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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- Do not cite references or include a bibliography.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

Spread of IR42 and IR3273-P339-2 in irrigated areas of Ghana

J. O. Olufowote, D. C. Pankani, and D. K. Das Gupta, West Africa Rice Development Association (WARDA), Subregional Headquarters, Accra, Ghana

IR42 and IR3273-P339-2 are very popular for irrigated cultivation in Ghana. Their spread was encouraged by WARDA on-farm trials from 1979 to 1983. Among varieties, IR42 yielded best in 5 yr at 14 locations (see table). Although IR3273-P339-2 was not among the top yielders, farmers prefer it to IR42. IR442, released in 1975 and yielding on par with IR3273-P339-2, remains popular with some farmers.

In 1983, the Afife Irrigation Project Site (830 ha) was planted primarily to IR3273-P339-2, as were 202 of 410 ha at the Asutsuare Imgation Project Site. At Kpong Farms, 73 ha were planted to the variety.

There also was considerable interest in IR42. Because no certified IR42 seed was available, about 1,000 t was imported from the Philippines with the assistance of the United States Agency for International Development and the United Nations Development Programme. Both IR42 and IR3273-P339-2 will be officially named and released at the next meeting of the Ghana Rice Varietal Release Committee. Both have good grain (small, translucent) and cooking qualities and are resistant to prevailing pests and diseases. IR42 is particularly suitable for low fertility management. □

Performance of IR42 and IR3273-P339-2 in WARDA on-farm trials at 14 sites, 1979-83.

Cultivar	Grain yield (t/ha)	Days to maturity	Plant height (m)
IR42	5.9	132	86
BR51-118-2	5.5	126	117
ADNY 11	5.4	116	115
IR3273-P339-2	4.9	128	90
IET2885	4.6	127	90
Checks			
Thailand	4.2	132	86
Dawhenya 3	4.9	125	116
IR442	5.1	122	94

Heritabilities in some rice crosses

A. Ghosh, Rice Research Station, P. O. Chinsurah, Hooghly, W. Bengal, Pin-712 102, India; and P. K. Bhaumik, College of Agriculture, University of Calcutta, 35, Ballygunge Circular Road, Calcutta, Pin 700019, West Bengal, India

We studied the estimates of heritability (broad sense) and genetic advance for 9 rice traits in 3 F_2 populations (Kanchi/Jayanti, Ratna/Jayanti, and IET1136/Ratna) using the formulae $H = \sigma_a^2/\sigma_A^2$ and $Gs = (k)(\sigma_A)(H)$.

The lowest estimated heritability was for grain length (25.54%) in Kanchi/Jayanti. Heritability exceeded 50% for days-to-heading, effective tillers/plant, number of filed grains/panicle, straw weight, 100-grain weight, and yield/plant in all crosses (see table). Ratna/Jayanti had more than 50% heritability for 100-grain weight and Kanchi/Jayanti had the same percentage for plant height.

Estimates of genetic gain showed selection could double straw weight in Ratna/Jayanti. Genetic gain was minimum for panicle length (3.6% to 6.0%) in all F_2 populations. Moderately high genetic gains were found for effective tillers per plant, straw weight, and yield/plant (see table). Genetic gains were moderate for number of filled grains/panicle.

In all F_2 populations, days-to-heading and 100-grain weight showed low genetic

Heritability (broad sense) and geneticgainin rice.

Character	Cross[a]	Heritability (%)	Genetic gain (%)
Days-to-heading	1	93.5	12.2
	2	81.2	13.0
	3	92.0	12.0
Plant height	1	66.0	12.0
	2	38.0	5.0
	3	32.3	7.4
Effective tillers/plant	1	84.2	64.3
	2	87.5	80.4
	3	89.5	76.8
Panicle length	1	32.0	5.0
	2	43.0	6.0
	3	33.2	3.6
No. of filled grains per panicle	1	91.2	54.8
	2	90.5	58.7
	3	97.0	61.7
Straw weight	1	97.0	87.8
	2	90.4	100.0
	3	93.4	91.0
100-grain weight	1	89.0	28.0
	2	65.0	11.0
	3	76.4	13.5
Grain length	1	25.5	29.1
	2	79.6	10.0
	3	38.6	40.5
Yield/plant	1	90.3	86.9
	2	91.5	94.6
	3	98.5	87.4

[a] 1 = Kanchi/Jayanti, 2 = Ratna/Jayanti, 3 = IET1136/Ratna.

gains and high heritability, indicating non-additive gene action. Similar gene action was observed in plant height of Kanchi/Jayanti and grain length of Ratna/Jayanti. □

Performance of NDR80 (IET7626) in 1982 and 1983 wet season in All India Coordinated Rice Improvement Program trials in India.

Location	Grain yield (t/ha)			CD 0.05
		1982		
	NDR80	Ratna	Rasi	
Aduthurai	5.4	2.5	2.6	0.8
Coimbatore	3.5	3.3	3.2	0.7
Hyderabad	5.8	5.4	5.1	1.1
Cuttack	2.5	1.2	1.6	0.8
Jeypore	5.4	4.3	4.9	1.4
Karimganj	4.2	3.2	3.6	0.7
Agartala	3.7	2.7	3.1	0.2
Faizabad	5.2	3.1	5.6	1.4
Varanasi	4.6	3.4	3.5	1.1
Patna	4.1	3.0	3.8	0.5
Pantnagar	6.2	3.3	3.5	1.1
Kapurthala	6.0	2.4	3.5	0.9
Gurdaspur	5.8	4.0	4.7	0.9
Kaul	5.6	3.5	4.0	0.7
Nawagaon	6.5	5.1	6.1	0.8
Mean	5.0	3.4	3.9	
Mean d to 50% flowering	91	91	37	
		1983		
	NDR80	Rasi	IR36	
Mannuthy	4.8	3.3	3.9	1.3
Pattambi	3.1	1.8	3.0	0.9
Aduthurai	5.8	4.4	5.2	0.4
Coimbatore	4.6	5.5	5.3	0.9
Pondichery	4.5	2.3	3.8	1.3
Cuttack	4.6	1.8	3.6	0.8
Chinsurah	3.7	1.8	3.1	1.0
Karimganj	3.3	2.2	3.1	0.4
Raipur	3.0	1.8	2.9	0.8
Rewa	4.1	2.5	4.0	0.3
Kanke	2.4	2.1	2.5	0.6
Faizabad	4.7	3.1	3.6	0.9
Varanasi	2.5	2.0	2.8	0.9
Pantnagar	4.1	3.4	2.8	1.1
Kaul	4.8	3.0	3.3	1.2
Banswara	5.9	3.9	5.3	1.2
Kota	4.9	3.0	4.7	1.0
Karjat	2.1	1.8	2.2	0.4
Nawagaon	4.6	3.9	4.6	1.2
Mean	4.1	2.8	3.7	

