like Bala, with 7.26% protein content.

In yield trials from 1976 to 1980 at altitudes below 900 m in Himachal Pradesh, HPU8020 yielded an average 4.8 t/ha; 14% more than IR579, a high yielding semidwarf (Table 2). HPU8020 (IET5878) was evaluated throughout India in the All India Coordinated Rice Trials from 1978 to 1981. In direct-seeded rainfed conditions. HPU8020 yielded an average 3.1 t/ha, 13% more than Cauvery, the check variety (Table 3). It yielded highest. 7.3 t/ha, at Sabour in 1979. HPU8020 flowers in 84 d, vs 77 for Cauvery.

In transplanted trials, HPU8020 yielded an average 4.1 t/ha, 10%, more than Cauvery (Table 3). It yielded highest. 8 t/ha. at Bikaner in 1979, compared to 7 t/ha for Cauvery. In transplanted experiments, HPU8020 flowered in 88 d, vs 83 d for Cauvery.

HPU8020 has strong blast resistance and resistance to gall midge, stem borer, and green leafhopper.

It has been released for general cultivation in Pondicherry, India, and identified for All India Coordinated Rice Improvement Program minikit trials in south and southeast India in rabi. It has been nominated for release for general cultivation in low altitude areas of Himachal Pradesh.

Table 1. Agronomic and quality characteristics of HPU8020 and parent variety Bala, Himachal Pradesh, India.

Characteristic	Bala	HPU8020
Plant height (cm)	71.8	74.8
Panicles/plant (no.)	5	8
Panicle length (cm)	19	20
Panicle weight (g)	2.8	3
Spikelets/panicle	142	155
l000-grain wt (g)	21	22
Sterility (%)	17	14
Yield/plant (g)	12	17
Plant efficiency (yield/ plant per d)	0.12	0.14
Panicle density		9.46
Grain 1ength:breadth		2.02
Protein (%)		7.26
Chlorophyll content at flowering (mg/g fresh wt)		1.24
Chlorophyll a:b		0.74
Leaf area index		1.09

Table 2. Grain yield of HPU8020 in Himachal Pradesh, India, 1976-80.

	HP118020		lR579 (check)	
Year	Yield (t/ha)	Sites (no.)	Yield (t/ha)	Sites (no.)
1976	4.3	5	3.9	5
1977	4.7	10	4.4	10
1978	4.9	7	4.3	4
1979	4.4	4	3.0	4
1980	5.8	4	4.9	4
Mean	4.8		4.2	

Table 3. Grain yield of HPU8020 in All India Coordinated trials.

Year	Sites (no.)	Yield (tiha)	
		HPU8020 (IET5878)	Cauvery
		Direct seeded rainfed trials	
1978	16	3.3	2.9
1979	14	3.3	2.9
1980	30	3.2	2.8
1981	17	2.4	2.3
		Transplanted experiments	
1978	6	3.5	3.2
1979	8	5.0	4.8
1980	13	3.9	3.6
1981	17	4.1	3.7

Ethyl methane sulfonate (EMS) induced rice mutants

J. Ahmed, Rice Research Station, Chinsurah 712102, India

Randhunipagal is a tall (150 cm), aromatic, indica rice with 150-160 d maturity. We exposed unhusked

Effects of EMS on some characters of selected M_2 plants, Chinsurah, India.

Selection	Duration (d)	Height (cm)	Panicle no.	Panicle length (cm)	Grain size		Grain shape (L:B)	1000-grain wt (g)	Aroma
					Length (mm)	Breadth (mm)			
Control	152	156	8	24	6.0	2.2	2.7	13.0	Present
CNM-RDP-42	120	100	8	16	5.5	2.8	2.0	12.5	Present
CNM-RDP-39	118	134	9	26	7.4	2.7	2.7	18.1	Present
CNM-RDP-41	136	133	6	24	7.2	2.5	2.9	16.0	Absent
CNM-RDP-46	124	19	7	20	7.8	2.5	3.1	16.5	Absent
CNM-RDP-48	139	133	6	24	7.5	2.5	3.0	16.5	Absent
CNM-RDP-35	134	100	7	21	8.8	3.0	2.6	22.3	Present
CNM-RDP-36	119	85	9	23	9.5	2.8	3.3	25.1	Absent
CNM-RDP-38	124	114	8	26	8.9	2.8	3.1	22.4	Absent
CNM-RDP-37	123	134	10	24	9.5	2.7	3.4	19.8	Present
CNM-RDP-40	120	110	9	26	8.9	2.1	4.2	15.1	Absent
CNM-RDP-43	120	103	8	26	9.3	2.0	4.5	17.6	Absent
CNM-RDP-49	137	138	6	26	9.2	2.1	4.3	17.0	Absent
CNM-RDP-50	127	81	11	21	8.9	2.2	3.9	17.5	Present

Randhunipagal seeds to EMS at 0.25, 0.50, 0.75, and 1% concentrations for 24 h to cause mutation and develop a dwarf, aromatic, long-slender grained line, and to quantify optimum EMS dosage for this purpose.

The M_1 was grown in 1977 kharif and the M_2 in 1978. Mutation rate was highest at 0.25% concentration, followed by 0.50%. None of the M_1 produced seeds at EMS concentrations higher than 0.50%. This may be caused by mutagenic effects at higher doses that involve many genes and lead to spikelet sterility and plant death.

Morphological and grain type mutants were studied in the M_2. All mutants matured earlier than the control. Plant height, panicle number and length, grain size and shape, and grain weight differed substantially from those of the control (see table). Some nonaromatic mutants were obtained. Largest variation was in grain shape and weight.

IR36 for rainfed conditions in Madhya Pradesh, India

V.N. Sahu, R.K. Sahu, M.N. Shrivastava, and P. S. Shrivastava, Zonal Agricultural Research Station, Raipur, Madhya Pradesh. India

IR36 is a semidwarf rice with long, slender, translucent grains and good cooking quality. It matures in 120 d and is tolerant of gall midge and bacterial leaf blight.

In Madhya Pradesh, 80% of rice is gown in rainfed fields. IR36 performed well in multilocation tests (see table), and has become popular in areas where rainfall begins the 3d wk of Jun and continues through mid-Sep.

Grain yield of IR36 in rainfed areas of Madhya Pradesh.

Variety	Grain yield [a] (t/ha)						
	Raipur	Jabalpur	Waraseoni	Bagwai	Rewa	Jagdalpur	Mean
				1978			
IR36	4.3	4.0	5.4*	4.2*	6.2*	-	4.8
Rasi	3.4	3.7	4.5	3.4	4.9	-	4.0
Ratna	3.5	3.8	4.5	3.8	4.9	-	4.1
				1980			
IR36	0.6	2.4	4.1*		3.8	-	2.7
Abha	0.9	2.2	3.3		3.3	-	2.5
				1982			
IR36	3.2	3.4	3.7	3.7	2.3	5.0	3.5
Anupama	2.9	3.7	3.5	4.0	3.4	4.7	3.7
				1983			
IR36	2.9*	2.1	-	2.9	3.1*	-	-
Anupama	3.0	3.1	-	2.1	2.7	-	-
Deepti	2.1	2.8	-	3.1	2.6	-	-

[a] The asterisk (*) means that IR36 was superior to Ratna in 1978, to Abha in 1980, and to Deepti in 1983.

Promising new rice varieties for late kharif in the Cauvery Command Area, Karnataka, India

B. Vidyachandra, S. M. Imtiaz, Gubbaiah, and T. Geeta Devi, Regional Research Station, University of Agricutural Sciences, Mandya, India

Low temperatures during reproductive phase and stem borer incidence limit late kharif (Sep) rice in the Cauvery Command Area. In 1983, the All India Coordinated Rice Improvement Project at Mandya identified several short-duration, high yielding, stem borer

Performance of stem borer-resistant, late kharif varieties, Karnataka, India.

Variety	Days to 50% flowering	Grain yield (t/ha)	Whiteheads (%)
IET7633	109	3.2	10
IET7614	102	3.0	7
IET7261	102	2.8	8
IET7617	85	1.4	30
Mangala	94	2.3	18
CD (0.05)	-	11.7	7

resistant varieties as possible replacements for locally grown Mangala (see table). The most promising varieties were IET7633 and IET7614, both of Rasi Finegora, and IET7261 from Rasi Mettasamma.

BG367-4, a promising short-duration rice

K. Ganesan, T. Sundaram, W.W. Manuel, and S. Palanisamy, Paddy Experiment Station (PES), Ambasamudram 627401, Tamil Nadu, India

BG3674 (BG280-12/PTB 33) is a promising short-duration rice received through the International Rice Testing Program. It was evaluated at PES in the 1980 International Rice Observational Nursery (IRON), and performed well in 1980-84 in Jun-Sep.

BG367-4 yielded 9.5 t ha in 1983, with average yields of 6.5 t ha over 4 yr. It yielded 25% more than TKM9 and 35% more than ADT36 (see table). Duration ranged from 109 to 115 d, averaging 112 d.

BG3674 has semidwarf (91 cm) stature, long slender grains, and white rice. The 1,000-grain weight is 23.4 g.

Yield potential is high because of high panicle weight (1.33 g).

The variety has been nominated for the 1985-86 Rice Coordinated Yield Trial-2 (100-120 d) at Tamil Nadu Agricultural University experiment stations and is being used as a donor in the PES hybridization program.

Performance of BG367-4 at Ambasamudram, India, 1980-84.

Variety	Grain yield (t/ha)						Flowering time (d)	Plant ht (cm)	Panicles/ hill	1000-grain wt (g)	Panicle wt (g)
	IRON 1980	Yield trial 1981	Yield trial 1982	IRYN (VE) 1983	Yield trial 1984	IRYN (VE) 1984					
BG3674	6.9	5.5	5.1	9.5	6.1	6.1	82	91	8.3	23.4	1.33
ADT36	5.1	4.4	5.2	–	4.1	5.4	84	84	8.9	24.2	1.16
TKM9	–	5.0	5.3	6.6	4.3	4.6	82	82	8.2	24.5	1.27
m + σ	6.9	–	–	–	–						
CD (P = 0.05)	–	1.1	0.5	1.4	0.1	1.3					

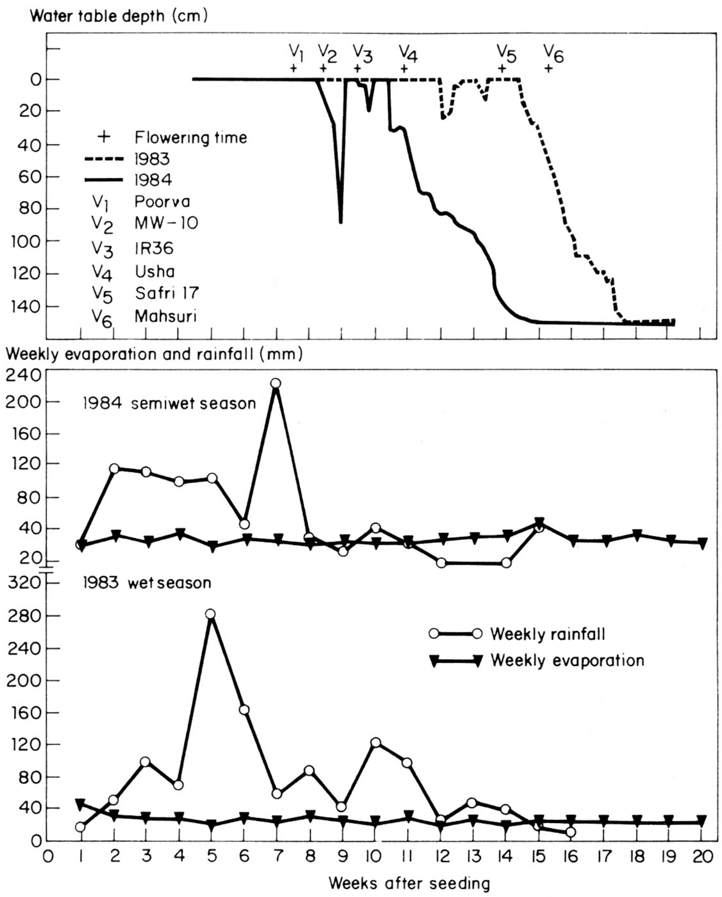
Evaluation of six rice genotypes in relation to field hydrology

I.K. Jaggi, R.O. Das, and D.C. Bisen, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Zonal Agricultural Research Station. Labhandi, Raipur, Madhya Pradesh. India

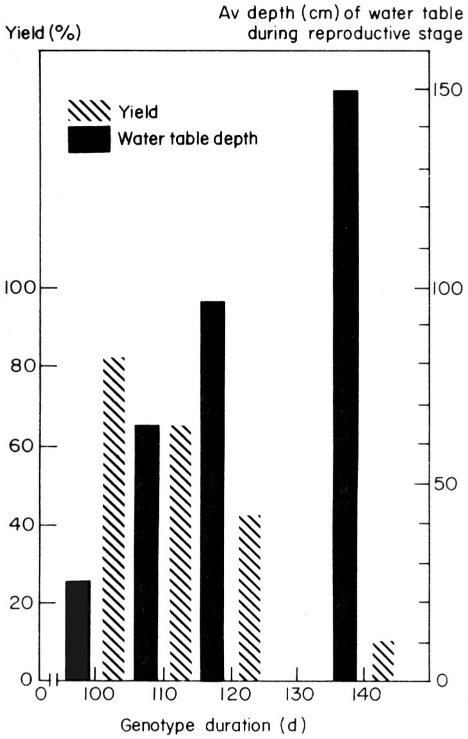
We evaluated the effect of drought on yield of six rices with different durations in 1983 wet and 1984 semiwet seasons.

In both seasons, the rices were planted on 7 Sep and grown with similar agronomic practices. Weekly precipitation, evaporation, daily groundwater level, and flowering time were recorded (Fig. 1). Drought was longer and more severe in semiwet season. Evaporation exceeded precipitation 11 wk after seeding in semiwet season and after 16 wk in wet season. In semiwet season, groundwater level was below 80 cm 12 wk after seeding.

Short-duration MW 10 performed best in semiwet season, yielding 2.5 t/ha. Late-maturing Mahsuri yielded lowest, 0.3 t/ha. Poorva, IR36, Usha, and Safri I7 produced intermediate yields. Safri I7



1. Weekly precipitatlon. evaporation, daily groundwater level, and flowering time of 6 genotypes. Kaipur, India



2. Effect of subsurface water level on rainfed rice, Raipur, India.

was less susceptible to drought than Mahsuri. It had less leaf rolling and high root density.

Figure 2 shows the role of subsurface water in rainfed culture. The groundwater level fell during the cropping season. Longer duration rices suffered more drought stress and yields declined. Subsoil moisture (30-80 cm deep) was particularly important to medium and late duration varieties in semiwet season (see table).

Effect of subsoil moisture on 6 rice genotypes, Raipur, India.

	Poorva	MW10	IR36	Usha	Safri 17	Mahsuri
			Grain yield [a] (t/ha)			
Wet	2.5	3.5	2.8	3.0	2.7	3.1
Semiwet	2.0	3.5	1.8	1.3	1.0	0.3
Mean	2.3	3.5	2.3	2.2	1.9	1.7
			Reduction (%) in yield			
	18	0	35	57	62	91
			Subsoil moisture contribution (%)			
	21	32	41	57	61	

[a] CD at 5% — Season 0.4; Genotypes 0.3; Interaction 0.4

The International Rice Research Newsletter (IRRN) invites all scientists to contribute concise summaries of significant rice research for publication. Contributions should be limited to one or two pages and no more than two short tables, figures, or photographs Contributions are subject to editing and abridgment to meet space limitations. Authors will be identified by name, title, and research organization.

Genetic Evaluation and Utilization

DISEASE RESISTANCE

Scented rices with stem rot (SR) and bacterial blight (BB) resistance

K. Singh, H. Chand, and D. Singh, Haryana Agricultural University Rice Research Station (HAURRS), Kaul, Haryana, India

SR, caused by *Sclerotium oryzae,* and BB, caused by *Xanthomonas campestris* pv. *oryzae,* reduce rice yields in Haryana. We evaluated 68 scented rices for their reaction to these diseases at HAURRS in 1983-84 and 1984-85.

To screen for BB resistance, each entry was planted in 2-m rows at 20- × 15-cm spacing. Plants were clip-inoculated with a BB suspension 21 d after transplanting (DT) for kresek and 45 DT for leaf blight and rated for resistance using the *Standard evaluation system for rice.*

SR screening was in field and laboratory. In the laboratory, cut stem pieces were wound-inoculated with a small piece of agar-cultured *S. oryzae* Inoculated stems were kept standing in a test tube rack in a tray with 2.5 cm of water. They were covered with plastic bags to maintain high humidity and were incubated at 28-30°C. Lesion length was measured 10 d after inoculation. Entries with lesions less than 10 mm long were considered resistant; those with 10-30 mm lesions, moderately resistant; and those with lesions more than 30 mm long, susceptible.

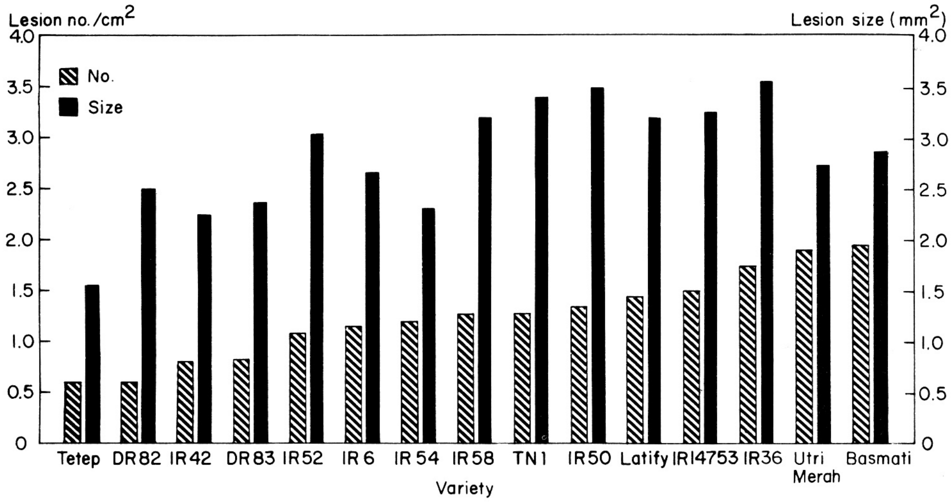
HKR220 was resistant to SR in laboratory tests in both seasons. HKR216 and HKR219 were resistant in the field. Pak basmati and RPSC 136 were SK resistant in all tests. They are a good source of SR resistance for breeding purposes.

Pak basmati also was moderately resistant at the kresek phase of BB. RP2144-108-5-3-2and NDR 601 also had moderate resistance to kresek. However, none of the materials were resistant to both BB phases.

Rice seedling resistance to brown spot (BS)

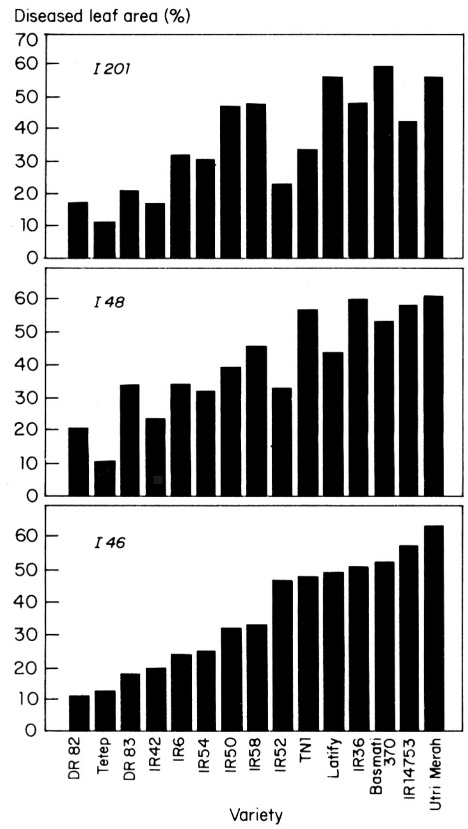
K. K. Baloch and J. M. Bonman, Plant Pathology Department IRRI

We tested 15 rice varieties for seedling resistance to isolates of *Bipolaris oryzae* the BS fungus. In the greenhouse, 23-d-old seedlings were artificially inoculated with 3 isolates using a spore concentration of 3×10^4 spores/ml. Disease was measured on the 3d fully expanded leaf as lesion number per cm^2 and lesion size (mm^2), and percent diseased leaf area was calculated.



The varieties had from 0.6-2.0 lesions/cm^2 and lesion size varied from 1.6 to 3.6 mm^2 (Fig. 1). Diseased leaf area ranged from 10.2 to 63.6% (Fig. 2). Tetep was resistant to three isolates. DR82 and IR42 produced the same lesion number and almost the same lesion size. IR36 was susceptible. Although there was some isolate-by-variety interaction, it was not sufficiently distinct to constitute evidence of physiological races of the BS fungus.

1. Mean lesion number and mean lesion size on 15 rice varieties inoculated with 3 isolates of *Bipolaris oryzae* at seedling stage. IRRI, 1985.



2. Mean diseased leaf area percentage recorded on 15 rice varieties inoculated with 3 isolates of *Bipolaris oryzae* at seedling stage. IRRI, 1985.

Individuals, organizations, and media are invited to quote or reprint articles or excerpts from articles in the IRRN

Genetic Evaluation and Utilization

INSECT RESISTANCE

Whitebacked planthopper (WBPH) growth and development on rices with monogenic or digenic resistance

H.R. Rapusas and E.A. Heinrichs, Entomology Department, IRRI

Monogenic rice cultivars with genes *Wbph 1, Wbph 2, Wbph 3, Wbph 4,* and *Wbph 5* for resistance to WBPH *Sogatella furcifera* and digenic cultivars with genes *Wbph 1* + *Wbph 2, Wbph 1* + *Wbph 3, Wbph 1* + 1 unidentified recessive gene, and *Wbph 2* + 1 unidentified recessive gene were tested for their effect on WBPH growth and development. Theoretically, rice cultivars with more than one gene for resistance are more resistant than those with only one gene.

Six-day-old seedlings of the test varieties were transplanted in 5-cm-diam clay pots at 1 seedling/ pot. There were 10 replications with 3 pots/replication. The pots were set in standing water on a galvanized iron tray in the greenhouse and arranged in a randomized complete block design.

Two weeks after transplanting, potted plants were placed in mylar film cages. Two newly hatched WBPH nymphs reared on TNl were placed in each cage. As adults emerged, they were counted and the date was recorded. Individual adults were placed in plastic vials and weighed in an electric Mettler balance (1 µg sensitivity). When emergence was complete, percent survival, mean development time, and growth index and weight per adult were computed.

$$\%\ \text{survival} = \frac{\text{no. of adults that emerged}}{\text{no. of nymphs used for infesting}} \times 100$$

$$\text{Growth index} = \frac{\%\ \text{survival}}{\text{mean development period (d)}}$$

To determine WBPH population growth on the cultivars, 6-d-old seedlings were transplanted in 10-cm-diam clay pots at 5 seedlings/pot. There were 10 replications with one pot as one replication.

Two weeks after transplanting, the plants in each pot were placed in a 10-× 90-cm mylar film cage to exclude other rice pests and natural enemies. Ten days later, the plants were examined, pests and predators were removed, and 5 pair of 3-d-old WBPH adults were placed in each cage. Twenty-five days later, WBPH population was counted and progeny per female was computed.

Levels of resistance of monogenic cultivars with the five different genes were similar except in the population growth test, in which Podiwi A-8 (*wbph 4*) was least resistant and did not differ from susceptible TN1 (see table). WBPH resistance was not related to the number of genes for resistance.

IR2035-117-3 (*Wbph 1* + *Wbph 2*) was the most resistant cultivar. High resistance level was indicated by low WBPH survival, long nymphal period, low growth index, low female weight, and low population growth. NP130, CI 5662-2, and ARC5752 have the same major genes for resistance, but were less resistant and for most growth parameters were equal to monogenic cultivars.

Results show that the levels of resistance of a cultivar cannot be predicted by studies of other cultivars with the same genes for resistance.

Development of WBPH on rice cultivars with different genes for resistance[a], IRRI, 1985.

Variety	Resistance genes	Adult survival (%)	Nymphal period (d)	Growth index	Female wt (mg)	Population growth (no. progeny/ female)
N2	2 *Wbph 1*	77 bcd	11.6 abcd	6.57 bcd	1.18 abc	19 ab
ARC10239	*Wbph 2*	63 abc	11.8 bcd	5.40 abc	1.44 cde	54 cd
ADRS	2 *Wbph 3*	67 abcd	11.5 abcd	5.85 bc	1.24 abcd	25 abc
Podiwi A-8	*wbph 4*	72 abcd	11.2 ab	6.41 bcd	1.59 e	89 e
N'Diang Marie	*Wbph 5*	71 bcd	11.1 ab	6.87 bcd	1.51 de	35 abcd
IR2035-117-3	*Wbph 1* + *Wbph 2*	50 a	13.4 e	3.81 a	0.99 a	7 a
NP130	*Wbph 1* + *Wbph 2*	80 bcd	11.4 abc	7.03 cd	1.38 bcde	28 abc
CI 5662-2	*Wbph 1* + *Wbph 2*	17 bcd	11.3 abc	6.76 bcd	1.31 abcd	33 abcd
ARC5752	*Wbph 1* + *Wbph 2*	68 abcd	12.0 cd	5.74 bc	1.28 ab	42 bcd
Chaia Anaser	*Wbph 1* + *Wbph 3*	77 bcd	11.8 bcd	6.51 bcd	1.42 cde	63 de
Katuyjar Dhan	*Wbph 1* + *Wbph 3*	59 ab	11.6 abcd	5.15 ab	1.33 bcde	64 de
Colombo	*Wbph 2* + 1 recessive	82 cd	12.2 d	6.70 bcd	1.09 ab	13 ab
368	*Wbph 1* + 1 recessive	68 abcd	11.8 bcd	5.83 bc	1.90 abcde	35 abcd
WC1240	*Wbph 1* + 1 recessive	65 abcd	11.7 abcd	5.51 bc	1.15 abc	27 abc
65	*Wbph 1* + 1 recessive	75 bcd	11.1 ab	6.76 bcd	1.44 cde	55 cd
274 A	*Wbph 1* + 1 recessive	65 abcd	11.4 abc	5.72 bc	1.25 abcd	39 abcd
TN1	– – –	85 d	11.0 a	7.71 d	2.04 f	88 e

[a] Separation of means in a column by Duncan's multiple range test at the 5% level. Av of 10 replications.

Although the varieties have the same major gene, they have diverse pedigrees and may have different sets of minor genes which greatly influence the resistance levels of these cultivars to the insect.

IET7575: a brown planthopper (BPH)-resistant variety for Karnataka, India

Gubbaiah and B. Vidyachandra, All India Coordinated Rice Improvement Project, Rice Research Station (RRS). V. C. Farm Mandya, Karnataka, India

In 1982 kharif, we screened 47 rices for field reaction to BPH at RRS, Mandya. In 1983 we screened promising entries of the 1982 trials. IET7575 (Sona/ Manoharsali) was resistant to BPH. In 1983 and 1984 kharif, verification trials were conducted in large plots with BPH-susceptible TN1 grown next to IET7575. TNI was hopperburned, but there were only 2-3 BPH/hill on IET7575.

IET7575 matures in 135 to 140 d. It has moderate tillering; broad, green leaves; late senescence; long slender grains without white belly; 2-wk seed dormancy; and good grain quality. With 100 kg N/ha, it yielded an average 6.8 t/ha. Trials conducted in farmer fields in BPH endemic areas confirmed its resistance to BPH. It also yielded more than popular high yielding varieties.

In summer and kharif 1984, IET7575 performed well in large BPH-prone areas in Channapatna (Bangalore District) and Maddur Talus (Mandya District). The State Department of Agriculture plans large-scale demonstrations to popularize the variety in Karnataka.

Virulence of *Nephotettix virescens* colonies on resistant rices

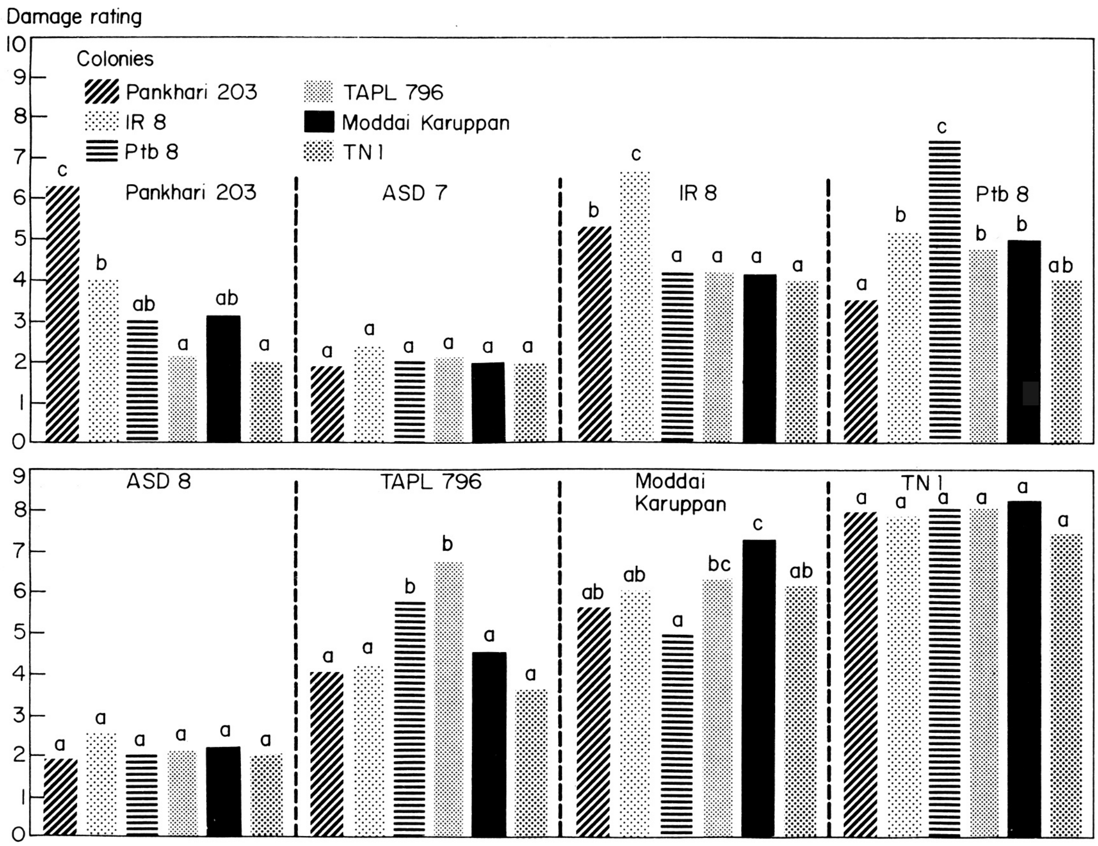
H. K. Rapusas and E. A. Heinrich. Entomology Department, IRRI

Colonies selected for virulence on rices with genes for resistance to *N. virescens* were compared with a colony reared on susceptible TN1 for 100 generations. Their virulence to ASD7, ASD8, and the varieties on which they were reared was studied to determine whether *N. virescens* populations can adapt to previously resistant varieties in the greenhouse.

Resistant varieties on which the insect colonies were reared were Pankhari 203 (*Glh 1* gene for resistance), IR8 (*Glh* 3). Ptb 8 (*glh 4*), TAPL, 796 (*Glh 6*), and Moddai Karuppan (*Glh 7*). The colonies were tested for virulence to Pankhari 203, ASD7 (*Glh 2*), IR8, Ptb 8, ASD8 (*Glh 5*), TAPL 796, and Moddai Karuppan. Virulence was determined by plant damage.

Twenty seeds/row per variety were sown in three replications. Seedlings were thinned to 151 row 6 d after seeding (DAS). At 7 DAS they were infested with three 2d- and 3d-instar nymphs/seedling from the respective colonies. Plant damage was recorded for 7 d beginning 5 d after insect infestation, using the Standard evaluation system for rice. Damage was calculated as the mean of seven ratings.

Colonies were most virulent to the varieties on which they were reared (see figure). Some colonies had cross virulence — IR8 on Pankhari 203. Pankhari 203 on IR8, and Ptb 8 on



Virulence of *N. virescens* colonies on resistant rices, IRRI. For each cultivar, means with a common letter are not significantly different at the 5% level by DMRT.

TAPL 796. None were virulent to ASD7 or ASD8.

Results indicate that *N. virescens* can adapt to resistant varieties in the greenhouse. This also may happen in the field. With this result, the stability of resistance of a variety in the field can be predicted. The cross virulence observed on some colonies suggests that *N. virescens* can adapt to varieties with different genes for resistance.

Genetic Evaluation and Utilization

HYBRID RICE

Wei You 64 — an early duration hybrid for China

L. P. Yuan, Hybrid Rice Research Institute, Hunan Academy of Agricultural Sciences, Changsha, Hunan, China; and S. S. Virmani and G. S. Khush, Plant Breeding Department, IRRI

In 1979, several elite rice lines with multiple disease and insect resistance were introduced in China through the China-IRRI collaborative program on hybrid rice. They were intended for use as improved restorers for hybrid rice development.

In 1980, test crosses were made with the cytoplasmic-genetic male sterile line V20A in China and at IRRI. Evaluation of nursery results identified IR9761-19-1 as an effective restorer. The F_1, V20A/IR9761-19-1, was more productive than its male parent.

In 1981 dry season, the lines were again crossed at IRRI and the F_1 was evaluated at four sites in Hunan and at IRRI in wet season. At all sites, fertility restoration was complete and the hybrid matured earlier than the restorer.