NDR80, a semitall, nonlodging rice

D. M. Maurya, C. P. Vaish, and S. P. S. Rathi, Genetics and Plant Breeding Department, Narendra Dev University of Agriculture and Technology (NDUAT), Faizabad 224001 India

At NDUAT we developed NDR80, a semitall, nonlodging, stiff-strawed rice with 115-d maturity. It averages 100 cm tall and is resistant to most foliage diseases. This line has high yield potential and adaptability for irrigated cultivation in India (see table). It has long bold grains with white kernels and has yielded consistently more than check varieties and other new rices. Semitall height helps it compete with weeds at early growth stages. At demonstration plots in Uttar Pradesh, farmers have chosen NDR80 because of high grain and straw yield. □

Yield evaluation of major indigenous rice varieties grown on Cuu Long Delta

Bui Chi Buu and Nguyen Van Luat, Cuu Long Delta Rice Research Institute, O Man, Hau Giang, Vietnam

Much of the Cuu Long Delta still is planted to indigenous rice varieties that yield 1.5-4.5 t/ha. In 1982 and 1983 we surveyed yields of major indigenous rices grown in Cuu Long and Hau Giang Provinces. Crop-cut samples were from 10 m^2 plots and mean yields were recorded.

In 1982 in Cuu Long, we took 407 samples of 52 varieties (Table 1). Where rice grows in fresh water, Trang Chum yielded well in fields flooded 31-70 cm deep.

Nang Cho and Nang Trich performed better in 71-cm-deep water. In fields influenced by salinity intrusion (5-8 mo freshwater regime), Lua Phi and Trang Lun yielded best.

Table 1. Yields of selected indigenous rice varieties in Cuu Long Province, 1982.

Water depth (cm)	Variety	Crop-cut sample (no.)	Yield (t/ha)
	Freshwater area		
31-50	Lem Lun	13	3.6
	Trang Chum	11	3.3
51-70	Cho Bien	20	3.5
	Trang Chum	13	3.5
	Chet som	15	3.4
	Tay Lieu	13	3.4
	5-8 mo freshwater area		
31-50	Lua Phi	23	2.8
51-70	Trang Lun	10	3.4
	Lua Phi	39	2.7

Table 2. Yields of selected indigenous rice varieties in Hau Giang Province, 1983.

Harvest month	Water depth (cm)	Variety	No. of crop-cut samples	Yield (t/ha)
Jan	31-50	Tang Chum	12	4.5
		Trang Phuoc	12	4.2
		Cho Bien	11	3.8
	51-70	Trang Chum	23	4.6
		Trang Phuoc	23	4.2
		Nang Chet	10	3.2
		Trang Lun	17	3.1
	71-90	Trang Phuoc	14	4.4
		Trang Chum	16	3.2
Feb	51-70	Ba Tuc	10	3.3
		Huyet Rong	22	3.2
		Duoi Trau	19	3.2
	71-90	Duoi Trau	23	2.8
		Mong Chim	12	2.7

In 1983 in Hau Giang, we took 508 samples of varieties (Table 2). Of the varieties harvested in Jan, Trang Chum and Trang Phuoc yielded well at 31-90 cm water depths. Of the late varieties, harvested in Feb, four yielded best. □

Genetic Evaluation and Utilization

AGRONOMIC CHARACTERISTICS

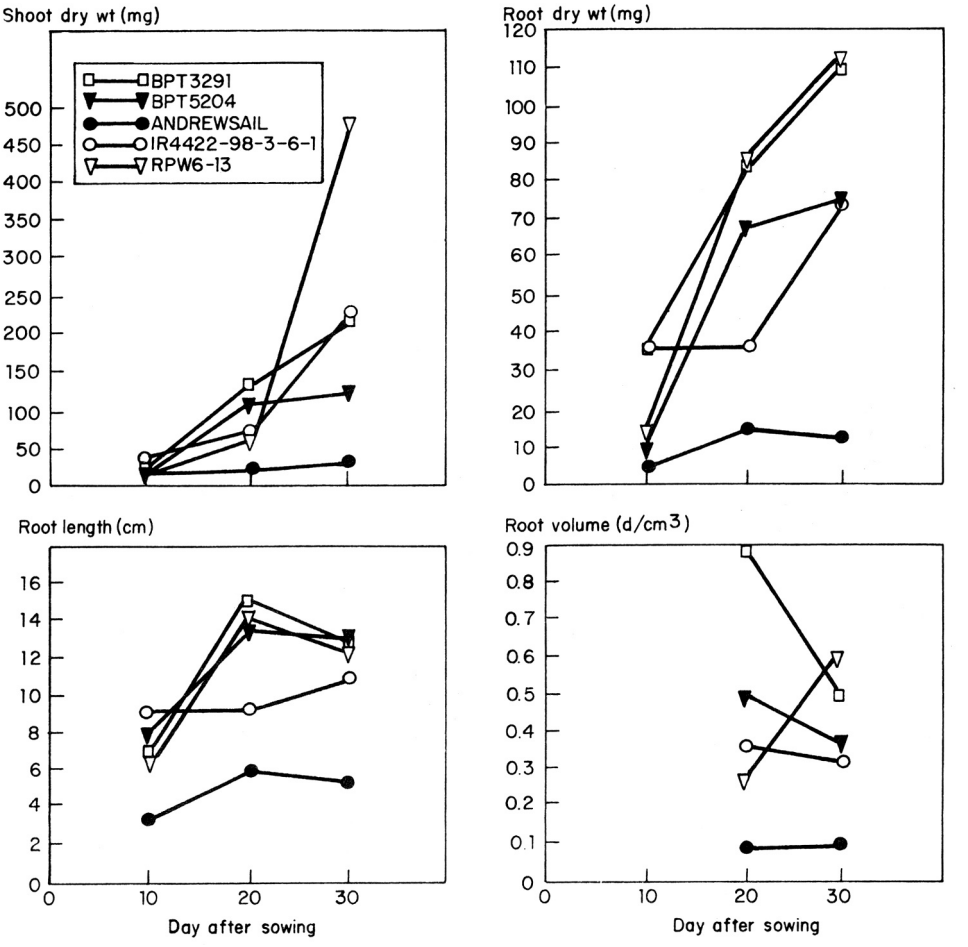
Root and shoot characters of medium- and long-duration rice genotypes

C. P. Rao, K. C. Kotaiah, K. R. K. Murthy, and J. R. Reddy, Andhra Pradesh Agricultural University, Department of Genetics and Plant Breeding, Agricultural College, Bapatla 522101, Andhra Pradesh, India

We studied variations in the root and shoot characters at different nursery stages in 24 medium-duration (< 140 d) and 35 long-duration (> 140 d) rice genotypes. The nursery was sown in uniform sand at 15-cm interrow spacing in a randomized block design with 3 replications in 1982 kharif. The nursery received 0.5-0.22-0.42 kg NPK/100 m^2 area and was watered daily.