Chinese scientists purified the restorer line and produced enough seeds of IR9761-19-1 with plant selection 64 (IR9761-19-1-64) to evaluate in 1981 replicated yield trials. The results were encouraging. In 1981-82 winter season, hybrid seeds were grown on 3.3 ha on Hainan Island. Mean seed yield was 2.2 t/ha. In 1982 second season, the combination was reevaluated in replicated yield trials and on-farm trials in Hunan and compared to the commercial hybrid Wei You 6 (V20A/IR26). V20A/IR9761-19-1-64 matured 2 wk earlier and yielded about 1 t/ha more than Wei You 6 (Table 1).

Seed was multiplied in Hunan and Hainan and 6,500 ha of the new hybrid was grown in summer 1983 in Hunan, Guangdong, Jiangsi, Zhejiang, and Fukien. In 1984, the hybrid was named Wei You 64 and was planted on 0.26 million ha in China.

Wei You 64 yielded about 1 t/ ha more than conventionally bred Xian Ai Zhao 9 in national yield trials in the South Yangtze Valley (Table 2). It matured in 124 d. Wei You 64 yielded the same as Wei You 6 but matured 12 d earlier (Table 3). Its short duration allows a second crop planting as late as 1 Aug without significant yield loss. If planted that late, Wei You 6 yields only 3 t/ ha. Highest yield of Wei You 64 in China has been 11.3 t/ ha.

Wei You 64 is resistant to blast, bacterial blight, brown planthopper (BPH), and green leafhopper and moderately resistant to yellow dwarf virus in China. It yields more seed (1.5-2.5 t/ ha) than Wei You 6 (1-2 t/ ha) because its male parent produces more pollen. Wei You 64 is susceptible to sheath blight, and therefore unsuitable for waterlogged soils. It is moderately resistant to lodging.

Table 1. Performance of V20A/IR976 1-1 9-1-64 (Wei You 64) and Wei You 6 in regional yield trials (second crop) in Hunan, China, 1982.

Hybrid	Trials (no.)	Yield (t/ha)	Growth duration (d)	Productivity (kg/ ha per d)
V20A/IR9761-19-1-64	17	6.1	101	57
Wei You 6	17	5.1	125	41

Table 2. Performance of Wei You 64 and Xian Ai Zhao 9 in national yield trials (first crop) in China, 1984.

Hybrid	Trials (no.)	Yield (t/ ha)	Growth duration (d)	Productivity (kg/ ha per d)
Wei You 64	14	1.7	124	62
Xian Ai Zhao 9	14	6.8	119	57

Table 3. Performance of Wei You 64 and Wei You 6 in national yield trials (one crop) in China, 1984.

Hybrid	Trials (no.)	Yield (t/ ha)	Growth duration (d)	Productivity (kg/ha per d)
Wei You 64	10	1.8	124	63
Wei You 6	10	1.9	136	58

V20A/IR9761-19-1 also has shown promise in trials in Indonesia, India, and Korea. At IRRI, however, its yields are limited by tungro, ragged stunt, and grassy stunt 2, and by BPH biotype 2.

Genetic Evaluation and Utilization

DROUGHT TOLERANCE

Developing closely related rice lines with different drought-induced abscisic acid (ABA) accumulation

I.E. Henson, Plant Breeding Institute, Cambridge, U.K.; and G. C. Loresto, and T. T. Chang, IRRI

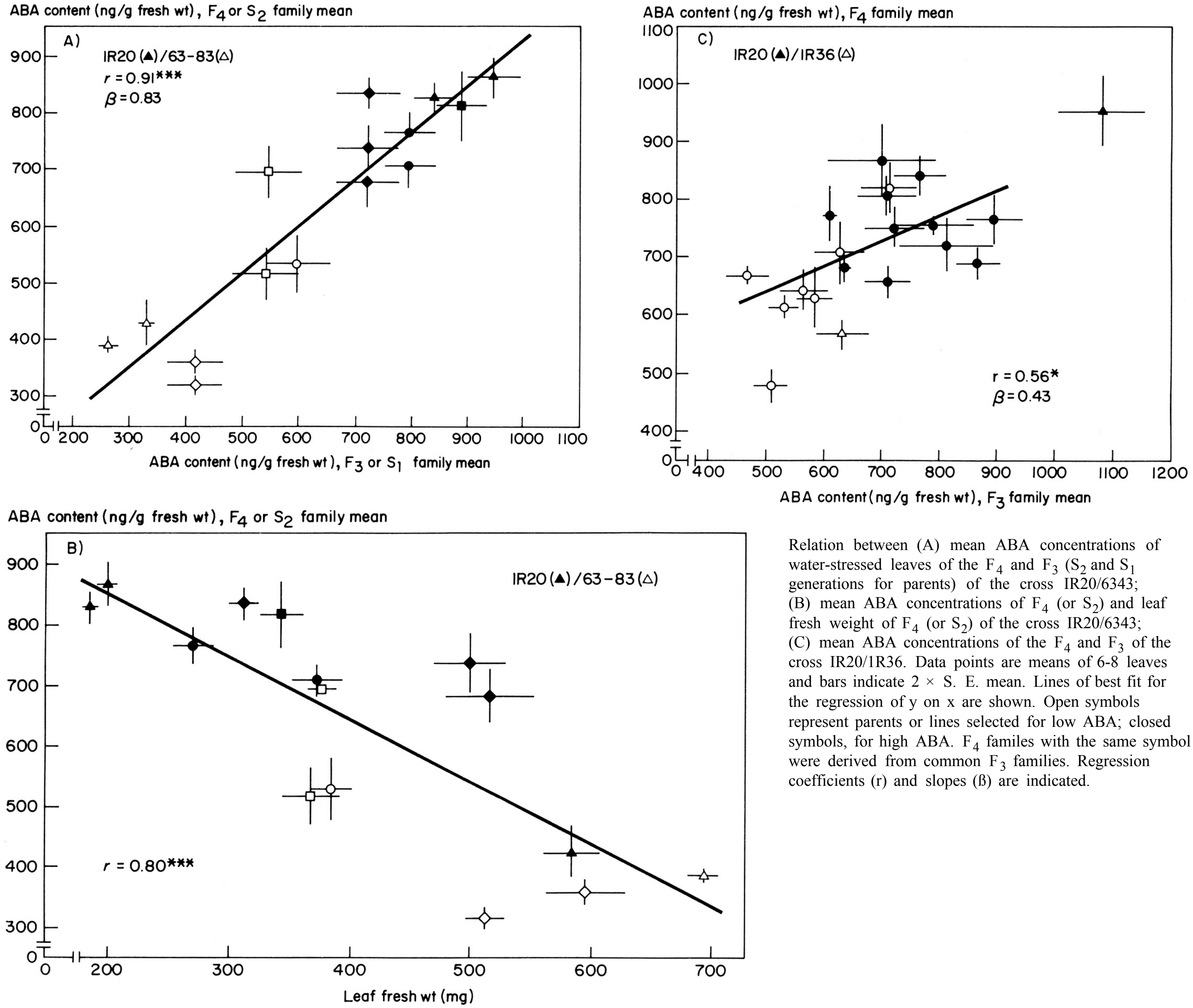
ABA is a plant hormone that mediates plant responses to drought stress. It causes stomata to close, thus reducing transpirational water losses. Differences in the ability of plants to accumulate ABA could affect their ability to withstand drought.

To objectively evaluate the consequences of differences in drought-induced ABA accumulation (DIAA) on survival or yield ability during drought, genetic stocks with contrasting DIAA but similar characteristics are required. We screened several rices for DIAA using a test in which leaves were detached and rapidly water-stressed. ABA concentrations were determined in leaf extracts using a gas-liquid chromatograph fitted with a pulse-

Characteristics of F_4 plants of two rice crosses and plants of the parental genotypes. [a]

	ABA content (ng/g fresh weight)	Leaf fresh weight [b] (mg)	Plant height at maturity (cm)	Days to panicle emergence from sowing
		IR20/63-83		
Low-ABA selections (n=12)	391	455	64.8	90.2
High-ABA selections (n=21)	814***	398 ns	17.9*	91.0 ns
63-83(n=6)	428	629	100.5	85.3
IR20 (n=6)	909***	190***	41.8***	85.0 ns
		IR20/IR36		
Low-ABA selections (n=15)	606	206	54.2	84.2
High-ABA selections (n=22)	844***	181 ns	52.2 ns	83.5 ns
IR36 (n=3)	512	185	51.3	86.7
IR20 (n=3)	919*	110***	38.1**	93.0 ns

[a] Plants were grown in a glasshouse at Cambridge, U. K. *, ** and *** indicate significant differences at $P < 0.05$, 0.01 and 0.001, respectively, between low- and high-ABA selections and between parental genotypes; ns = not significant. [b] Leaf six for IR20/63-83 and leaf five for IR20/IR36.



Relation between (A) mean ABA concentrations of water-stressed leaves of the F_4 and F_3 (S_2 and S_1 generations for parents) of the cross IR20/6343; (B) mean ABA concentrations of F_4 (or S_2) and leaf fresh weight of F_4 (or S_2) of the cross IR20/6343; (C) mean ABA concentrations of the F_4 and F_3 of the cross IR20/1R36. Data points are means of 6-8 leaves and bars indicate 2 × S. E. mean. Lines of best fit for the regression of y on x are shown. Open symbols represent parents or lines selected for low ABA; closed symbols, for high ABA. F_4 familes with the same symbol were derived from common F_3 families. Regression coefficients (r) and slopes (ß) are indicated.

modulated electron capture detector. Cultivars that contrasted most in DIAA were crossed and their progeny screened and selected for differences in DIAA in F_2 to F_4.

The progeny of two crosses were examined in detail. In IR20/63-83 (lowland/ upland), the parents differed about threefold in DIAA. IR20 leaves produced about 940 ng ABA/g fresh weight after 2 h stress, and 63-83 produced about 316 ng. F_2 plants of the cross had a continuous range of DIAA between that of the parents. Because of a high negative correlation between DIAA and leaf size (fresh or dry weight) (r = 4.47; $P < 0.001$) at F_2, only those tines in which DIAA was apparently unrelated to leaf size were studied in detail.

For them, DIAA at F_3 was significantly correlated with DIAA at F_2 ($r = 0.89$; $P < 0.02$). At F_4 there also was good DIAA heritability (Fig. 1A). Leaf size and DIAA still were associated (Fig. 1 B), but some lines had similar-sized leaves but different DIAA.

In IR20/ IR36 (lowland/ lowland), the correlation between DIAA at F_3 and DIAA at F_2 was poor ($r = 0.28$; $P > 0.05$). However, by selecting only the more extreme types at F_3, heritability of DIAA was improved in the next generation (Fig. 1C). There was no correlation between DIAA and leaf size.

For the progeny from both crosses, differences in leaf fresh weight and height between the high and low ABA lines were much smaller than the corresponding differences between parental genotypes (see table).

There were no differences in mean flowering dates of different ABA groups. Thus, these selections will be suitable for determining the effects of different DIAA on plant growth and yield under drought, without confounding the results by having large differences in morphology and phenology.

Genetic Evaluation and Utilization
TISSUE CULTURE

Effect of a conditioned medium on callus production and plant regeneration in rice anther culture

F. J. Zapata, L. B. Torrizo, and R. R. Aldemita, Tissue Culture Facility, IRRI

Although the efficiency of rice callus production is increasing, total efficiency still is low (no. of calli/no. pollen grains), considering that 1 rice anther has about 1,000 pollen grains. Tobacco and barley anthers produce more calli if the culture medium has been conditioned. We studied the effect of conditioned medium (CM) on rice callus production.

Conditioning medium (C) was prepared by culturing mature anthers (pollen grains with starch granules) of Giza 170 and Taipei 309 in Gamborg's liquid B5 as a base medium. It contained 2% sucrose, 0.5% glucose, and 0.5 mg indoleacetic acid/litre, 0.5 mg benzyladenine/litre, and 1.0 mg 2, 4-dichlorophenoxyacetic acid/ litre as growth regulators at pH 5.6 (E_{10}). Plating density was 13 anthers/ml of medium. Anthers were incubated in the dark for 7 d, crushed, and the debris was separated from the medium by centrifugation at 100 × g for 5 min.

CM was prepared by diluting C with fresh medium at 1:0, 1:1, 1:2, 1:4, 1:8 (C:fresh E_{10} medium). Fresh E_{10} medium was the control.

Taipei 309 and Giza 107 anthers at mid-uninucleate to early binucleate development were plated at 5 anthers/ ml in the CM treatments. They were incubated at 8 °C for 8 d and kept in dim light conditions until calli formed. One-mm calli were inoculated in the regeneration medium. The base medium was semisolid Murashige and Skoog with 1 mg naphthalene acetic acid/litre and 1 mg kinetin/litre as growth regulators, and 0.8% agar at pH 5.6.

More Taipei 309 calli formed on all CM dilutions than in the control (see table). At 1:8 dilution, callus production was 1.6 times higher than in the control. On subsequent plant regeneration, the 1:2 dilution gave the highest percentage of callus-producing green plants. Perhaps CM triggered embryogenic calli production, thus increasing plant regeneration efficiency.

In contrast, CM reduced the efficiency of Giza 170 callus production and green plant regeneration (see table).

Effect of CM on callus production and green plant regeneration in Taipei 309 and Giza 170. IRRI, 1985.

Data	Medium[a]								
	Taipei 309				Giza 170				
	E_{10}	1:8	1:4	1:2	E_{10}	1:4	1:2	1:1	Pure CM
Anthers plated (no.)	415	372	361	316	316	288	298	54	22
Calli produced (no.)	729	1022	995	741	814	676	711	0	0
Callus production[b] (%)	175.7	274.8	271.1	234.5	216.6	234.1	238.6	0	0
Calli plated for regeneration (no.)	31	34	40	34	38	42	38	0	0
Callus-producing green plants (no.)	11	13	11	17	26	22	16	0	0
Callus-producing green plants[c] (%)	35.5	38.2	27.5	50.0	68.4	52.4	42.1	0	0
Green plant production (no.)	38	38	41	58	70	60	48	0	0
Average green plant production[d] (no.)	1.2	1.1	1.0	1.7	1.8	1.4	1.3	0	0

[a] The ratio means 1 part CM and 8, 4, 2, or 1 part fresh E_{10} medium.

[b] $\text{Callus production (\%)} = \frac{\text{calli produced (no.)}}{\text{anthers plated (no.)}} \times 100.$

[c] $\text{Callus-producing green plants (\%)} = \frac{\text{callus-producing green plants (no.)}}{\text{calli planted for generation (no.)}} \times 100.$

[d] $\text{Average green plant production (no.)} = \frac{\text{green plant production (no.)}}{\text{calli plated for regeneration}}$

Seeds of anther culture-derived lines are available at IRRI

F. J. Zapata, R. R. Aldemita, L. B. Torrizo, A. U. Novero, L. B. Magaling, and R. R. Rola, Tissue Culture Facility, IRRI

The IRRI anther culture section has been working on androgenesis of rice pollen for 5 yr. Anther culture was developed to accelerate the development of homozygous varieties.

Anthers are collected from a rice floret at booting stage. Middle uninucleate to early binucleate pollen grain development is the most suitable stage for plating. Anthers are plated in specific callus-induction medium composed of macronutrients and micronutrients with vitamins, sugars, and growth regulators. Calli that form are transferred to a regeneration medium with the same basic nutrients, but perhaps different amounts and sources. Regenerated plants are transferred to a nutrient solution for root

Table 1. Anther culture-derived lines from varieties, IRRI, 1985.

Variety	Anther culture-derived lines (no.) with seeds
Mingolo	4
Mingolo (TCP 5)[a]	2
Minehikari	5
Minehikari (TCP 258)[a]	15
Jado	2
Baekgogna	1
Paikantao	3
Suweon 290	12
IR40	1
Moosa tarum	2
Hunan 72	4
Taichung 65	1
Leb Mue Nahng III	1
Taichung Sen Yu 195	1
Nong Baek	3
Tainan 5	1
BG 90-2	1
Taipei 309	398
Taipei 309 (TCP 1040-6a)[a]	34
Taipei 177	188
Taipei 177 (TCP 260)[a]	26
Taipei 177 (TCP 301-1)[a]	26
Taipei 177 (TCP 701-1)[a]	1
Fujisaka 5	78
Giza 170	154
KK11 (SR 3044-78-3)	203
Total	1,167

[a]Anthers collected from anther-culture plants of the same variety.

development and are grown in the phytotron. After 4 wk, the plants are planted in soil, where they grow to maturity. The seeds are collected, multiplied, and stored in a cold room.

By late 1984, more than 8,000 plants had been regenerated from anther culture. They included haploids, diploids, and polyploids. More than 4,300 derived lines have been produced from varieties (Table 1) and crosses (Table 2) of upland, lowland, deep water, and cold-tolerant rices, and rice adapted to problem soils. Field experiments on the anther culture-derived lines are in progress.

IRRI will supply seeds of anther culture-derived lines for breeding studies and screening for tolerance for environmental stresses.

Table 2. Anther culture-derived lines from crosses, IRRI, 1985.

Cross	Parents	Anther culturederived lines (no.) with seeds
IR29492	IR4683-54-2/Cul. 854	4
IR29863	Silewah/Taichung 65	1
IR29867	Taipei 309/IR36	1
IR30345	Mingolo/D66	1
IR32014	Taipei 309/IR30	1
IR36356	IR29/IR48	4
IR36366	Suweon 290/IR48	6
IR36460	Mi-48/Pokkali	4
IR36781	IR9752-71-3-2/IR19792-15-2-3-3-3	7
IR36870	IR19226-355-1-1-18/IR520-1-26	1
IR37343	IR48/BG90-2	19
IR37344	IR48/Suweon 290	37
IR37348	BG90-2/Suweon 290	1
IR37349	BG90-2/Taipei 309	37
IR37350	BG90-2/Tatsumi mochi	17
IR37352	Suweon 290/BG90-2	9
IR37355	Taipei 309/IR48	1
IR37356	Taipei 309/BG90-2	2
IR37358	Taipei 309/Tatsumi mochi	46
IR37359	Tatsumi mochi/IR48	3
IR37360	Tatsumi mochi/BG90-2	82
IR37361	Tatsumi mochi/Suweon 290	25
IR38641	New Sabarmati/IR27300-124-2	9
IR38644	Ngakywe/IR4570-124-3-2-2-2	7
IR38646	Pawsanbaykyar/IR4570-124-3-2-2-2	6
IR38650	Rodjolele/IR21841-81-3-3-2	2
IR38656	Sabanet Taungpyan/New Sabarmati	11
IR40344	Suweon 290/Ceysvoni SML	3
IR42800	IR2298-PLBP-3-19-1-2/Wase Toramochi	1
IR43049	Niaw Sanpah Tawng/IR2184865-3-2	7
IR44173	Chiang Tsenf Tao Ju/Line 62//Suweon 295-11	45
IR44175	Chiang Tsenf Tao Ju/IRI 347//Milyang 54	21
IR45445	Tox 896-R-R-R-l02/Chenab 64-117	14
IR45776	Barkat/Calrose 76	5
IR45788	China 972/Cahose 76	35
IR46012	IR19226-355-1-1-30/New Sabarmati//IR25873-22-5-3	2
IR47373	Rodjolele/IR10781-75-3-2-2	2
IR47704	Moroberekan/Kinandang Patong	9
IR47705	Moroberekan/Palawan	22
	Subtotal	510
Chinese crosses		
#19	FuH/Double haploid 14	33
#24	Fujisaka 5/Double haploid 14	1
#27	Fujisaka 5/Double haploid 95	10
	Subtotal	44
SR 11191	SR 10249-B-5/Baegyangbyeo	14
SR 11426	Fukuhikari/Fukei 126	73
SR 11428	Fukuhikari/Fujihikari	14
SR 11433	Chulweon 32/Fujihikari	365
SR 11436	Remei/Fujihikari	39
SR 11440	Seolagbyeo/Fujihikari	3
SR 11451	RAC 3/Hamaasahi	371
SR 11452	RAC 3/Ishiokamochi	773
SR 11453	RAC 3/Fujihikari	910
SR 11455	Suweon 303/Hamaasahi	16
SR 12192	Milyang 64/Shinsonchapyo	2
SR 12200	Mineyutaka/Somachinpyo	4
SR 12212	Norin 6/Sonampyo	25
SR 12246	54BC68/Sonampyo (Seonambyeo)	8
	Subtotal	2,617
	Total no. of lines from crosses	3,171

The International Rice Research Newsletter (IRRN) invites all scientists to contribute concise summaries of significant rice research for publication. Contributions should be limited to one or two pages and no more than two short tables, figures, or photographs. Contributions are subject to editing and abridgment to meet space limitations. Authors will be identified by name, title, and research organization.

Effect of some media components and organic additives on callus induction in rice anther culture

F.J. Zapata and L.B. Torrizo, Tissue Culture Facility, IRRI

One constraint in rice anther culture is the low frequency of callus induction. Although we can trigger high frequency of callus induction in liquid medium, only a few anthers may respond. We sought to induce a high number of anthers that produce calli by determining the effect of some media components and organic additives — N, mannitol, coconut water, and mashed banana — on callus production.

Taipei 309 anthers at mid-uninucleate to early binucleate development were inoculated in Linbro multiwell plates. Individual anthers were placed in 1.0- × 0.6 cm wells at a plating density of 1 anther/ 0.3 ml medium. They were plated horizontally with the lower surface touching the medium. Cold treatment at 10ºC for 8 d followed. Then the plates were kept in darkness at 25ºC for 6 wk, after which we recorded the number of anthers that produced calli. E_{10} semisolid — a modification of Gamborg's B-5 medium — was used as the base medium in all four experiments.

In the N content experiment, the E_{10} control had optimum concentration for inducing maximum anther-producing calli (see table). NH_4^+ was added to E_{10} medium as 134 mg $(NH_4^+)_2SO_4$/litre and NO_3^- was added as 2500 mg KNO_3/litre.

Adding mannitol at 1% stimulated the most anthers and induced almost 1.5 times as many calli as the control. Although not considered as a readily available C source, mannitol may influence the medium's osmotic potential, a critical factor in callus induction.

Coconut water contains myo-inositol, growth regulators, and aminoacids, which can increase callus production. Adding 10% coconut water produced 1.4 times the calli in the control. Mashed banana increases plantlet formation in immature orchid embryos, but inhibits rice callus induction.

Effect of some media component and organic additives on callus induction in Taipei No. 309, IRRI.

Treatment	Anthers plated (no.)	Anther-producing calli	
		no.	%
N [a]			
E_{10}	149	21	14
E_{10} - 0.5 N	149	16	11
E_{10} - 1.5 N	149	17	11
E_{10} - 2.0 N	149	8	5
Mannitol [b]			
E_{10}	168	30	18
E_{10} - M_1	168	43	26
E_{10} - M_2	168	35	21
E_{10} - M_3	168	26	15
Coconut water [c]			
E_{10}	185	18	10
E_{10} - C_5	185	16	9
E_{10} - C_{10}	185	25	13
E_{10} - C_{15}	185	17	9
Mashed banana [d]			
E_{10}	223	23	10
E_{10} - B_5	223	23	10
E_{10} - B_{10}	223	14	6
E_{10} - B_{15}	223	2	1

[a] N concentration (NH_4^+ and NO_3^-) relative to E_{10} in the control were 0.5, 1.5, and 2.0 times that of E_{10}. [b] Mannitol concentrations were 0, 1.0, 2.0, and 3.0% wt/vol. [c] Coconut water concentrations were 0, 5.0, 10.0, and 15.0% vol/vol. [d] Mashed banana concentrations were 0, 5, 10 and 15% wt/vol.

Pest Control and Management

DISEASES

Rice grain discoloration and its chemical control

R. Singh and H. Chand, Haryana Agricultural University Rice Research Station (HAURRS), Kaul 132021, Kurukshetra, Haryana, India

Surveys indicate that rice grain discoloration (also known as glume discoloration, dirty panicle, or pecky rice) commonly occurs in Haryana. Infected grains are covered with brown- to dark brown lesions. Isolations from the infected grains suggest the primary causal organisms are *Curvularia lunata, Trichoconis padwickii,* and *Helminthosporium oryzae.*

We studied the control of grain discoloration at HAURRS in 1984. Fungicides edifenphos, zineb, mancozeb, thiophanate-methyl, carbendazim, captafol, and IBP and an insecticide, sevin, were sprayed on susceptible Jaya at heading. To increase their efficacy, the chemical solutions were prepared in 0.01% Sel Wet 99 solution. To evaluate results, 20 panicles were randomly collected from each plot at harvest and examined for diseased seeds. The experiment was in a randomized block design with three replications.

Only edifenphos and mancozeb gave significant disease control. None of the chemicals significantly increased yield (see table).

Effect of chemical treatment on grain discoloration and yield at Kaul, India.

Treatment	Application rate (%)	Discolored grain [a] (%)	Yield [a] (t/ha)
Edifenphos	0.1	43	7.6
Zineb	0.2	54	7.6
Mancozeb	0.15	51	7.3
Thiophanate-methyl	0.1	55	7.4
Carbendazim	0.2	64	7.4
Captafol	0.2	53	7.5
IBP	0.1	53	7.4
Sevin	0.4	56	7.6
Control	–	63	7.3
CD (0.05)	–	11	ns

[a] Mean of 3 replications.

Chemical control of ufra disease in transplanted rice

M. L. Rahman and S. A. Miah, Plant Pathology Division, Bangladesh Rice Research Institute, Joydebpur, Gazipur, Bangladesh

We tested four nematicides, common salt, and zinc sulfate for control of ufra caused by the stem nematode *Ditylenchus angustus*. Two-month-old BR4 plants with visible mottling and leaf chlorosis were collected from a farmer's field and planted 3 plants/pot in 3 replications for each treatment. Seven and 27 d after planting, 1.5 kg carbofuran 3%, 10.0 kg fenamiphos 5%, 10.0 kg disulfoton 10% 3.0 kg aldicarb 10% ai/ha, 67 kg common salt, and 20 kg zinc sulfate/ha were applied as basal, basal + foliar, or foliar. For foliar application, the chemicals were soaked 48 h in water, sieved through a fine cotton cloth, diluted to 120 ml to make an adequate amount to cover the leaf surface of the plants, and sprayed on the plants with a small hand sprayer. For basal + foliar treatment half the dose was used for each application. Control pots were sprayed with tap water.

At harvest, recovery was 64% with carbofuran, 69% with fenamiphos, and 73% with disulfoton. Plants treated with these nematicides yielded 14, 21, and 20 g/pot. There was no yield from other treatments. Secondary tillers of the three successful treatments were not ufra-infected. All tillers died in the other treatments.

We conducted a trial in an ufra-infested transplanted aman field to identify the proper carbofuran dosage to be applied after plants show ufra symptoms. Carbofuran at 0.5, 1.0, or 1.5 kg ai/ha was incorporated in soil in 2-3 cm standing water at 1-mo intervals at tillering and late tillering. Carbofuran at 1.5 kg ai/ha gave best results (see table). In most cases, ufra infestation was less at harvest than at booting stage. The experiments showed that nematicides can control ufra in transplanted rice, even after symptoms have developed.

Effect of carbofuran 3% on ufra severity and yield of transplanted rice.[a] Joydebpur, Bangladesh, 1984.

Carbofuran 3% (kg ai/ha)	Ufra severity (%) Booting	Ufra severity (%) Harvest	Healthy panicles (%)	Yield (t/ha)
0	81.2 a	69.7 a	30 c	05 b
0.5	73.7 a	49.4 a	51 b	1.0 b
1.0	49.6 ab	43.8 ab	56 ab	1.0 ab
1.5	28.3 b	31.3 b	69 a	1.6 a
F-values[b]	7.35*	4.78*	4.99*	8.10*
CV	23	21	17	31

[a]Av of 4 replications. Column values with a common letter do not differ significantly at 0.05 level by DMRT. [b] * = significant at 0.05 level of significance.

Rice disease status in India

R. K. Upadhvay, Directorate of Plant Protection, Quarantine, and Storage, N. H. IV, Faridabad, Haryana, India

Rice is planted on about 40.7 million ha in India. Yields often are substantially reduced by disease. To monitor disease incidence, the Directorate of Plant Protection, Quarantine, and Storage and state departments of agriculture have organized insect pest and disease surveys since 1970. Twenty-six survey teams have covered standard routes through about 300,000 ha of rice land at 10-d intervals since 1980. Disease severity has been rated using the *1980 Standard evaluation system for rice.* The table shows major disease outbreaks and distribution.

Tungro virus is the most common disease. Most popular varieties are susceptible, including Tella Hamsa, Surekha, IET2508, IET1444, Co 40,

Present status and geographical distribution of major rice diseases in India.

State	Incidence of rice diseases[a]														
	B1	BS	NBLS	LSc	SR	ShB	ShR	Gld	FSm	KSm	Udb	BB	BLS	RTV	GSV
Andhra Pradesh	5-8[b]	3-7[c]	1-3[b]	1-3[b]	–	3-5[c]	5-9[c]	3-5[c]	1-3[b]	–	–	3-5[c]	3-5[b]	3-1[b]	–
Assam	4-6[c]	1-3[b]	1-3[b]	1-3[b]	1-3[b]	–	–	–	1-3[b]	–	–	1-3[c]	–	1-2[b]	–
Bihar	3-5[b]	3-7[c]	1-3[b]	–	3-5[c]	3-5[b]	3-5[b]	1-3[c]	1-3[c]	–	0-1[b]	3-5[c]	1-3[b]	3-7[b]	–
Haryana	4-6[b]	3-6[c]	3-9[b]	–	3-5[b]	1-3[b]	3-5[c]	3-5[c]	3-9[c]	–	–	3-1[c]	–	–	–
Karnataka	4-6[b]	1-3[c]	1-3[b]	3-5[c]	–	–	1-3[b]	1-3[b]	3-5[c]	–	1-5[c]	3-5[b]	–	–	–
Kerala	–	1-3[b]	–	1-3[b]	–	35[c]	–	–	–	–	1-5[b]	1-3[b]	–	1-2[b]	–
Madhya Pradesh	5-7[b]	3-6[c]	0-1[b]	1-3[b]	3-7[c]	1-3[c]	5-9[c]	5-7[d]	1-3[c]	1-3[b]	–	3-5[c]	1-3[b]	–	–
Maharastra	3-5[b]	3-6[c]	–	1-3[b]	–	1-3[b]	–	–	1-3[c]	–	1-5[c]	3-5[c]	1-3[b]	–	–
Orissa	4-6[b]	3-6[c]	1-3[b]	1-3[b]	1-3[b]	1-3[b]	1-3[b]	–	1-3[b]	–	0-1[b]	3-5[c]	1-3[b]	1-3[b]	–
Punjab	1-3[b]	2-5[b]	3-5[b]	–	3-7[c]	3-5[b]	3-7[d]	3-5[c]	1-5[b]	–	–	5-7[b]	3-5[b]	1-3[b]	–
Tamil Nadu	3-5[b]	2-4[b]	1-3[b]	1-3[b]	–	1-5[b]	3-7[c]	1-3[b]	–	1-3[b]	1-3[b]	1-3[b]	1-3[b]	3-7[c]	0-1[b]
Uttar Pradesh	2-6[b]	3-1[c]	–	1-3[b]	3-5[b]	1-3	[b]3-5[b]	1-3[b]	3-5[b]	–	–	3-5[b]	1-3[b]	3-7[b]	–
West Bengal	1-3[b]	1-3[b]	–	1-3[b]	3-5[b]	1-3	[b]3-5[c]	1-3[b]	–	–	–	3-5[b]	1-3[b]	3-7[c]	–

[a] B1 = blast, BS = brown spot, NBLS = narrow brown leaf spot, LSc = leaf scald, SR = stem rot, ShB = sheath blight, ShR = sheath rot, Gld =glume discoloration, FSm = false smut, KSm = kernel smut, Udb = udbatta disease, BB = bacterial blight, BLS = bacterial leaf streak, RTV = rice tungro virus, GSV = grassy stunt virus. [b] Isolated/rare fields. [c] Scattered/sporadic. [d] Widespread.

NLR9672, Madhu, Vaigai, IETl722, TKM9, Kanchi, Rasi, Kannagi, ADT36, ADT31, TKM8, IR8, TNl, IR5, Co 25, Bhavani, Ponni, BCPI, and IR20. Other serious diseases include blast (Bl) and brown spot (BS).

Once minor diseases, bacterial blight (BB), sheath blight (ShB), sheath rot (ShR), and grain discoloration (Gld) are increasingly destructive and are beginning to affect almost all rice growing areas. False smut, bacterial leaf streak (BLS), stem rot, leaf scald, udbatta, narrow brown leaf spot, and grassy stunt virus diseases also are increasing.

BB infection has been moderate to severe (3-7) in many states (see table) since 1980, and occurred in epidemic proportions in almost all of the Punjab in 1980 and 1981 kharif. Losses generally were 15-20% and sometimes rose to 40%. IR8, Jaya, and PR106, which are widely grown were highly susceptible.

BLS occurs widely but was worst in Andhra Pradesh and the Punjab in 1980. Bl is common (see table) and attacks Jaya, Ratna, Basmati, Surekha, Mahsuri, Gurmatia, Phalguna, Kranti, IR8, and PR106. BS is a problem in upland and low fertility soils. ShR and Gl attack almost all high yielding varieties, including Phalguna, Surekha, Bangoli, PR106, IR8, Jaya, Co 40, Kranti, Ratna, and Mahsuri. However, Basmati, Mahsuri, Usha, Asha, and Pankaj varieties proved tolerant.

Recovery of virus from tungro (RTV)-infected leaves with or without leafhopper infestation

M. M. Rahman, senior scientific officer, Bangladesh Rice Research Institute, and H. Hibino, Plant Pathology Department, IRRI

Six-week-old TN1 seedlings were caged with green leafhopper (GLH) *Nephotettix virescens* that had fed on RTV-infected plants. RTV symptoms developed 2 wk after inoculation. Two or three new leaves were yellow or twisted, but the older leaves remained green and apparently healthy. Leaves with and without symptoms were taken from the infected plants and separately confined in test tubes for 1 d with new adult GLH. The GLH then were allowed individual 1-d inoculation access on 7d-old TNl seedlings. Inoculated seedlings were transplanted in pots and percent seedling infection was recorded in 2 wk.