Mean root and shoot performance of medium-duration rices, Andhra Pradesh, India.

Genotype	Root length (cm)			Root dry wt (mg)			Root volume (cm^3)		Shoot dry wt (mg)		
	10 d	20 d	30 d	10 d	20 d	30 d	20 d	30 d	10 d	20 d	30 d
IR52	4	14	13	15	125	210	0.8	0.8	10	179	401
IET3116	7	9	12	19	25	50	0.3	0.3	12	51	112
IET7231	8	13	12	12	52	129	0.5	0.6	21	74	255
IR1561-228-3-3	4	7	6	10	31	19	0.2	0.1	15	36	47



Root and shoot performance of long-duration rices. A. P., India.

Sample seedlings were collected from the well-watered nursery with a small digging plate that penetrates 20 cm into the soil. Seedlings were pushed from the soil with balls of compact wet sand adhering to the roots. The sand was washed off in a bucket of water and clean plant samples were obtained without disturbing the root system.

Data were recorded from 3 seedlings per replication per genotype at 10, 20, and 30 d after sowing. Root length was measured from the juncture of the shoot and root to the tip of the longest root. Root volume was measured by water displacement. Root and shoot portions of each seedling were separated, washed, oven-dried, and weighed. There were significant differences among medium- and long-duration rices for all characters.

Medium-duration IR52 had a prolific root system with maximum root length and volume at 20 d. At 30 d, IET3116 had high root dry weight and IET7231 had high shoot dry weight. IRl561-228-3-3 had low mean values for the characters studied (see table).

Long-duration IR4422-98-3-6-1 show good root length, root dry weight, and shoot dry weight at 10 d. BPT3291 had maximum expression of root and shoot characters at 20 d. BPT5204 showed maximum root length at 30 d (see figure).

Mean root length and root and shoot dry weight increased with growth duration The varietal differences in root character should be considered in drought resistance studies. □

Genetic Evaluation and Utilization

GRAIN QUALITY

Genetic stability of crack resistance in rice grains

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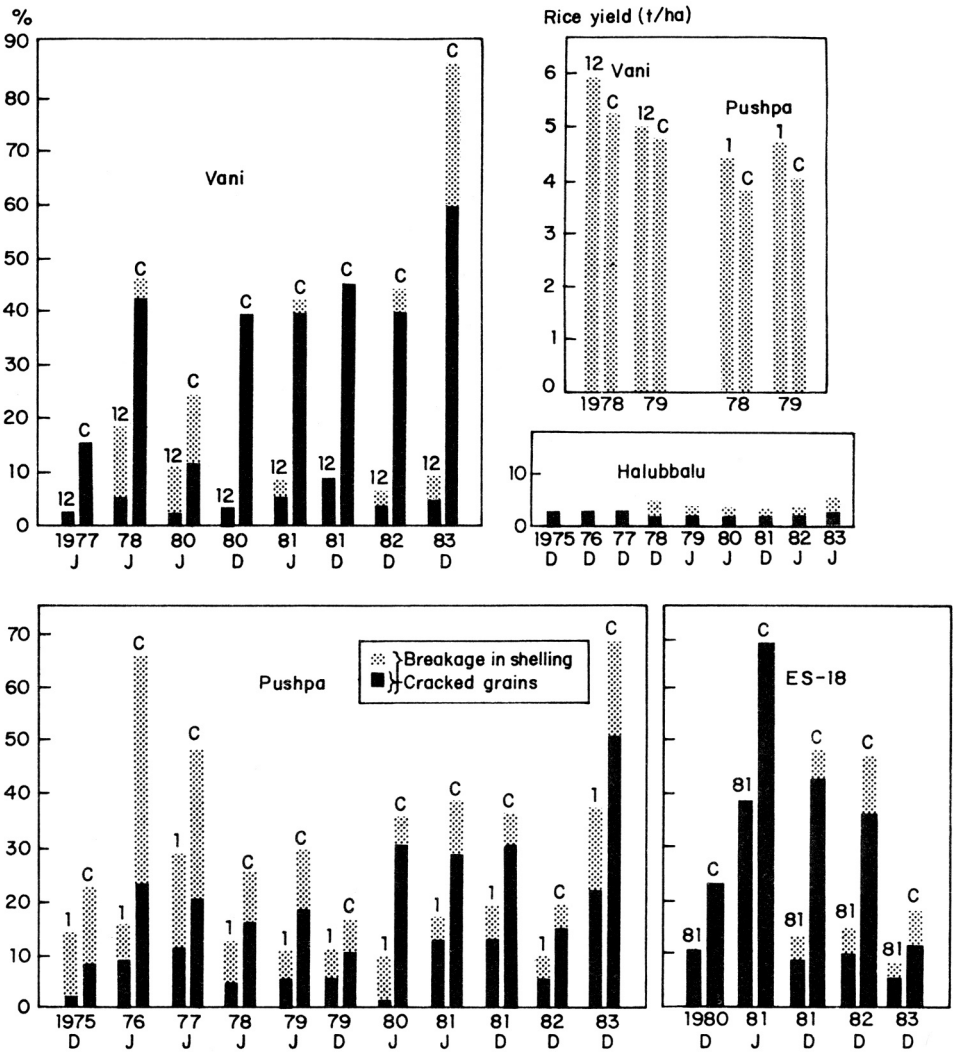
Late harvesting and uncontrolled drying cause cracks in rice grains that cause milling losses. We identified crack-resistant (CR) and crack susceptible (CS) varieties by screening rices grown and harvested under controlled conditions. Most high yielding, commercial rices were CS.

We tried to develop CR rices by intravarietal selection of some high yielding varieties. A standard index was developed to measure genetic differences in cracking within a variety. The mean of the percentages of green grains, field-cracked grains, and stress-cracked grains was the index for the first generation and, thereafter, percentage of shelling breakage was used instead of green grains.

Three CR lines — FT-1, FT-12, and FT-81 — were established in varieties Pushpa, Vani, and ES-18. For other varieties tested (Jaya, Mangala, Madhu, Pusa 150, and Intan), genetic variation in crack resistance was either very small or nil and was masked by environmental variations, which prevented intravarietal selection.

The CR lines were identical to their parents in plant, grain, and yield characters (see figure). The genetic stability of the



Cracking resistance of 4 lines isolated through intravarietal selection, Mysore, India. D = Dec, J = Jan.

newly identified CR lines was unknown, so we continued to observe their performance in the advanced generations and to compare them with their parents. The CR lines had 40 to 93% fewer cracked grains and 25 to 85% less shelling breakage than their parents. Seasonal effects caused more variation in parent than CR lines. Halubbalu had exceptional resistance to cracking and breakage and high genetic stability.

In each variety and derivative, the percentage of cracked grains varied with the percentage of shelling breakage and served as a round index for predicting breakage properties (see figure).