GLH recovery of virus from leaves of TN1 plants infected with RTV at 2 stages, IRRI, 1985.

Leaf position	Insects		
	Tested (no.)	With virus (no.)	With virus (%)
	6 wk after soaking		
1st youngest	20	19	95
2d	17	12	71
3d	20	10	50
4th	–	–	–
	2-leaf stage		
1st youngest	40	37	93
2d	40	35	88
3d	39	7	18
4th	40	5	13

All the GLH recovered virus from leaves with symptoms and 57% of GLH recovered virus from the older leaves without symptoms. GLH recovery of RTV was highest from younger leaves (see table). Leaves also were collected from plants inoculated at second-leaf stage 1 mo after inoculation. Virus recovery was also highest from younger leaves (see table).

A method for producing *Rhizoctonia solani* inoculum for field inoculation

Y. J. P.K. de Silva and W. P. Adikari, Regional Agricultural Research Center, Bombuwela, Sri Lanka

Artificial inoculation is necessary for studying sheath blight (ShB) caused by *R. solani.* Growing the fungal colony on potato dextrose agar (PDA) plates and inoculation by placing agar blocks in leaf sheaths works well for laboratory and greenhouse studies, but is cumbersome in the field. We sought to develop more suitable methods of inoculum production for field studies.

Table 1. Growth of *R. solani* on different media, Bombuwela, Sri Lanka.

Medium	Colony diameter[a] (mm)			
	After 24 h	After 48 h	After 72 h	After 96 h
Chaff	11.3	35.5	84.0	84.3
Straw	10.0	26.0	33.0	68.3
WA	33.0	57.5	86.0	86.0[b]
Husk	8.6	16.0	74.6	84.0
Sawdust	7.3	11.3	12.6	13.8
Grain	16.6	86.0	86.0[b]	86.0[b]
Chaff + grain	14.3	37.6	84.0[b]	84.0[b]
PDA	25.5	85.0	85.0[b]	85.0[b]
Agar + chaff	12.3	36.6	84.0	84.0
Rice dust	7.6	57.3	83.3	84.0

[a] Av of 3 replications. [b] Started to produce sclerotia.

Table 2. Effect of different media on R. solani sclerotia production, Bombuwela, Sri Lanka.

Medium	Mycelial growth	Sclerotial initiation[a]	Sclerotial produced[b] (no.)
Chaff	Fast	10	94.3
Straw	Moderate	24	93
WA	Very fast	4	20.3
Husk	Moderate	6	17.6
Sawdust	Slow	3	7
Grain	Very fast	3	3000
Chaff + grain	Fast	3	490
PDA	Very fast	3	65.6
Agar + chaff	Fast	4	143.6
Rice dust	Fast	4	39.6

[a] In days after inoculation. [b] Av of 3 replications.

We tested rice chaff, straw, dust, husk, and grain and sawdust for growing *R. solani.* Five grams of each medium and 15 ml of distilled water were placed in petri dishes and autoclaved at 15 psi at 12 1ºC for 15 min. These plates and plates of PDA and water agar (WA) were inoculated with one fast-growing *R. solani* sclerotium, placed in the center of the dish. Colony growth was measured by surface diameter.

The same media were tested in 250-ml flasks by mixing 15 g of raw materials and 45 ml distilled water and autoclaving as before. One *R. solani* sclerotium was the inoculant and sclerotia were counted after 30 d. PDA and WA were used as checks. Each of the following media was tested in three replications: chaff, straw, husk, grain, dust, sawdust, WA, PDA, End 1:l mixtures of chaff + grain and chaff + agar.

R. solani grew rapidly in PDA and WA (Table 1), but mycelial density was very low in WA. After 48 h, growth in the PDA and grain media did not significantly differ. Growth on chaff + grain, agar + chaff, chaff, rice, dust, and straw was moderate, and was very low on sawdust and husk. Grain medium produced the most (more than 3,000) sclerotia (Table 2). Chaff + grain produced 490 sclerotia.

Mycelial growth in grain and PDA did not significantly differ, but grain produced more sclerotia. The grain has more surface area on which *R. solani* can grow.

After the first experiment, grain and PDA were compared to quantify disease development. Equal amounts of the media were placed within the sheaths of potted rice plants or spread on water around the plant, and disease development was recorded. Treatments were thrice replicated.

Disease development was affected by inoculation method, but not by the media. When media were placed within sheaths, ShB symptoms developed in 4 d; when spread on water, symptoms developed after 6 d.

Grain media perform well for field inoculation of *R. solani.* It also is easily available, inexpensive, and simple to prepare.

Pest Control and Management
INSECTS

Spider mortality implicated in insecticide-induced resurgence of whitebacked planthopper (WBPH) and brown planthopper (BPH) in Kedah, Malaysia

W. T. Vorley, postdoctoral fellow, School of Biogical Sciences, University Saints Malaysia, Pulau Pinang, Malaysia

We studied the effect of two widely used carbamate insecticides (carbofuran and BPMC) and two pyrethroids (cypermethrin and cis-2-cypermethrin [formerly alphamethrin]) on WBPH, BPH, other rice pests, and planthopper enemies.

Seribu Gantang was transplanted in 10-m^2 plots at 20 × 20 cm in a randomized block design with 4 replications. Each plot was surrounded by an earth boundary and a 1 -m alley. Insecticides were applied at 20, 40, and 63 d after transplanting (DT). Foliar sprays from a shoulder sprayer were directed at the plant canopy and applied at 400 litres/ ha. Carbofuran granules were broadcast onto field water.

Planthoppers and spiders were sampled using boards consisting of 25- × 18-cm perspex sheets covered with Gumbug sticky material. The boards were held horizontally beside the rice hill to be sampled. The hill was struck firmly three times so that hoppers and other arthropods fell onto the board. Twenty hills were sampled each week, with extra

Table 2. Spider densities and number of WBPH and BPH nymphs per spider early in the population growth of the 2 planthopper species,[a] Kedah, Malaysia.

Treatment	WBPH				BPH			
	48 DT		55 DT		64 DT		69 DT	
	Spiders/ hill	N:S	Spiders/ hill	N:S	Spiders/ hill	N:S	Spiders/ hill	N:S
Carbofuran	0.55 ab	11	1.22 ab	33	2.32 ab	2.5	3.17 b	2.0
BPMC	0.24 bc	45	0.92 bc	23	1.92 b	0.7	2.59 b	0.8
Cypermethrin	0.06 c	249	0.21 d	547	0.34 c	13	0.37 c	40
Cis-2-cypermethrin	0.18 c	95	0.31 cd	352	0.34 c	106	0.18 c	371
Untreated control	0.73 a	26	1.62 a	40	3.05 a	4.7	4.97 a	6.1

[a]All figures are av of 4 replications, corrected for sampling efficiency. Means followed by a common letter are not significantly different by Waller-Duncan K-ratio t-test. N:S = no. of hopper nymphs/ spider. DT = days after transplanting.

Table 1. Populations of WBPH and BPH, percentage hopperburn, and yields in carbamate- and pyrethroid-treated plots, [a] Kedah, Malaysia.

Treatment	WBPH/hill		RR[b]	BPH/hill		RR	Total hopperburn (%) 103 DT [c]	Grain yield [d] (t/ha)
	55 DT	69 DT		76 DT	90 DT			
Carbofuran 2G, 600 g ai/ha	40.2 a	39.0 a	0.43	16.9 a	39.1 a	0.22	0 a	5.9 a
BPMC EC50, 0.1%	21.3 a	87.6 a	0.93	16.3 a	55.1 a	0.31	0 a	5.6 ab
Cypermethrin EC150, 35 g ai/ha	98.5 c	240.4 b	2.54	37.9 a	101.6 a	0.56	0 a	5.0 b
Cis-2-cypermethrin EC100, 15 g ai/ha	151.2 d	257.1 b	2.86	176.4 b	313.9 b	1.68	19.6 b	3.8 c
Intreated control	70.2 b	89.8 a	–	44.9 a	180.4 a	–	3.2 a	5.3 ab

[a] All figures are av of 4 replications, corrected for sampling efficiency. Means followed by a common letter are not significantly different by Waller-Duncan K-ratio t-test. DT = days after transplanting. [b] Resurgence ratio (RR) = treated/control. [c] Analysis on arc sine transformed values. [d] corrected from 19% to 14% moisture content.

samples 1 d before and after insecticide application. Each board was examined under a dissecting microscope.

Cypermethrin and cis-2-cypermethrin caused WBPH resurgence. Cis-2-cypermethrin caused BPH resurgence and hopperburn, and reduced yield 28% below that of the unsprayed control (Table 1). Carbofuran and BPMC gave good control of both planthoppers.

When changes in populations of spiders, Coleoptera, mirid predators, and egg parasitoids were considered, the decline in spider populations was closely related to WBPH and BPH resurgence. Both pyrethroids were highly toxic to spiders, contributing to high hopper nymphspider ratios early in the period of hopper population increase (Table 2).

Carbamates were less toxic to spiders and other natural enemies. Carbofuran and BPMC gave moderate or poor control of most other rice pests. Both pyrethroids gave excellent control of other rice pests and tested doses were not toxic to fish.

Gall midge (GM) activity and parasitization by *Platygaster oryzae* in Jaya stubble and wild rice at Bhubaneswar, India

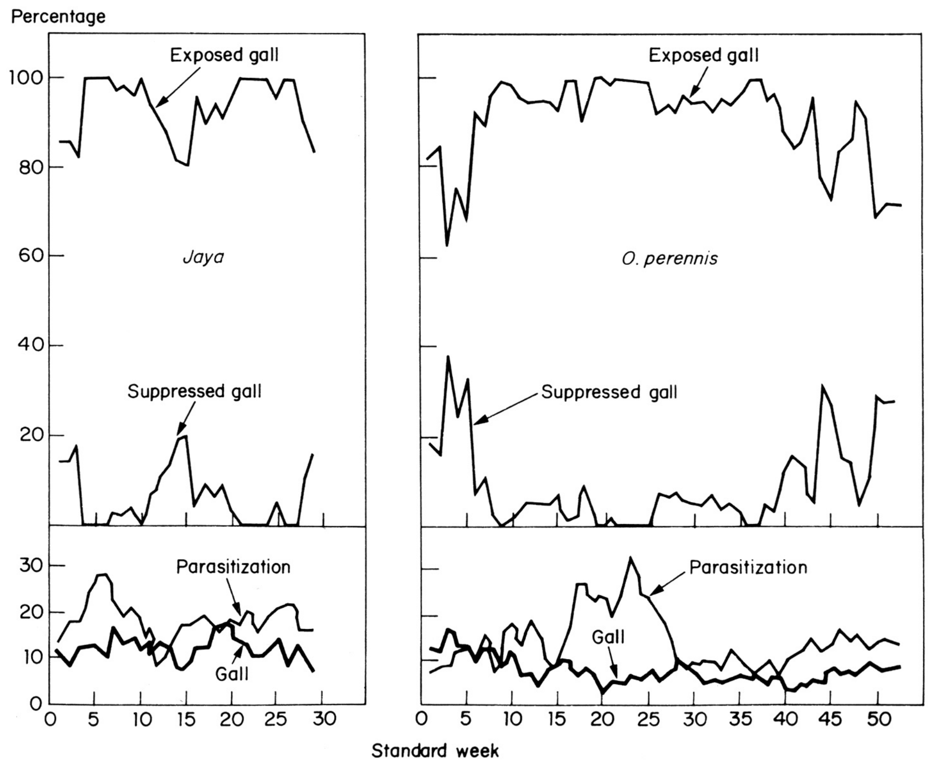
B. C. Jena, entomologist, Regional Research Station, Semiliguda (Sunabeda), Koraput, Orissa; and N. C. Patnaik and N. Panda, Entomology Department, Orissa University of Agriculture and Technology (OUAVT), Bhubaneswar, India

GM *Orseolia oryzae* (Wood-Mason) breeds in Jaya rice stubble during the off-season (Jan-Jun) and also in wild rice *Oryza perennis* (Moench). GM-infested tillers turn into silvershoots or galls which protrude from the leaf whorl (exposed galls). In unproductive and late formed tillers, many galls do not protrude from the leaf whorl and remain hidden in the culm (suppressed galls).

We studied GM abundance, activity, and parasitization due to *Platygaster oryzae* (Cameron) in Jaya rice stubble and in wild rice at OUAT in 1982.

Stubble was left in unsprayed fields planted to Jaya after harvesting the wet season crop (Jul-Dec). It was occasionally irrigated to encourage ratoon growth. Fields were divided into four quadrats and each quadrat into five subplots. From each subplot, one hill was uprooted at random at weekly intervals. In the laboratory, silvershoot infestation was recorded and the exposed and suppressed galls were dissected to determine parasitization. Twenty randomly selected hills of wild rice were collected weekly from swamps adjoining the Jaya fields and examined for midge attack and parasitization.

Gall midge was prevalent in Jaya stubble throughout the off-season, peaking at 17 wk (23-29 Apr). Parasitization peaked at 5 and 6 wk (29 Jan-11 Feb). Suppressed galls were maximum at 15 wk (9-15 Apr) (see figure).



Exposed and suppressed galls and parasitization of Jaya stubble and *O. perennis,* Bhubaneswar, India.

O. perennis also harbored GM throughout the year, but infestation was lower than in stubble. Parasitization, however, was higher. Gall occurrence was highest in the 3d (15-21 Jan) and 46th wk (12-18 Nov) and most galls were suppressed. GM infestation and parasitization followed a wax and wane cycle.

Stem injury in deep water rice as a guide for determining stem borer (SB) infestation at different growth stages

S.K. Datta, D. Konar, S.K. De, and P.K. Banerjee, Operational Research Project, Pandua, Hooghly, West Bengal, India

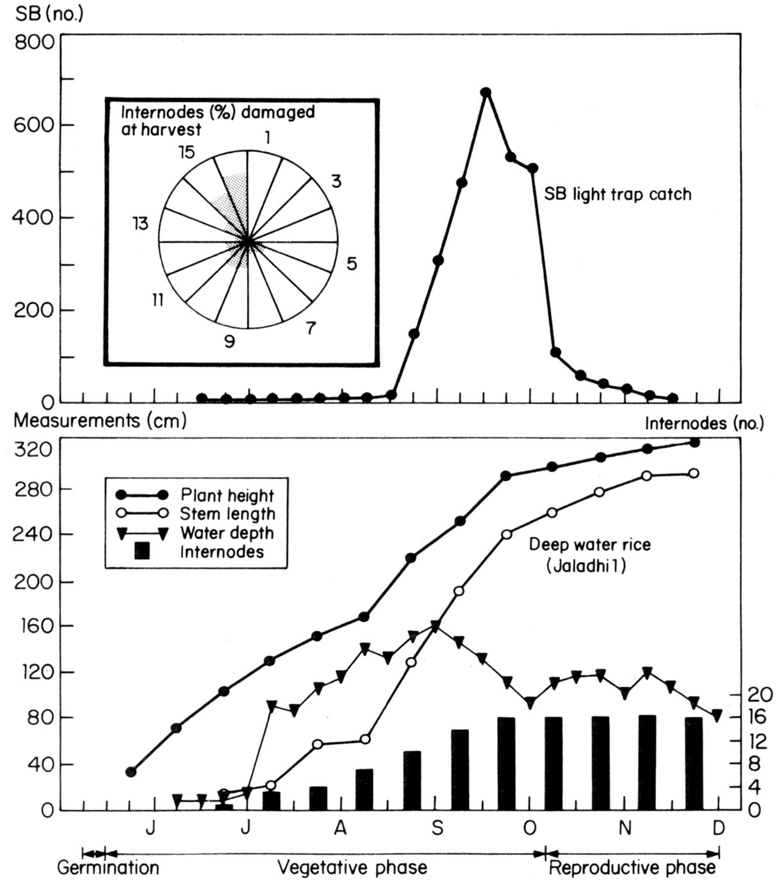
SB *Scirpophaga incertulas* infestation generally is high in deep water rice. We studied SB infestation at different internodes of deep water rice plants at harvest. Water level, plant height, stem elongation, internode formation, and growth phase were considered.

A 0.2-ha deep water field was planted to photoperiod-sensitive Jaladhi 1 in early Jun 1983. Soil was a clay loam with pH 7.0-7.5. At land preparation, 10 t farmyard manure/ha was applied. Standard cultivation methods were practiced, and harvest was in late Dec.

Water depth was recorded weekly. SB were caught daily from 1800 to 2200 h in a light trap 200 m from the field. Each morning the catch was recorded. The first SB were trapped the 2d wk of Jul (see figure). Population increased rapidly between late Sep and late Oct, then declined. Every 2 wk, 10 plants were randomly collected and height, stem length, and number of internodes of the main shoot were recorded. At harvest, 140 plant samples were collected, and percent SB damage at different internodes of the main stem was recorded (see figure).

Almost no SB were trapped at early seedling growth when soil was dry. During early elongation (Jul-Sep), when almost all of the stems were submerged, SB infested few plants. Peak SB infestation was at preflowering. At harvest, damage was low in the 13th internode, but was substantially higher in the last 3 internodes (see figure).

Data on peak SB emergence reflect the period of maximum plant infestation. Also, SB infestation increases with decreasing water level.



Percent SB-damaged internodes (base to apex) of deep water rice plants at harvest and variations of light trap catch, water level, plant height, stem length, and number of internodes, West Bengal, India.

Stem borer infestation on hybrid rice

Chieng Chienyun, research assistant, Plant Protection Institute, Hunan Academy of Agricultural Science (HAAS), Changsa, China

Hybrid rice was released in China in 1978. Since then, striped stem borer (SSB) *Chilo suppressalis* (Walker) and yellow stem borer (YSB) *Scirpophaga incertulas* damage has increased. SSB attacks rice in Hunan, Jiangxi, Jiangsu, Zhejiang, and Sichuan Provinces, and YSB damages rice in southern Jiangxi and Fujiang, and northern Guangdong.

In surveys at the HAAS farm beginning in 1978, we found that SSB populations in hybrid rice fields were 28 to 36% higher than in other rice fields and that there were 107 to 170% more egg masses. There are 7 to 17 times as many YSB egg mass as in other rice fields.

Survival rates of SSB larvae during 3 yr were 8, 18, and 19% higher on hybrid than on other rices, and YSB larvae survival was 13 to 20% higher. Larvae and pupae of SSB that fed on hybrid rice weighed 17 and 13% more than those collected from other rices. The mean weights over 2 yr of SSB pupae that fed on hybrid rice were 30 and 32% higher than the weights of those that fed on other rices. The first year, SSB females grown on hybrid rice produced 46 to 103 eggs/female; in the second and third years, they produced 46 to 82 more eggs/female than SSB females reared on other rices.

YSB larvae reared on hybrid rice weighed an average 63 mg. Those reared on other rices weighed an average 51 mg. YSB females produced an average 262 eggs/female on hybrid rice and 224 eggs/female on other rices. Over 4 yr, YSB hibernating on hybrid rice had 89, 23, 40, and 46% mortality vs 11, 9, 21, and 24% on other rices.

Most hybrid rice lines have large stems, heavy foliage, thick sheath, and long duration, which may favor SSB and YSB development.

The correct name of the African rice stem-boring Diopsidae (stalk-eyed fly)

H.R. Feijen. Plant Protection Scheme Zanzibar, P.O. Box 1062, Zanzibar, Tanzania

In the 1950s a stalk-eyed fly (Diopsidae) was identified as an important rice stem borer in Africa. The fly became known as *Diopsis thoracica* Westwood, 1837. Subsequently most authors wrote that *thoracica* was a junior synonym of *Diopsis macrophthalma* Dalman, 18 17, which had *Diopsis longicornis*

Macquart, 1835, as a second junior synonym. Alternatively, some authors have claimed that *macrophthalma* was in fact a *Diasemopsis,* although all recent authors agreed on the synonym of *longicornis* and *thoracica.* In recent applied literature, both *macrophthalma* and *thoracica* have been used to indicate this stalk-eyed fly.

I have examined the *macrophthalma,* with the cooperation of the Stockholm Museum, and although the specimen was teneral and discolored it is unmistakably a *Diasemopsis.* The correct name of the African stem-boring stalk-eyed fly is *Diopsis longicornis* Macquart, 1835. Junior synonyms are *thoracica* Westwood, 1837, and *phlogodes* Hendel, 1923. *Diopsis longicornis* is a common rice stem borer throughout Ethiopian Africa. Damage often is compensated for by the growing rice plants.

Other *Diopsidae* are mentioned as potentially important rice stem borers, among which is a stalk-eyed fly with apical wingpots. This fly has been identified as *Diopsis apicalis* Dalman, 1817, or *Diopsis tenuipes* Westwood, 1837. As part of a systematic revision of *Diopsis* with an apical wingspot, I have examined types of both species and find they are synonymous. However, about 10 *apicalis-* like *Diopsis* are found in rice in Africa. *Diopsis apicalis* (syn. *tenuipes)* only occurs in West Africa, where it is the dominant *Diopsis* with an apical wingspot. In East, Central (up to Cameroon), and Southern Africa there is another, closely related, dominant *Diopsis* with an apical wingspot. This latter species and about eight other *Diopsis* with apical wingspots that occur in rice, maize, and other gramineous crops have yet to be described. Until I have published my revision of this group of *Diopsis,* it is best to refer to flies with apical wingpots as species belonging to the *apicalis*-complex. These flies are secondary stem borers, and lay eggs on shoots with deadhearts or other damage.

Seasonal stem borer (SB) population fluctuations in Mymensingh, Bangladesh

M. Husain and N. Begum, Bangladesh Institute of Nuclear Agriculture (BINA), P.O. Box 4, Mymensingh, Bangladesh

In Bangladesh, several SB species attack rice and cause economic damage. We studied seasonal SB population fluctuations around the BINA farm from Jan to Dec 1982. Each week, 50 rice hills of the test fields were randomly sampled and SB larvae were removed from infested tillers. Populations of different species were recorded (see table).

From Jul-Oct, *Scirpophaga incertulas* constituted 60 to 97% of the SB population. From Nov to May, *Chilo polychrysa* and *C. auricilia* constituted 19 to 85% of the population. The *Sesamia inferens* population always was low, but increased from Nov to May, perhaps because wheat, an alternate host, is planted.

Population of three SB species in Mymensingh, Bangladesh.

Mo	Percent of SB population		
	S. incertulas	*Chilo* sp.	*S. inferens*
Jan	25	56	19
Feb	4	85	11
Mar	2	71	21
Apr	21	19	60
May	20	61	19
Jun	–	–	–
Jul	79	21	0
Aug	60	38	2
Sep	97	0	3
Oct	76	24	0
Nov	9	62	29
Dec	21	56	17

Changing populations of rice insect pests in Chhattisgarh, India

S. K. Shrivastava, M. P. Rice Research Institute, Raipur 492012, Madhya Pradesh, India

Expanded irrigation, double-cropping, and cultivation of N-responsive modern rices have changed insect populations in Chhattisgarh.

Populations of 12 common pests have not changed, but those of 10 are causing more damage (see table).

Status of rice pests in Chhattisgarh, India. [a]

Insect	1960-70	1971-84
Cnaphalocrocis medinalis (Guen.)	xx	xx
Nilaparvata lugens (Stal.)	–	xx
Nephotettix virescens (Dist.)	xxx	xxx
Nephotettix nigropictus (Motsch.)	xxx	xxx
Sogatella furcifera (Horva th)	xxx	xxx
Orseolia oryzae (W.M.)	x	xxx
Scirpophaga incertulas (Walker)	x	xxx
Sesamia inferens (Walker)	x	x
Mythimna spp.	xxx	xxx
Nymphula depunctalis (Guen.)	xx	xx
Dichdispa armigera (Oliv.)	xx	xx
Pamara mathias (F.)	x	x
Hydrellia sp.	x	x
Baliothrips biformis (Bagnall)	x	x
Spodoptera spp.	xx	xx
Leptocorisa spp.	x	x
Irigonotylus doddi (Dist.)	–	x
Cymodema basicornis (Motschulsky)	–	x
Nanophyes spp.	–	x
Cryptocephalus ovulum Suffrian	–	x
C. sehestedtii Fabricius	–	x
Phyllotreta rhotonica Quvivier	–	x

[a] xxx = major pest causing severe damage, xx = minor pest causing occasionally heavy damage, x = minor pest; = not reported.

Evaluation of 26 insecticides for armyworm *Mythimna separata* Walker) control

R. P. Basilio and O. Mochida, Entomology Department, IRRI

Rice is sporadically damaged by *M. separata* larvae, which attack rice at all growth stages but are most damaging during heading, when they cut rice panicles. Insecticides with a high knockdown effect control this insect best.

We evaluated 26 insecticides for *M. separata* control in a contact toxicity test. Larvae were dipped into each insecticide solution for 30 s and then placed on untreated plants. In a foliar spray test, potted rice plants were sprayed with insecticide and infested with untreated larvae 1 d later. Mortality was recorded 48 h after treatment (HT) or infestation (HI), and leaf damage was rated.

Of the 26 insecticides, 17 caused 100% mortality in contact toxicity tests, 13 caused more than 80% mortality in foliar spray tests, and 12 caused 10% defoliation. High mortality did not necessarily correlate with low defoliation (see table).

Twelve insecticides were highly promising and four (U 57770, RH 0994, MTI 500, and MTI 220) were potentially promising. Cypermethrin killed insects and prohibited larvae from feeding (see table).

Toxicity of insecticides to *M. separata,* IRRI.

Insecticide [a]	Formulation	Mortality [b] (%) of 5th-instar larvae: Contact toxicity	Foliar spray	Defoliation (%)
		Test I		
Methidathion	40EC	100 a	90 ab	10
M 9918	200E	100 a	100 a	10
Cypermethrin †	5EC	97 a	33 a	10
UC SF-1	40F	100 a	70 bcd	10
M 10604	200E	100 a	97 ab	10
UC 54229	100SP	100 a	41 cde	63
RH 0308	48EC	100 a	93 ab	10
UC/MP 19779	48EC	100 a	77 abc	10
Carbosulfan	20EC	97 a	90 ab	10
UC 17867	50WP	100 a	93 ab	10
Monocrotophos	30EC	100 a	100 a	10
Triazophos	40EC	100 a	93 ab	10
Dioxicarb	50WP	73 b	20 ef	63
Methiocarb	50WP	97 a	30 def	63
RH 0994	48EC	100 a	87 ab	11
Dioxathion	96EC	17 c	7 g	83
Check (water)		0 c	10 f	90
		Test II		
Phoxim	50EC	100 a	67 b	27
NS 8265	75EC	100 a	0 c	93
Propoxur	20EC	97 a	3 c	90
MTI 500 †	20EC	100 a	90 ab	17
Pirimicarb + pirimiphos methyl	10EC	100 a	10 c	97
Pirimiphos methyl + carbophenothion	20EC	100 a	0 c	93
U 57710	85WP	63 b	87 ab	13
Monocrotophos	30EC	100 a	98 a	10
Triazophos	40EC	100 a	100 a	10
U 56295	85WP	70 b	93 a	10
MTI 220 †	20EC	100 a	83 ab	20
B. thuringiensis ‡		0 e	0 c	91
Check (water)		0 e	0 c	93

[a] Application rate was 0.075% ai in the contact toxicity test, except for the pyrethroids (...), which was 0.005% ai; and 0.75 kg ai in the foliar spray test except for † , which was 0.05 kg ai/ha. For ‡, the rate was 0.4 kg/ha of the formulated product. [b] Av of 3 replications. Mortality was recorded 48 h after treatment in the contact toxicity tests and 48 h after placing the larvae on treated plants in the foliar spray test. Separation of means in a column under each test by DMRT at the 5% level.

A strategic modelling approach to brown planthopper (BPH) management

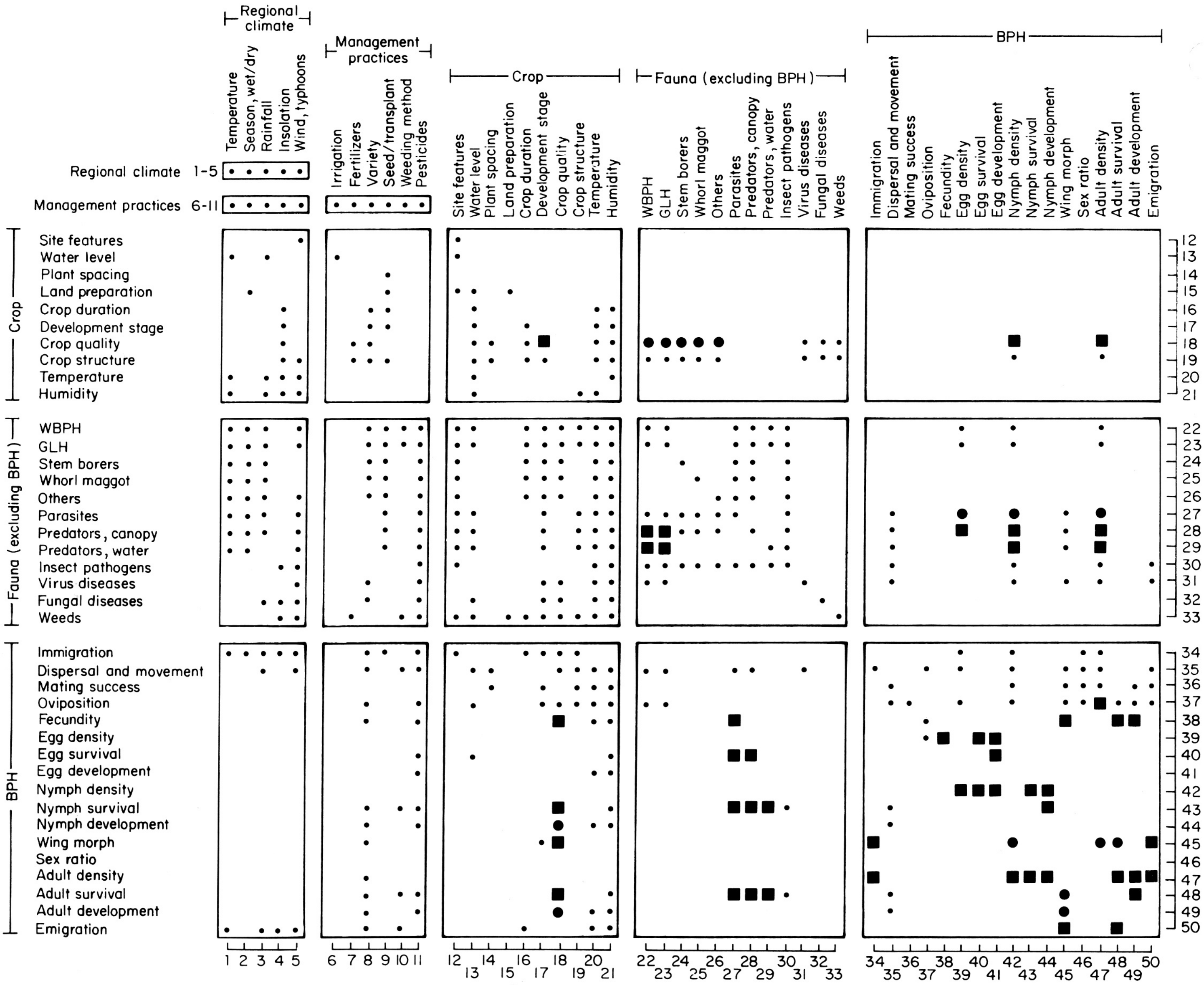
J. Holt and G.A. Norton, Silwood Centre for Pest Management, Imperial College, Silwood Park, Ascot, SL5 7PY; and T.J. Perfect and A.G. Cook, Tropical Development and Research Institute, College House, Wrights Lane, London W85SJ, United Kingdom

We monitored populations of BPH and associated rice fauna at a field site in Laguna, Philippines, throughout each growing season from 1979 to 1983. These data and other information obtained from the literature are being used to construct a population model to explain BPH population dynamics observed on rice crops at different Philippine sites. The model will subsequently be used to study the impact of BPH on changes in management, including resistant varieties and insecticides, in different climatic zones.

Two modelling techniques are being used. Initially, interaction matrices and other qualitative modelling techniques were used to identify the major relationships between components likely to contribute to BPH population changes.

The interaction matrix is shown in Figure 1. Each cell is concerned with the primary effect of the column component on the row component. Secondary effects can be determined by working

The International Rice Research Newsletter (IRRN) invites all scientists to contribute concise summaries of significant rice research for publication. Contributions should be limited to one or two pages and no more than two short tables, figures, or photographs. Contributions are subject to editing and abridgment to meet space limitations. Authors will be identified by name, title, and research organization.



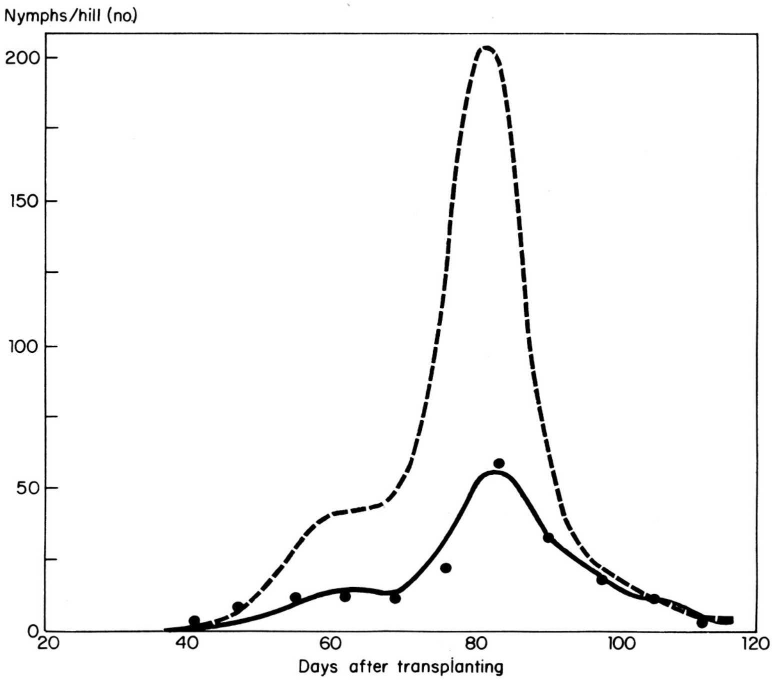
1. An interaction matrix for BPH on a rice crop in the Philippines. Key to symbols: (■) interaction explicitly included in the model; (•) interactions planned for immediate inclusion; (•) interactions for future consideration; ( ) no interaction.

through the matrix. For example, column 11 and row 28 indicate that pesticides affect canopy predators, while column 28 and rows 40, 43, and 48 indicate that predators affect BPH egg survival and adult survival. Thus, the model incorporates the resurgence effect of pesticides caused by predator suppression. The matrix provides an overview of the system and is a valuable tool for problem analysis; we hope that publishing the matrix will stimulate discussion.