Future genetic study of crack resistance should elucidate the chemical nature of the endosperm in relation to cracking. □

Genetic Evaluation and Utilization

DISEASE RESISTANCE

Recovery from blast (BI) defoliation in rice

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During screening of rice lines for B1 resistance, we recorded disease at 5 and 8 wk after seeding. The lines were F_6 selections bred for earliness and resistance to late season drought under rainfed conditions. At 8 wk several B1-susceptible lines had produced vigorous new growth following B1 attack scored at 6-8 by the 1980 *Standard evaluation system for rice.* Other B1-susceptible lines under the same management had little or no recovery. Many of the recovered lines yielded 3-4 t/ha. The selection procedure employed in F_4 and F_5 for those lines involved digging up surviving plants from a drought-affected, largely dead segregating population, and encouraging, under irrigation, new growth from ratoon tillers to produce seed.

If confirmed, the existence of strong genetically controlled differences in recovery between varieties following defoliation should be of interest to rice breeders. Apart from drought and B1, insects such as caseworms, leaffolders, and grasshoppers frequently reduce crop leaf area. Some recovery from hopperburn could also be envisaged.

B1 recovery also could be included in a disease resistance breeding program. If race changes of the B1 fungus cause susceptibility, a variety with both vertical resistance and residual recovery ability should give farmers and breeders time to identify a replacement variety. Testing for recovery in a vertically resistant variety poses some problems. Mowing or a sublethal paraquat spray might be effective, but we have not tested those methods.

Table 1. Lines with best recovery, Zanzibar, Tanzania.

Cross	Line no.
BKN/IRAT	746c, 345, 3029A & B, 333
BKN/1746	777B, 770A, 2031
3839/DV	715A
IAC/Bb	172c, 179CB, 200A
Aus/Bin	501A, 3000
IRAT/Bg	177c, 177f, 3021c
Bb/Affa	703a

Table 2. Parents and origin of lines with best recovery, Zanzibar, Tanzania.

Parent	Source (via IRTP)
BKN6858-6-3-2	Thailand
IRAT 10	Ivory Coast
IAC25	Brazil
IR1746-226	IRRI
IR3839	IRRI
Aus 8	India
Affa Kilombero	Tanzania
BG33-2	Sri Lanka
DV110	Bangladesh

Table 1 lists the lines with the best recovery, and Table 2 gives their parentage. □

Screening for brown spot (BS) resistance in deep water rice

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BS, caused by *Drechslera oryzae,* is a major disease of long-duration, lowland, deep water, and floating rices. In 1982, three deep water screening sets (IRDWON I, II, and III) with 156 lines, received through the International Rice Testing Program, were grown in deep water areas at Pusa and evaluated for BS resistance. The varieties and lines were sown directly in the fields and spray-inoculated with *Drechslera oryzae* suspension in Sep. Flowering rices were scored for resistance using the 1980 *Standard evaluation system for rice* in Oct.

Five alternate leaves beginning with the flag leaf were scored and the highest score was considered an index of the entry. Local severity index was 7.2 in 1982 and 7.9 in 1983. Resistant lines identified in 1982 also were evaluated in 1983. Local Bajal was the check. Of the 12 test lines selected, CR98-7216-CRRP-34, CR1002, BKNFR2606-3-2-1-2, and IR42 had consistent resistant reactions (see table). □

Reaction of deep water rice cultures to BS in 1982 and 1983, Bihar, India.

Designation	Resistance level [a]		Reaction
	1982	1983	
CR98-7216-CRRP-34	3	3	R
CR149-5010-228	3	7	S
IR4829-89-2	3	7	S
CR1002	3	3	R
IR3257-24-IB-P 2	3	7	S
IR19061-57-IE-Pl	3	7	S
Achra 108-1	3	5	MR
BKNFR2606-3-2-1-2	3	3	R
IR42	3	4	R
BKNFR76004-4-1-1-1	3	5	MR
BKNFR76052-100-1-5-1	4	7	S
BKNFR76025-100-1-5-2	4	7	S
Bajal (check)	7	9	S

[a] By the 1980 SES.

Screening of elite rice strains and varieties for bacterial blight (BB) resistance

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

BB, caused by *Xanthomonas campestris* pv. *oryzae,* is a major rice disease in the Tarai region of western Uttar Pradesh, and incidence is increasing throughout the state. In 1983 kharif, 6 All India Coordinated Rice Improvement Project (AICRIP) variety trials—uniform varietal trials 1, 2, and 3; preliminary variety trials 2 and 3; and Aromatic Slender Grain Varietal Trial (ASGVT), with 15, 22, 30, 64, 64, and 22 entries, were evaluated for BB incidence in replicated trials at the Crop Research Center of G. B. Pant University. Environmental conditions favored natural disease development and BB incidence was very high. Disease reaction was recorded at 50% flowering stage on a 0-9 scale.

Of 317 entries evaluated, 37 showed resistant reaction (3) (see table). The resistant entries were evaluated under artificial epiphytotic conditions in 1984 kharif using standard clipping for disease inoculation. Under heavy BB pressure, all entries had susceptible reaction, scoring between 7 and 9. Results show that presently available elite materials in AICRIP trials have a low level of BB resistance. Therefore, there is a need to increase the level of resistance by incorporating new resistance genes into elite lines to combine stability with higher yields. DV85 and BJ1, which showed resistance at Pantnagar under artificial epiphytotic conditions, might be used as donors. □

Rice varieties with field resistance to BB at Pantnagar in 1983 kharif.

Experiment	Varieties or elite strains with BB resistance
UVT 1	RP1670-1418-2205-1582 (IET7613), Govind, Cauvery
UVT 2	CR200-788-3 (IET6775), CR167-7 (IET4507), AD9246 (IET6985), OR173-1-1 (IET7179), RP1036-35-2-5-1-1 (IET7230), PR103 (IET7267), Pusa 205-15-1 (IET7279), CR163-CRRD-50 (IET780), CR75-93 Mut. 11-4 (IET7713)
UVT 3	IR54 (IET7296), or 147-1-137 (IET7174), Pant Dhan 4
PVT 2	RP1575-636-6-1 (IET8713), RP1775-243-719-681 (IET8718), NDR302 (IET8054), KR10-47 (IET8055), RAU4056-53-5, (IET8056), or 79-21 (IET5975), SKL 6 (IET7169), or 131-5-8 (IET7433), HPU804 (IET7500), BPT1235 (IET8040), BIET263 RAU49 (IET8044), UPR79-164 (IET8048), UPR254-21-1-1 (IET8049), UPR103-44-2 (IET8050), NDR301 (IET8053), NSRPII Late (IET8700), BAU4090-1 (IET8702), UPR81-44 (IET8709), BK670 (IET8711), NRL 326-3 (IET8713), Rasi, Prasad
PVT 3	Pant Dhan 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
INSECT RESISTANCE

Field screening of rice cultivars for resistance to black bug *Scotinophara coarctata*

I. T. Domingo, E. A. Heinrichs, G. S. Khush, T. Masajo, D. M. Wood, R. Aseron, and R. Vigonte, IRRI

The first reported black bug outbreak in the Philippines was in Bonobono, Bataraza, southern Palawan, in 1982. Rices were screened for black bug resistance in a farmer field at Maasin, Brookes Point, in Jul-Dec 1983.