The second modelling technique involves computer simulation of BPH population processes. It works on a time-step of 1 d from transplanting to harvest, is written in Pascal, and is being run on a CDC 855 under NOS 2.3 operating system. Initial simulations of the observed changes in BPH populations at one Philippine site have used coefficients and relationships obtained from other sources. The model will be tested using data sets for different sites and seasons.

During the modelling process, possible causes of discrepancies between model simulation and observed data are identified and systematically reviewed before modifying the model. The construction of the initial population model and incorporation of those interactions indicated as (■)in Figure 1 is almost complete. A simulation generated by this model and the observed population curve for the initial data set are compared in Figure 2. The preliminary model has been used to test the hypothesis that polyphagous predators are an important cause of BPH mortality. It was found that a 50% reduction in the attack rates of the major polyphagous predators (spiders, *Microvelia atrolineata,* and *Cyrtorhinus lividipennis*) caused a threefold increase in the peak of the simulated BPH population (Fig. 2).

The role of the model is to formulate explicit hypotheses that describe important parameters affecting BPH population dynamics. These parameters can be used to identify potential strategies for improved BPH management.



2. Simulation of BPH population changes at the first test site (–) compared with the observed population (•). Simulation of BPH population when predation is reduced by 50% (----).

Complete slide sets of photos printed in *Field problems of tropical rice,* revised 1983, are available for purchase at $50 (less developed country price) or $60 (developed country price), including airmail postage and handling, from the Communication and Publications Department, Division R, IRRI, P. O. Box 933, Manila, Philippines. No orders for surface mail handling will be accepted.

Pest Control and Management
WEEDS

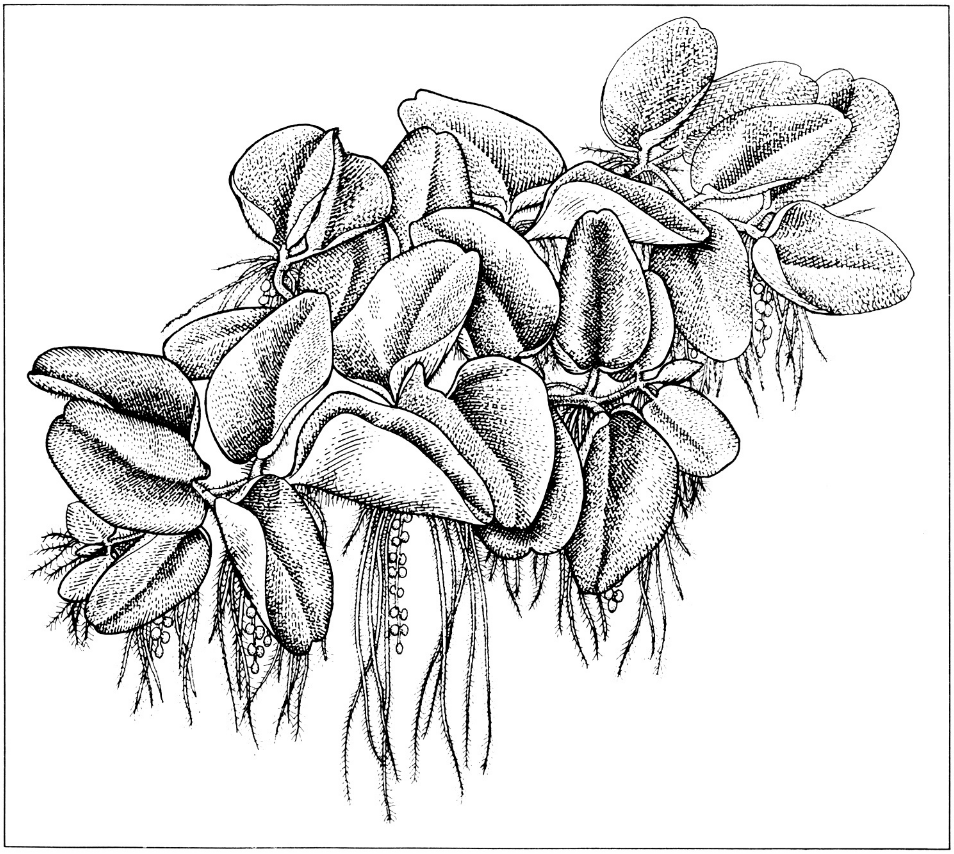
Salvinia molesta found in Philippine rice fields

K. Moody, J. P. Descalsota, P. C. Gonzales, and V. N. Cacnio, IRRI

Salvinia molesta D. S. Mitchell, a free-floating, mat-forming, perennial fern, which reproduces vegetatively at an alarming rate, has been found in transplanted rice (Fig. 1) and drainage canals in Iloilo Province, Panay Island, Philippines. *S. molesta* is a native of Brazil and has become a serious weed in most countries where it has been introduced.

Individual plants are up to 30 cm long and have many leaves (Fig. 2). Each node of the slender stem produces three leaves. Two are green and floating and one is brown, root-like, and submerged. The floating leaves of young plants are round to oval, 0.5-2.0 cm long, and lie flat on the water surface. With age and crowding, they become two-lobed, folded sharply along the midrib, 2.0-3.5 cm long, and only the midrib is in contact with the water. The submerged leaf is

1. *Salvinia molesta* growing in transplanted rice in the Philippines.



much divided and from 5 to 25 cm long. Sporocarps are 2 to 3 mm in diameter and sterile. They are found on parts of the submerged leaves.

To our knowledge, this is the first time the weed has been found in rice in the Philippines.

2. Diagram showing floating leaves, submerged leaves, and sporocarps of *S. molesta.*

The International Rice Research Newsletter (IRRN) invites all scientists to contribute concise summaries of significant rice research for publication. Contributions should be limited to one or two pages and no more than two short tables, figures, or photographs. Contributions are subject to editing and abridgment to meet space limitations. Authors will be identified by name, title, and research organization.

Herbicides for weed control in rice nurseries

C.L. Patel, Z.G. Patel, R.B. Patel, and H.R. Patel, Agronomy Department, Gurajat Agricultural University (GAU), Navsari 396450, India

Effect of herbicide treatments on weed dry weight and rice seedling dry matter yield at 26 d after sowing, Naysari, India.

Treatment [a]	Weed dry wt (g/m^2)	Seedling dry matter yield (g/m^2)
Unweeded control	31	29
Hand weeding 15 DAS	8	47
Propanil 2.0 kg/ha	17	34
Thiobencarb (kg ai/ha)		
1.0	16	32
1.5	16	33
2.0	12	37
Butachlor (kg ai/ha)		
1.0	18	33
1.5	10	34
2.0	9	36
Pendimethalin (kg ai/ha)		
1.0	19	34
1.5	10	44
2.0	6	47
CD at 5%	3	6

[a]DAS = days after sowing.

We evaluated five herbicides and application rates for controlling weeds in an IR22 nursery at GAU Farm in 1984 kharif (Jun-Nov). Thiobencarb, butachlor, and pendimethalin were applied at different doses 5 d after sowing, and propanil was applied 15 d after sowing. Samples of weeds and rice seedlings were collected from a 1-m^2 area 26 d after sowing and dry weight was recorded. Weeds were *Cyperus difformis* and *C. iria* (53%), *Echinochloa spp.* (41%), and *Eclipta alba* (6%).

Butachlor controlled sedges and pendimethalin controlled monocots. Higher doses of all the herbicides were more effective than lower doses. Only propanil was phytotoxic, causing slight leaf tip burning.

Weed dry weight and dry matter yield of rice seedlings showed a significant negative correlation (r = -0.73). Lowest weed dry weight (6 g/ m^2) and highest seedling dry matter yield (47 g/m^2) were with pendimethalin at 2.0 kg ai/ ha, closely followed by hand weeding (see table).

Soil and Crop Management

Effect of harvest time on IR44 ratoon grain yield

J. S. Chauhan, F. S. S. Lopez, and B. S. Vergara, IRRI

Ratoon crop duration is very important for ratoon grain yield. Although an advantage of a ratoon crop is its short growth duration, sometimes duration is too short for tillers to produce enough leaf area to support a well-filled panicle The result is low ratoon grain yields. Relatively longer ratoon crop duration contributes to higher grain yield, but if duration is too long, productivity/ d per ha declines

IR44 is a good ratooning variety, but the ratoon crop has nonsynchronous maturity and its growth duration can be more than 100 d. Nonsynchronous maturity also makes ratoon harvesting difficult.

We studied the effect of harvest time of an IR44 ratoon crop on grain yield in Dec 1983-Jul 1984 at IRRI. Twenty-day-old seedlings were transplanted at 2 seedlings/ hill in a 23.0- × 23.2-m^2 plot. NPK was applied at 120-13-25 kg/ ha. Half of the N and all of P and K were incorporated at final puddling. The remaining N was topdressed at 28 and 40 d after transplanting. At maturity, five 6-m^2 subplots were sampled for main crop grain yield.

Plants were ratooned by cutting stalks at 15-cm height. Immediately after cutting, 40 kg N/ha was broadcast followed by insecticide spray. The ratoon crop was harvested at 75, 80, 85, and 90 d after main crop harvest (DAH). we 6-m2 subplots were sampled at each harvesting date. Ten random plants from each plot were taken to record panicles/ plant, spikelets/ panicle, and spikelet fertility. Unfilled grains were separated by specific gravity method using saline solution (1.65 kg/ 10 litres of water). Grain yield at 14% moisture content was recorded and expressed in g/m^2.

Effect of harvest time on grain yield and components in an IR44 ratoon crop, IRRI, 1984 dry season. [a]

DAH	Panicles/ plant	Spikelets/ panicle	Spikelet fertility (%)	Fully filled grains(%)	1000-grain wt (g)	Grain yield (g/m^2)	
						Actual	Adjusted
75	14 ns	61 ns	70 bc	83 b	25 ns	126 b	136 b
80	14	70	67 c	88 a	25	161 a	188 a
85	12	72	73 ab	92 a	25	168 a	196 a
90	13	67	75 a	92 a	25	151 ab	178 a

[a] In a column, means followed by a common letter are not significantly different at the 5% level. ns = nonsignificant.

Main crop grain yield was 516 g/m^2. Ratoon crop harvest time significantly affected spikelet fertility, fully filled grains, and ratoon grain yield (see table). Ratoon grain yield varied from 126 g/m^2 for 75 DAH to 168 g for 85 DAH. Number of regenerated hills among treatments varied from 86% for 75 DAH to 75% for 90 DAH. Ratoon grain yield was calculated based on maximum recorded regeneration (92%) to eliminate the differences due to number of regenerated hills, which caused large variations in ratoon grain yield and partially concealed the effect of time of harvest.

The lowest grain yield (136 g) was at 75 DAH and the highest at 85 DAH; however, they were not statistically different from those at 80 and 90 DAH. Spikelet fertility did not differ significantly between 85 and 90 DAH. Spikelet fertility at 75 DAH was at par with that at 80 and 85 DAH. The differences in spikelet fertility did not explain the differences in grain yield. The proportion of fully filled grains was the lowest at 75 DAH.

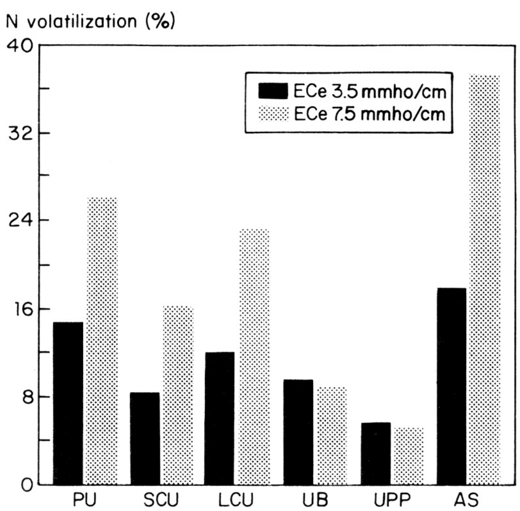
The differences in fully filled and total spikelets/ panicle can explain the differences in grain yield among the treatments. Late tillers with low spikelet number/ panicle contributed to low yields in 90 DAH treatment. Shattering of overripe grains also reduced yield. The optimum time of IR44 ratoon crop harvest is 80-85 d after main crop cutting, which is still too long for most situations.

Nitrogen volatilization from fertilizers applied to salt-affected coastal soils

B.K. Bandyopadhyay and H. S. Sen. Central Soil Salinity Research Institute, Regional Research Station, Canning, West Bengal 743329, India

We studied N volatilization losses from different N fertilizers in upland and lowland salt-affected soils. Volatilized ammonia gas was trapped in a foam pad soaked with dilute sulfuric acid. The foam pad was placed 30 cm above the soil on a grill on top of a perforated cylindrical support. Volatilization was estimated using a standard curve prepared against actual losses estimated for identical field situations.

N at 100 kg/ ha was applied as ammonium sulfate (AS), prilled urea (PU), sulfur-coated urea (SCU), lac-coated urea (LCU), urea briquet (UB) 3 g, and PU (3 g) in paper packets (UPP) to puddled, waterlogged fields with ECe 3.5 and 7.5 mmho/ cm In a pot experiment, AS and PU were applied to

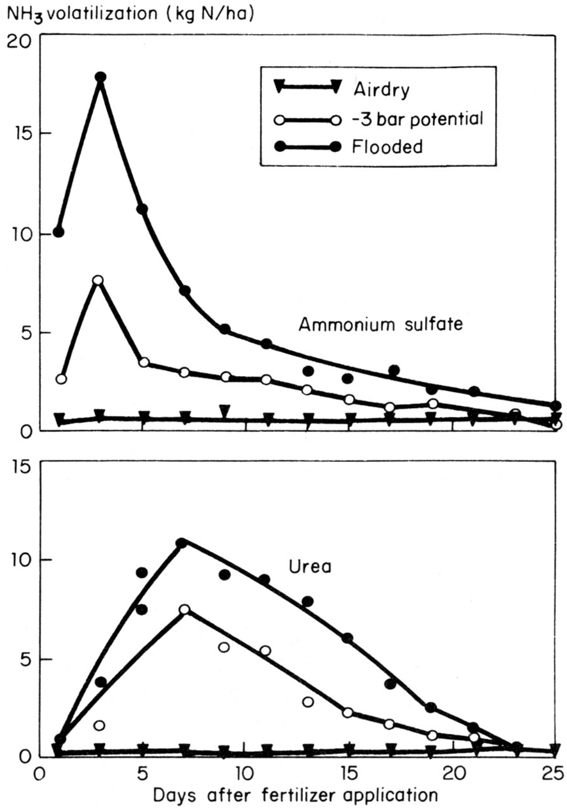


1. Volatilization losses of N from different fertilizers, West Bengal, India. PU = prilled urea, SCU = sulfur-coated urea, LCU = lac-coated urea, UB = urea briquet, UPP = PU in paper packets, AS = ammonium sulfate.

soil with ECe 7.4 mmho/cm at 3 soil moisture levels: airdried, -3 bar soil water potential (20% moisture), and waterlogged. Both experiments were in three replications. Except in the first 24 h, volatilization rate was measured at 48-h intervals. Soil and floodwater pH (1:2) were 7.5 and 8.2 before fertilizer application.

Except with UB and UPP, volatilization nearly doubled at 7.5 mmho/cm (Fig. 1). Figure 2 shows that the loss from both PU and AS increased with increasing soil moisture. Volatilization was greatest during the first 3-7 d, and then gradually declined.

Results showed that N use efficiency could be improved by reducing volatilization in salt-affected lowland rice fields by applying PU instead of AS, and by placing PU 5 cm deep in soil as UPP or UB. For upland fields, fertilizer application should be timed so that soil moisture is low during and immediately following N application.



2. Volatilization loss of NH3 at 3 soil moisture levels, West Bengal, India.

Response of rainfed rice to post-planting soil-management practices

B. R. Sharma and K. K. Katoch, Vivekananda Lahoratory for Hill Agriculture, Indian Council of Agricultural Research, Almora. Uttar Pradesh 263601, India

We studied the response of rainfed rice (VRS16) to 4 postemergence management practices: minimum tillage, interrow compaction at Proctor moisture content to achieve bulk densities of 1.6 and 1.8 g/cm^3, embedding polythene strips in the interrow space, and conventional practices. Soil was a loamy sand with 0.44% organic C, bulk density of 1.36 g/cm^3, and saturated hydraulic conductivity of 45 mm/h. Rice was sown in rows spaced at 23 cm on 6 Jul 1984. It received a basal application of 20-18-33 kg NPK/ha and topdressing of 20 kg N/ha 45 d after sowing. Treatments were imposed after complete crop emergence.