Three hundred rice breeding lines were sown in thermo cups and transplanted in caged plots at 15 test entries/plot and 10 hills/entry, 2-3 seedlings/hill. Water was maintained 3-5 cm deep for 20 d after transplanting (DT). Field-collected black bug adults were introduced 20 DT at 5 bugs/hill (750 black bugs/test cage plot). Plot size was 1.5 × 3 m. Immediately after infestation, the field was drained, which favored black bug survival. The field remained saturated throughout the experiment.

Of the 300 rices screened, 20 were selected based on damage reaction. They were retested in the same field in Jan-May 1984 with 35 black bug adults/hill and treatments in 4 replications. The number of black bugs in 5 randomly chosen hills/test entry was recorded 20 d after infestation (DAI). Plant damage was rated at 20, 40, and 60 DAI based on the following scale:

Rating	*Description*
0	No damage.
1	Wilting of youngest leaf.
3	Wilting of youngest leaf and partial yellowing of the first, second, and third older leaves.
5	Wilting of more than two leaves and pronounced yellowing of the first, second, and third older leaves.
7	More than half the plants wilting or dead and remaining plants severely stunted.
9	All plants dead or bugburned.

Reaction of selected breeding lines to the black bug,[a] Palawan, Philippines in 1984 dry season.

Breeding line[b]	Black bugs (no./hill) 20 DAI	Plant damage at indicated DAI		
		20	40	60
IR13149-71-3-2	149 abc	3.5 a	4.0 a	5.0 a
IR10781-75-3-2-2	133 ab	4.0 b	4.0 a	5.5 a
IR18350-175-2-3	155 abc	3.5 a	5.5 ab	7.5 ab
BG379-1	200 c	3.5 a	5.5 ab	8.0 b
IR19661-23-3-2-2	126 ab	5.0 bc	5.5 ab	8.0 b
IR12721-24-3-1	173 bc	5.0 bc	6.5 abcd	8.0 b
BW295-4	129 ab	4.5 bc	7.5 cdef	8.0 b
BR316-15-4-4-1	131 ab	5.5 bcd	6.0 abc	8.5 b
BR445-60-1b	162 bc	5.0 bc	7.0 bcdef	8.5 b
IR13240-108-2-2-3	134 ab	6.0 c	7.0 bcdef	8.5 b
IR25774-3-1-1	169 bc	4.5 bc	7.0 bcdef	8.5 b
IR36 (check)	167 bc	5.5 bcd	7.0 bcdef	8.5 b
Tjeremas (purple base)	109 ab	7.0 d	8.0 def	8.5 b
BG400-1	134 ab	5.5 bcd	8.5 g	9.0 c
B2791b-Mr-257-3-2	145 abc	4.5 bc	6.5 abcd	9.0 c
B3981c-Pn-200-2-2	97 a	7.0 d	8.5 g	9.0 c
Cul. 6914	170 bc	5.0 bc	8.5 g	9.0 c
IR12979-24-1	133 ab	5.5 bcd	7.0 bcdef	9.0 c
IR13415-9-3	161 bc	5.0 bc	7.0 bcdef	9.0 c
C1754-5	121 ab	5.5 bcd	7.5 cdef	9.0 c
IR31917-31-3-2	148 abc	5.5 bcd	8.0 def	9.0 c
Tjeremas (green base - local check)	203 c	5.0 bc	7.5 cdef	9.0 c

[a] Av of 4 replications. In a column, means followed by a common letter are not significantly different at the 5% level by Duncan's multiple range test. [b] Breeding lines selected from the 300 test entries screened in Jul-Dec 1983.

The first 5 test entries tolerated high black bug population at 40 DAI (see table). However, IR13149-71-3-2 and IR10781-75-3-2-2 were the only entries that survived to 60 DAI. IR10781-75-3-2-2, which matures in 13 1 d, yielded 7 t/ha in 1980 dry season, is resistant to brown planthopper biotypes 1 and 3, and moderately resistant to green leafhopper. The two most resistant lines are being tested for yield under black bug infestation in Palawan. □

Evaluation of germplasm accessions for green leafhopper (GLH) resistance

Q. M. A. Razzaque and E. A. Heinrichs, IRRI

From the IRRI germplasm collection, 204 GLH accessions with resistance to GLH *Nephotettix virescens,* brown planthopper, whitebacked planthopper, or leaffolder were evaluated for resistance to *N. nigropictus* (Stål) and *N. virescens* (Distant). Separate 60- × 40- × 10-cm seedboxes for each GLH species were used with IR29 as the resistant check and Nira as the susceptible check. Seven days after sowing, seedlings were thinned to 15-20 per entry and infested with 4-5 3d-instar nymphs per seedling. When Nira seedlings died, entries were rated for damage using the *Standard evaluation system for rice* 0-9 scale.

Sixty-five entries scored 0-5 for *N. nigropictus* and 105 for *N. virescens.* The entries were further evaluated in three replications. Susceptible entries (scores 6-9) were rejected.

Reactions to both GLH species were similar for many varieties. Fifty-one (25%)

Damage ratings of rice cultivars in seedbox screening for resistance to *N. nigropictus* and *N. virescens,* IRRI, 1983-84.

Cultivar	IRRI accession number	Origin	Damage rating[a] (grade 0-9)	
			N. nigropictus	*N. virescens*
Resistant to *N. nigropictus* and *N. virescens*				
Ari	25830	Bangladesh	3.7	2.4
Ashni	25831	Bangladesh	3.7	2.3
Aus Jhari	25833	Bangladesh	3.7	3.0
Bathuri	25838	Bangladesh	3.7	3.7
Chamka	25844	Bangladesh	3.0	3.7
Chiknal	25848	Bangladesh	3.0	3.0
Dhalashaita	25851	Bangladesh	2.3	3.0
Garia	25854	Bangladesh	1.3	2.3
Gungur Murali	25858	Bangladesh	3.0	3.0
Hasha	25861	Bangladesh	3.7	2.3
Hijolee	25862	Bangladesh	1.0	2.3
Pankhiraj	25911	Bangladesh	3.7	1.7
Terabali	25926	Bangladesh	3.7	1.7
Pahari Balam	31904	Bangladesh	3.0	3.7
D 59-6	33045	Bangladesh	3.0	3.0
Lalmoti	37522	Bangladesh	3.7	1.7
Kalimekri 77-5	37649	Bangladesh	3.7	3.0
Bow Pagal	43796	Bangladesh	3.0	3.0
Chakulia	43798	Bangladesh	3.7	3.0
Molica	43925	Bangladesh	3.0	3.0
Hnanwa Phingauk	4142	Burma	3.7	3.7
ASD7	6303	India	3.7	2.3
Shatika	35150	India	3.7	3.0
ARC14960	43034	India	3.0	3.0
Hassan Tareme	32311	Iran	3.7	3.0
Gadur	16246	Nepal	3.7	3.0
IR2034-289-1-1-1	32684	Philippines	3.7	3.0
Sulai	8908	Sri Lanka	1.7	1.7
Chianung Sen 11	26955	Taiwan	3.0	3.0

Cont'd

Cultivar	IRRI accession number	Origin	Damage rating[a] (grade 0-9)	
			N. nigropictus	*N. virescens*
Moderately resistant to N. nigropictus and N. virescens				
Gauk	33072	Bangladesh	5.0	5.0
Chini Atap	37403	Bangladesh	5.0	5.0
BR3	38625	Bangladesh	5.0	5.0
Dharia Bogi	43814	Bangladesh	5.0	5.0
Hanpa (Black)	43851	Bangladesh	5.0	4.0
Maguria	43921	Bangladesh	5.0	5.0
Sxc 108	35172	India	4.3	4.3
Amla	44932	India	5.0	5.7
I.B. Rose/Latisail	45848	India	5.0	5.0
Karpursail	46050	India	5.0	5.0
Rupsail	46586	India	5.0	5.0
Sachi	46612	India	5.0	5.0
Sadlaghu	46625	India	5.0	5.0
Intan	4230	Indonesia	5.0	5.0
Mas	5334	Indonesia	5.0	5.0
Dikwee	7814	Nigeria	4.3	5.0
Resistant to N. virescens and susceptible to N. nigropictus				
Chungur bali	25855	Bangladesh	6.3	3.0
Muijuri	25907	Bangladesh	7.0	1.7
Sona Biron	31633	Bangladesh	9.0	1.7
Lal Aswina	31670	Bangladesh	9.0	1.7
Molladiga	31675	Bangladesh	9.0	3.7
Kala Aman 961	32908	Bangladesh	7.0	3.7
Ellai	37424	Bangladesh	7.0	3.0
Lal paika	37523	Bangladesh	7.0	3.0
Laki 146	37709	Bangladesh	7.0	1.7
Dudhswar 15-146	37956	Bangladesh	7.0	1.7
Jessobalam 3-23	38009	Bangladesh	7.0	3.7
Latisail 11-122	38082	Bangladesh	9.0	3.0
Dhalgora	43813	Bangladesh	6.3	3.0
Ta-Poo-Cho z	4285	China	7.0	3.0
Ptb 20	5920	India	7.0	3.7
Katki	46091	India	7.0	3.0
Ratrio	28181	Pakistan	7.0	3.0
Milagrosa Mutant	26967	Philippines	7.0	3.7
IR5853-135-3-P3	39425	Philippines	7.0	3.0
IR5865-32-3	39434	Philippines	7.0	3.7
IR5896-10-2	39441	Philippines	7.0	3.0
Resistant to N. nigropictus and susceptible to N. virescens				
Najirsail	37237	Bangladesh	9.0	3.0
Peta	35	India	7.0	3.7
CO13	4897	India	9.0	3.7
ARC12176	41016	India	7.0	3.0
ARC14664	41672	India	7.0	3.0
Jessoa	45893	India	7.0	3.0
Katalgaria	46075	India	7.0	3.0
Bir-Co-Se-Mau 7	4349	China	6.3	3.7
IR2003-P7-7-4-2	32671	Philippines	9.0	3.7
IR2031-238-5-2-6-2	32680	Philippines	7.0	3.0
IR2070-464-1-3-6	32701	Philippines	9.0	3.7
IR42	36959	Philippines	7.0	3.7
Kosattawee	8927	Sri Lanka	6.3	3.7
Sir	Muragan36279	Sri Lanka	9.0	3.0

[a] 0 = highly resistant, 9 = susceptible.

were resistant (grades 1-3), 99 (48.5%) moderately resistant (grades 3.1-5), and 54 (26.5%) susceptible to *N. nigropictus* (scores 5.1-7); and 96 (47.1%) resistant, 38 (18.6%) moderately resistant, and 70 (34.3%) susceptible to *N. virescens* (see table). Twenty-nine cultivars were resistant to both species, 21 were resistant to *N. virescens* but susceptible to N. *nigropictus,* and 14 were resistant to N. *nigropictus* but susceptible to *N. virescens.* Accessions resistant to both leafhopper species should be considered for use as donors in the breeding program for GLH resistance. □

Screening for resistance of IR varieties to green leafhoppers (GLH)

Q. M. A. Razzaque and E. A. Heinrichs, IRRI

Several rices have been identified and incorporated in breeding programs in Asia for *Nephotettix virescens* resistance. Twenty-seven modern (IR5-IR62) rices with moderate to high levels of *N. virescens* resistance have been released.

We evaluated IRRI varieties IR5 to IR60 for resistance to *N. virescens* and *N. nigropictus,* another common rice green leafhopper, in a seedbox screening test. Separate seedboxes were used for each hopper species. Seeds were sown in rows in 60· × 40· × 10-cm seedboxes with Nira as the susceptible check. At 7 d after sowing seedlings were thinned to 15-20, entry and each was infested with 4-5 3d-instar nymphs of *N. nigropictus* or *N. virescens.* When the susceptible check died, test entries were rated for damage by the 1980 *Standard evaluation system for rice* (SES) 0-9 scale. Treatments were arranged in a complete randomized design with three replications.

Although the IR varieties were not bred for *N. nigropictus* resistance, levels of resistance were generally higher than

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.

Reactions of IR varieties to *N. nigropictus* and *N. virescens* in the seedbox screening test, IRRI, 1983-84.

Variety	Damage rating[a]	
	N. nigropictus	*N. virescens*
IR5	6.3 de	7.0 def
IR8	5.7 cde	6.3 cde
IR20	6.3 de	7.0 def
IR22	5.0 bcde	8.3 ef
IR24	4.3 bcd	4.3 abc
IR26	3.7 bc	5.7 bcd
IR28	3.0 b	3.7 ab
lR29	3.0 b	3.0 a
IR30	3.7 bc	3.0 a
IR32	4.3 bcd	6.3 cde
IR34	4.3 bcd	4.3 abc
IR36	3.0 b	6.3 cde
IR38	4.3 bcd	5.7 bcd
IR40	5.0 bcde	5.7 bcd
IR42	4.3 bcd	7.0 def
IR43	3.7 bc	4.3 abc
IR44	4.3 bcd	4.3 abc
IR45	4.3 bcd	5.7 bcd
IR46	5.7 cde	6.3 cde
IR48	5.0 bcde	7.0 def
IR5 0	4.3 bcd	3.7 ab
IR5 2	4.3 bcd	3.7 ab
IR54	4.3 bcd	3.7 ab
IR56	3.0 b	3.0 a
IR5 8	3.0 b	3.7 ab
IR60	3.0 b	3.0 a
Nira (susceptible check)	9.0 e	9.0 f