All soil modifications significantly increased grain yield as compared to the conventional practices (see table). Grain yield was highest when the interrow soil was compacted to a bulk density of 1.6 g/cm^3. Embedding polythene strips between the rows also was promising. Compacting the soil to a bulk density greater than 1.6 g/cm^3 reduced grain yield, possibly by restricting root proliferation. Straw yield did not differ significantly among treatments.

Rice grain and straw yield with different soil management practices, Almora, India.

Treatment	Yield (t/ha)	
	Grain	Straw
Minimum tillage	1.9	4.7
Compaction at Proctor moisture content to bulk density of 1.6 g/cm^3	2.0	5.1
Compaction at Proctor moisture content to bulk density of 1.8 g/cm^3	1.7	4.7
Embedding polythene strips in the interrow space	1.9	5.0
Conventional practices	1.4	4.1
CD at 5%	0.3	ns

Influence of N level and source on rice yield

T. S. Manickam and P. P. Ramaswami, Tamil Nadu Agricultural University (TNAU), Coimbatore 641003, India

We evaluated prilled urea (PU), urea supergranules (USG), and 1% PPD urea (PPDU) in a field experiment with Co 43 at TNAU. N levels were 0, 37.5, 75.0, and 112.5 kg/ha. P, K, and Zn were applied basally at 17.6, 33.2, and 2.3 kg/ha. USG was applied at 8-10 cm depth and PU and PPDU were applied in 3 splits. Soil was a clay (Typic Haplustalf) with pH 8.4, E.C. 0.2 mmho/cm, 107-9.8-263 ppm available NPK, 588 ppm total soil N, and 0.78% organic C.

Grain yield and crop performance were generally best with USC (see table). Plants recovered more N from USG, followed by PPDU and PU. N recovery ratio was higher at lower application rates. Postharvest soil analysis indicated that total N content did not change significantly, although USG plots had a maximum 729 ppm total N.

Influence of N source and level on grain yield and plant characters, Coimbatore, India.

Treatment (kg N/ha)	Tillers no./m^2	Tillers Increase over control (%)	Height cm	Height Increase over control (%)	Grains (no./Panicle)	Straw yield t/ha	Straw yield Increase over control (%)	Grain yield t/ha	Grain yield Increase over control (%)	N use efficiency	Total soil N at harvest
Control – no N	13	–	25	–	149	5.8	–	1.7	–	–	588
PU											
37.5	15	14	28	10	159	6.6	13	3.0	76	35	697
75.0	18	40	29	15	164	8.6	48	3.4	98	23	728
112.5	16	23	29	15	170	9.2	59	4.2	142	22	735
Av	16	25	28	13	164	8.1	40	3.5	105	24	720
USG											
37 5	16	28	29	15	169	8.0	39	3.4	100	46	679
75.0	17	35	30	19	186	8.5	47	3.9	127	29	721
112.5	22	71	33	30	188	8.9	53	4.6	165	25	788
AV	18	44	30	21	181	8.5	47	4.0	131	30	729
1% FPDU											
37.5	15	15	27	7	160	7.4	29	3.5	105	48	658
75.0	16	29	29	14	166	7.5	29	3.8	122	28	693
112.5	18	41	29	17	166	8.7	50	4.3	150	23	149
Av	16	28	28	13	164	7.9	36	3.9	126	29	700
	SED	CD	SED	CD		SED	CD	SED	CD		
Control vs root	0.99	2.0	0.56	1.1		0.6	1.2	0.26	0.5		
Source × level	0.77	1.6	0.43	0.9		0.5	1.0	0.20	0.4		
Source × level	1.33	2.7	ns	–		ns	–	ns	–		

Ammonia volatilization from waterlogged soils of North Bihar

A. K. Sarkar, senior scientist, and A.K. Roy, laboratory technician, Department of Soil Science and Agricultural Chemistry, Rajendra Agricultural University, Bihar, Pusa (Sumastipur) 848125, India

In flooded alkaline soils, fertilizer N is lost to air as ammonia during the first few weeks of submergence. We measured ammonia volatilization with different N sources. Soil was an alkaline sandy loam Entisol with pH 8.4, 0.34% organic C, 221 kg $KMnO_4$-N/ ha, and 31% free $CaCO_3$ Urea, lac-coated urea, neem cake and urea mixed 1:1 with green manure were the N sources. Rajendra Dhan 201 was grown in a flooded field in 20-m^2 plots. A 1.2-cm-diam × 35-cm-tall cylindrical frame covered with plastic bag was placed between rows of rice plants immediately after N fertilizer was applied. A petri dish filled with 100 ml of 0.1 N H_2SO_4 was suspended inside the frame. At 3-d intervals, the petri dish was emptied and the contents were distilled for NH_3 with MgO in a microkjeldahl apparatus. Volatilization loss was calculated based on area.

N losses through ammonia volatilization varied widely among N sources. After 16 d, the cumulative N loss ranged from 38 to 55 g/20 m^2. Volatilization loss was lowest for the urea-green manure treatment: 10 to 26% of fertilizer N volatilized within 4 d of application (see table). Rate of loss declined substantially over time. Total or cumulative loss in 16 d was between 20 and 30% with different N sources. Associated analysis of floodwater, soil solution, and wet soil indicated that high floodwater temperature, high HCO_3^- soil solution concentration, high soil pH, and high electrical conductivity caused high volatilization losses in North Bihar.

Percent N loss through NH_3 volatilization, North Bihar, India.

Treatment[a]	% loss of N through volatilization at indicated days after fertilizer application: 0-4 d	4-7 d	7-10 d	10-13 d	13-16 d	Cumulative loss (%) in 16d
Urea split (45 kg N/ha basal	25	1.8	1.9			
+ 22.5 kg N/ha at tillering	15[b] 19	2.2 1.9	1.3 1.4	0.8	0.3	29
+ 22.5 kg N/ha at panicle initiation	12[c]	1.8	0.4			
Urea basal (90 kg N/ha)	26	1.2	1.1	1.0	0.3	29
lac-coated urea basal	25	2.5	1.5	1.1	0.2	30
neem cake-coated urea basal	23	3.0	0.6	0.8	0.4	28
Green manure + urea (1:1)	18	1.0	0.6	0.8	0.2	21

[a]Each treatment received 45-45 kg PK/ha. [b]Loss after first urea split. [c]Loss after second urea split.

Evaluation of tractor-drawn puddlers and puddling operations

S. Aggarwal, research engineer, Rice Research Station, Kaul 132021, India

In Haryana, most farmers with tractors use mounted, spring-loaded cultivators for puddling. Some also use mounted disk harrows. Rotary blade puddlers, rototillers, and power tillers are unavailable. Tillage with cultivators and disk harrows varies from two to five times. We evaluated the cultivator, disk harrow, and rotary puddler for rice cultivation (see table).

Results indicate that

1. It takes more time to puddle with a disk harrow than with a cultivator or rotary puddler, presumably because the harrow has a higher draft requirement.
2. With only one tilling, a rotary blade puddler decreases infiltration rate most to 15 mm/d.
3. A second tilling with a harrow or cultivator further reduces the infiltration rate. One or two tillings with the rotary blade puddler produce the same effect.
4. Two cultivator tillings produce an infiltration rate similar to that from one tilling with a rotary blade puddler or a harrow.
5. The twice harrow-puddled field had lowest infiltration and yielded most.

Performance of various tractor-drawn puddlers in Kaul, India.

	Cultivator		Paddy disk harrow		Rotary blade puddler		
	Single operation	Double operation	Single operation	Double operation	Single operation	Double operation	CD 5%
Puddling time (h/ha)	2.9	4.9	4.0	6.7	3.6	5.8	
Puddling cost ($/ha)	17	29	24	40	22	35	
Infiltration rate (mm/d)	19	14	15	8	15	15	
Yield (t/ha)	4.2	4.3	3.9	4.5	3.8	3.9	0.075
Hills/m ^{2}	36.8	36	37	36.2	36.2	36.3	
Panicles/hill	8.5	8.2	8.5	8.8	8.2	8.0	
Grains/panicle	110	113	113	125	112	114	8.5
1000-grain mass (g)	28.5	29.6	28.0	28.3	29.7	30.7	1.8

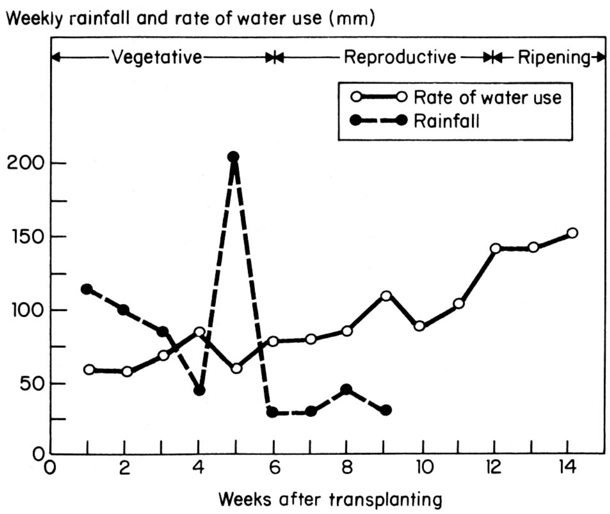
Effect of irrigation scheduling and nitrogen application on rice yield

I. K. Jaggi, R. O. Das, S. Kurnar, and D. C. Bisen, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Zonal Agricultural Research Station, Labhandi, Raipur, Madhya Pradesh, India

We studied the effect of four water regimes and three N levels and their interactions on rice yield (see table). The water regimes were imposed during a dry spell in mid-Sep 1984.

Crop water use was 1294 mm (see figure), of which 32% was used in vegetative phase, 45% in reproductive phase, and 23% during ripening. Rainfall met crop water demand until the vegetative phase. Five cm of irrigation water was applied when the groundwater table receded to 0 (T1), 10 (T2), 20 (T3), or 30 cm (T4). Total water use was 1294 mm at T1, 1110 at T2, 1067 at T3, and 927 mm at T4. Water regime did not significantly affect yield (see table), suggesting that continuous submergence is not necessary to produce high yield and that water use efficiency may be greater with a period of drainage between irrigations.

T1 with 80 kg N/ha produced significantly higher yields than the other treatment combinations, suggesting the need for continuous submergence at higher N application levels for good crop response to fertilizer. Lack of submergence during reproductive stage reduced the yield benefits under high N application. N level may be important to rice field water management.



Rate of water use at different rice growth stages, Raipur, India.

Effect of irrigation and applied N levels on rice yield, Raipur, India.

Water regime [a]	Grain yield (t/ha)		
	No N	40 kg/ha	80 kg/ha
T1	2.5	3.2	4.2
T2	2.5	3.3	3.7
T3	2.5	3.3	3.9
T4	2.5	3.3	3.8
CD	5%	1%	
N level significance	0.1	0.2	
Water level not significant	–	–	
Interaction significance	0.2	0.3	

[a] Tl-T4 received 5 cm irrigation water when groundwater level was at the indicated depth (in parentheses).

Growth depression of blue-green algae (BGA) in lowland fields on the Godavari Delta

R.A. Raju and M. N. Reddy, Agricultural Research Station, Maruteru 534122, W. G. Dt., Andhra Pradesh, India

BGA blooms do not develop in Godavari Delta rice fields even with inoculation (algalization). Some possible reasons for failure, obtained mainly from visual observations, are given here.

Soils usually have medium N fertility (0.75% organic C), low to medium available P (20-50 kg/ha), and high available K (350-500 kg/ha). P encourages BGA blooms, but K does not. BGA blooms disappear immediately after K fertilization.

In summer monsoon, river water is the main source of irrigation. It carries heavy silt deposits into rice fields. Water turbidity reduces incidental radiation and adversely affects photosynthetic algal activity. Moreover, the silt contains 3 to 5 ppm of K oxide, which may act as a mild algicide.

Close, dry season plant spacing results in a closed crop canopy and hinders penetration of solar radiation into the water. Weeds such as *Marsilea quadrifolia* and *M. minuta* may cover the water surface and further decrease available light.

Several algal grazers are common. Snails are voracious grazers. Snail infestation is largest the first 2 wk after transplanting, which also is the peak period of BGA bloom development. If field water depth increases, snail population increases. Tilapia, grass carp, catla, and rohu fingerlings abound in rice fields and also feed on algae.

Machinery Development and Testing

A wooden frame for transplanting rice

I. M. Bhatti and M. A. Bhutto, Rice Research Institute, Dokri, Sind, Pakistan

Proper plant development occurs only if a crop is well managed from planting to harvest. Management is enhanced with straight rows and evenly spaced hills. We developed an easy-to-handle wooden frame (see figure) to use for line or random transplanting for optimum plant population.

Wooden frame for transplanting rice, Sind, Pakistan.

The frame consists of 4, 1-m-long wood strips, 2.5 cm wide and 1 cm thick. All sides have cut markings every 20 cm for 20- × 20 cm spacing. Farmers who prefer random planting can transplant 25 plants/ hills. To further facilitate planting, an angle-iron partition in the center can be used to plant 12 hills in one portion and 13 in another to make 25 hills/ m^2.

The frame has been introduced in farmers' fields.

Announcements

De Datta honored

S. K. De Datta, head of the IRRI Agronomy Department, has received the following awards from the Weed Science Society of the Philippines (WSSP), the Philippine Council for Agriculture Resources Research and Development (PCARRD), the Soil Science Society of America (SSSA), and the American Society of Agronomy (ASA):

- Best Paper Award for a paper titled *Reducing the application volume of 2, 4-D with controlled drop applicators in rainfed rice* (WSSP),
- Most Outstanding Research and Development Award for the Los Baños Community for a paper titled *Fertilizer application and weed control technology for rice in a resource-scarce Philippine farmers situation* (PCARRD),
- American Fellow Award (SSSA), and
- International Service in Agronomy Award for 1985 (ASA).

De Datta earned his BS degree from Banaras Hindu University and the MS equivalent at the Indian Agricultural Research Institute, both in India, and the PhD at the University of Hawaii, USA. He has been head of the IRRI Agronomy Department since 1967, and has authored or coauthored more than 200 research and technical papers and three book chapters, and wrote *Principles and practices of rice production.*

Chang lectures published

Six special lectures given by T. T. Chang, head of the IRRI International Rice Germplasm Center, as part of the 1984 Iowa State University Plant Science Lecture Series, Plant Genetic Resources — Key to Future Plant Production, have been published in the Iowa State Journal of Research, Vol. 59, No. 4.

The lectures include Principles of genetic conservation, Collection of crop germplasm, Preservation of crop germplasm, Evaluation and documentation of crop germplasm, Germplasm enhancement and utilization, and Crop history and genetic conservation: Rice — a case study.

Copies may be obtained by writing the Agronomy Department, Attn. Ms. Darlene Kauffman, Iowa State University, Ames, IA 50011 USA. Price is $10.00 per copy.

Deposit promising genetic materials with the IRRI International Rice Germplasm Center (IRGC)

Many IRRN authors discuss new or unusual rice varieties and lines in their articles. IRRN readers frequently write to T.T. Chang, head of the IRGC, requesting seeds of the rices mentioned in those articles. Unfortunately, the seeds of many of those varieties have not been deposited with the IRGC.

Chang asks that contributing authors deposit (via airmail) their new, promising, or unusual rice strains with the IRGC so that the primary objective of exchanging useful information and valuable genetic materials through the IRRN can be fulfilled.

Please write T.T. Chang, International Rice Research Institute, P.O. Box 933, Manila, Philippines, for a Philippine seed import permit for such donations to the IRGC.

Science and rice in Indonesia

Science and rice in Indonesia, by William B. Ward, professor of Communication Arts at Cornell University, documents how investments and policies that promoted the growth of scientific research capabilities contributed to remarkable progress in agricultural development in Indonesia.

The book is the first in a new science and technology for development series published by the US Agency for International Development.

Copies, priced at $25, may be ordered from Delgeschlager, Gunn & Hain, 131 Clarendon Street, Boston, MA 02116, USA.

New IRRI publications

The following new IRRI publications are available for purchase from the Communication and Publications Department, Division R, IRRI, P.O. Box 933, Manila, Philippines:

- *A farmer's primer on growing rice* (Bikol edition)
- *Field problems of tropical rice* (Bikol, Thai, Punjabi editions)
- *Annual report for 1984*
- *Wetland soils: characterization, classification, and utilization*
- *The rice economy of Asia*, R. Barker and R.W. Herdt with B. Rose
- *Rice diseases*, 2d ed., S.H. Ou
- *Publications on international agricultural research and development*, 1985
- *International bibliography of rice research*, 1984 supplement
- *Parentage of IRRI crosses IR1-IR50,000*

ERRATUM

P.C. Srivastava and M.S. Gangwar. Evaluation of soil zinc fertility parameters. 10 (2) (Apr 85), 25-26.

Page 25: In column 3, line 4 from the bottom should read:

"soil, $\mu g/g)^{-1} = (1/K_1) + (K_2/K_1)$ (Zn in".

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

ISSN 0115–0944