[a] Av of 3 replications. In a column, means followed by a common letter are not significantly different at the 5% level by Duncan's multiple range test. The damage rating is based on the 1980 SES 0-9 scale.

those to *N. virescens.* Twelve varieties had similar reactions to both species (see table). IR56, IR58, and IR60 are highly resistant to both *N. nigropictus* and *N. virescens.* They also have resistance to brown planthopper. □

Screening wild rices for resistance to green leafhopper (GLH)

Q. M. A. Razzaque and E. A. Heinrichs, IRRI

We screened 91 wild rices for resistance to GLH *Nephotettix nigropictus* (Stål) and *N. virescens* (Distant) using the seedbox test in the greenhouse. Separate seedboxes were used for each GLH species. Test entries were sown in 60- × 40- × 10-cm seedboxes with resistant IR29 and susceptible Nira. Each seedbox was a

Reaction of wild rices to *N. nigropictus* and *N. virescens* in the seedbox screening test, IRRI, 1983-84.

Species	Origin	IRRI acc. no.	Damage rating[a]	
			N. nigropictus	*N. virescens*
O. latifolia	Costa Rica	100168	1.0	1.0
O. latifolia	Guatemala	100172	1.0	1.0
O. officinalis	Japan	100179	1.0	0.7
O. officinalis	Malaya	100180	1.7	2.0
O. officinalis	Burma	100181	1.0	1.7
O. sativa/O. rufipogon	India	100183	2.0	4.3
O. ridleyi	Taiwan, China	100820	0.7	0.7
O. ridleyi	Taiwan, China	100821	3.0	1.0
O. officinalis	India	100883	1.0	1.7
O. latifolia	India	100885	1.0	1.0
O. minuta	India	100887	1.0	1.0
O. latifolia	India	100890	1.7	0.7
O. latifolia	India	100891	1.7	1.7
O. punctata	India	100892	5.7	1.7
O. latifolia	USA	100895	1.7	1.0
O. officinalis	Thailand	100896	1.0	1.7
O. latifolia	Mexico	100914	1.0	0.7
O. sativa/O. nivara	Cambodia	100917	1.7	3.7
O. punctata	Ghana	100937	1.0	1.7
O. officinalis	India	100947	3.0	1.7
O. officinalis	India	100948	1.0	2.3
O. officinalis	India	100953	1.0	2.7
O. latifolia	India	100956	1.0	0.7
O. latifolia	Mexico	100959	3.7	1.0
O. latifolia	Guatemala	100962	3.7	1.0
O. latifolia	Guatemala	100963	1.0	1.0
O. latifolia	Guatemala	100964	3.7	0.7
O. latifolia	Costa Rica	100965	5.0	0.7
O. latifolia	Panama	100966	1.0	0.7
O. officinalis	Philippines	100973	3.7	1.7
O. officinalis	Philippines	101073	3.7	1.7
O. officinalis	Philippines	101074	3.0	2.3
O. officinalis	Philippines	101077	5.7	1.7
O. officinalis	Philippines	101078	5.0	1.7
O. minuta	Philippines	101081	4.3	1.7
O. minuta	Philippines	101082	5.0	1.7
O. minuta	Philippines	101084	5.7	1.7
O. minuta	Philippines	101086	5.0	1.7
O. minuta	Philippines	101089	5.7	0.7
O. minuta	Philippines	101094	6.3	1.0
O. minuta	Philippines	101096	3.7	0.7
O. minuta	Philippines	101097	0.7	0.7
O. minuta	Philippines	101099	3.7	0.7
O. minuta	Philippines	101100	3.7	1.0
O. minuta	Philippines	101101	3.0	0.7
O. officinalis	Philippines	101112	3.0	0.7
O. officinalis	Philippines	101113	5.7	0.7
O. officinalis	Philippines	101114	4.3	1.0
O. officinalis	Philippines	101115	1.3	1.0
O. officinalis	Philippines	101117	6.3	0.7
O. officinalis	Philippines	101118	5.7	1.0
O. officinalis	Philippines	101121	7.7	0.7
O. minuta	Philippines	101122	3.7	0.7
O. minuta	Philippines	101123	4.3	1.0
O. minuta	Philippines	101124	3.0	1.0
O. minuta	Philippines	101125	5.7	1.0
O. minuta	Philippines	101126	4.3	0.7
O. minuta	Philippines	101128	5.3	1.0
O. minuta	Philippines	101129	5.7	1.0
O. minuta	Philippines	101132	3.0	0.7
O. minuta	Philippines	101133	5.0	0.7
O. officinalis	Philippines	101137	3.0	1.0
O. officinalis	Philippines	101139	3.0	1.0
O. minuta	Philippines	101141	3.0	0.7
O. officinalis	Philippines	101142	5.7	0.7
O. minuta	Philippines	101143	1.3	0.7
O. officinalis	Malaysia	101149	3.0	1.0
O. officinalis	Malaysia	101150	1.3	0.7

Cont'd

Species	Origin	IRRI acc. no.	Damage rating [a]	
			N. nigropictus	*N. virescens*
O. officinalis	Malaysia	101152	4.3	1.0
O. officinalis	Malaysia	101154	5.0	1.0
O. officinalis	Malaysia	101155	4.3	1.0
O. officinalis	Philippines	101166	5.7	1.0
O. punctata	Tanzania	101171	6.3	1.7
O. punctata	Nigeria	101329	7.0	1.7
O. minuta	Japan	101386	7.7	3.3
O. minuta	Japan	101387	7.7	1.7
O. latifolia	Guatemala	101392	1.3	1.0
O. alta	USA	101395	3.0	0.7
O. officinalis	Vietnam	101399	5.0	1.7
O. punctata	Ghana	101408	5.0	1.0
O. punctata	Ghana	101409	3.7	0.7
O. officinalis	India	101412	4.3	1.7
O. officinalis	India	101414	4.3	1.7
O. punctata	Kenya	101417	4.3	0.7
O. eichingeri	Uganda	101422	5.7	1.7
O. eichingeri	Uganda	101426	4.3	1.7
O. punctata	Tanzania	101434	3.0	1.3
O. punctata	Ghana	101439	5.0	1.0
O. latifolia	Mexico	101443	0.3	0.7
O. officinalis	Indonesia	102382	3.7	1.3
O. latifolia	Nicaragua	102481	0.3	1.0
O. sativa (Nira)	India	1748 (susceptible check)	9.0	9.0
O. sativa (IR29)	Philippines	30414 (resistant check)	3.7	3.7

[a] Av of 3 replications. Damage rating is based on 0-9 scale.

replication. At 10-15 d after seeding, seedlings were infested with 4-5 3d-instar GLH nymphs per seedling. When Nira seedlings died, test entries were rated for damage using the *Standard evaluation system for rice* 0-9 scale. Each entry was replicated three times.

N. nigropictus is more virulent and caused more damage to wild rices than *N. virescens*. Of the 91 wild rices, 53 (59%) were resistant (score 0-39), 31 (33%) were moderately resistant (score 4.0-5.9), and 7 (8%) were susceptible (score 6.0-9) to *N. nigropictus* (see table). All but one of the wild rices were resistant to *N. virescens*.

When the IR varieties *(Oryza sativa)* were screened for GLH resistance in another test, *N. virescens* was generally more virulent. Also, the weed *Leersia hexandra* was a better host for N. nigropictus than for *N. virescens*. Thus, *N. nigropictus* is better adapted to feeding on wild rices and *L. hexandra* than on cultivated rice. □

Screening for green leafhopper (GLH) resistance

Q. M. A. Razzaque and E. A. Heinrichs, IRRI

We screened 18 rices with genes for resistance to *Nephotettix virescens* (Distant) for resistance to *N. nigropictus* (Stål) and *N. virescens* using the seedbox screening test. Test entries were sown in 60- × 40- × 10-cm seedboxes with IR29 as the resistant check and Nira as the susceptible check. Separate seedboxes were used for each hopper species. Seven days after seeding (DAS), seedlings were thinned to 15-20 per entry and infested with 4-5 3d-instar nymphs per seedling of each species. When all susceptible check seedlings died, entries were rated for damage using the *Standard evaluation system for rice* 0-9 scale.

All the rices with genes for *N. virescens* resistance were resistant (rating of 3-3.7) or moderately resistant (rating 4.3-5.7) to *N. nigropictus*. Jhingasail, Lien-tsan 50, Arai, IR30, and TAPL #796 were resistant and six rices were moderately resistant to both hopper species (see table). In general, reactions to both species were similar, except for IR36 and IR42, which had higher damage when infested with *N. virescens*. □

Reaction of rice cultivars with genes for *N. virescens* resistance when infested with *N. nigropictus* or *N. virescens* in the seedbox screening test, IRRI, 1983-84.

Variety	Origin	Gene	Damage rating [a]	
			N. nigropictus	*N. virescens*
Pankhari 203	India	*Glh* 1	3.0 bc	3.3 ab
Jhingasail	Bangladesh	*Glh* 2	3.0 bc	3.7 bc
Lien-tsan-50	China	*Glh* 2	3.0 bc	3.7 bc
ASD7	India	*Glh* 2	4.3 cde	3.7 bc
Godalki	Bangladesh	*Glh* 2	5.7 ef	5.0 bcd
Palasithari 601	Sri Lanka	*Glh* 2	5.0 def	3.0 a
H5	Sri Lanka	*Glh* 3	2.3 bc	6.3 cd
DNJ 97	Bangladesh	*Glh* 3	4.3 cde	3.7 bc
IR8	Philippines	*Glh* 3	5.7 ef	5.7 bcde
Arai	Bangladesh	*Glh* 3	3.7 cd	3.7 bc
IR30	Philippines	*Glh* 3	3.0 bc	3.0 a
Ptb 8	India	*glh* 4	3.7 cd	5.7 bcde
IR42	Philippines	*glh* 4	3.7 cd	7.0 cde
ASD8	India	*Glh* 5	5.0 def	3.0 a
IR36	Philippines	*Glh* 6	3.0 bc	7.0 cde
Ptb 18	India	*Glh* 6	4.3 cde	5.7 bcde
TAPL #796	Bangladesh	*Glh* 6	1.7 a	3.7 bc
Moddai Karuppan	Sri Lanka	*Glh* 7	3.0 bc	5.7 bcde
IR29 (resistant check)	Philippines	–	3.0 bc	3.7 bc
Nira (susceptible check)	India	–	9.0 f	9.0 e

[a] In a column, means followed by a common letter are not significantly different at the 5% level by Duncan's Multiple Range Test. Damage rating is based on a 0-9 scale. Av of 3 replications.

Genetic Evaluation and Utilization
ADVERSE SOILS TOLERANCE

Usar 1, a salinity- and alkalinity-tolerant rice for Uttar Pradesh

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Usar 1, a medium-maturing salinity- and alkalinity-tolerant rice variety, was released in May 1984 for cultivation in Uttar Pradesh. It was developed in Kanpur from Jaya/Getu and tested in the All India Coordinated Saline-Alkaline Resistance Varietal Trials in 1980-82 (Table 1) and in station trials from 1978 to 1983 (Table 2). Usar 1 is semitall, tillers moderately, matures in 128-135 d, and has high yield potential. Grains are short and bold with good cooking quality. It is resistant to bacterial leaf blight and bacterial leaf streak, and moderately resistant to major insect pests. Usar 1 is a good substitute for Jaya and traditional varieties in alkaline areas. □

Table 2. Performance of Usar 1 in state and coordinated varietal trials. UP, India.

Year and location	Yield (t/ha)		CD at 5%	Days to maturity		pH
	Usar 1	Jaya		Usar 1	Jaya	
Daleep Nagar, Kanpur						
1978	2.9	1.7	0.5	132	134	9.3
1979	3.7	2.1	0.6	133	134	9.5
1980	1.5	0.6	0.8	135	136	9.2
1981	5.3	4.6	1.1	132	135	9.1
1982	4.0	3.5	0.7	134	134	9.6
1983	4.2	3.5	0.8			
Kumarganj, Faizabad						
1978	3.0	2.0	0.4	128	132	9.1
1980	4.0	2.8	0.6	132	135	9.5
1981	4.0	3.5	0.5	134	136	9.5
1982	3.8	3.3	0.9	140	145	9.5

Table 1. Grain yield and ancillary characters of Usar 1 and Jaya at various locations, All India Coordinated Rice Improvement Trial, 1982 kharif. [a] UP, India.

Variety	Grain yield (t/ha)							Days to 50% flowering	Panicles/m^2
	Alkaline locations			Saline locations					
	Raipuram	CSSRI Karnal	Kumarganj Faizabad	Pondicherry	Panvel Raigarh	Keshpur	Vytilla		
Usar 1	1.7	3.4	3.8	0.9	2.4	1.1	9.5	101	348
Jaya	1.5	2.2	3.3	1.94	2.6	0.3	6.6	106	249
CD at 5%	ns	1.3	0.9	0.7	0.8	0.4	ns		
pH	9.5	9.1-9.8	9.6	na	7.5	6.0	na		
Ec	3.5	na	1.2	na	2.5-5.2	3.5-5.0	na		

[a] ns = nonsignificant, na = not available.

Genetic Evaluation and Utilization
HIGH TEMPERATURE

Tolerance of two rice lines for high temperature at meiosis and anthesis

D. R. Khan, research scholar, and D. J. Mackill, associate plant breeder, IRRI

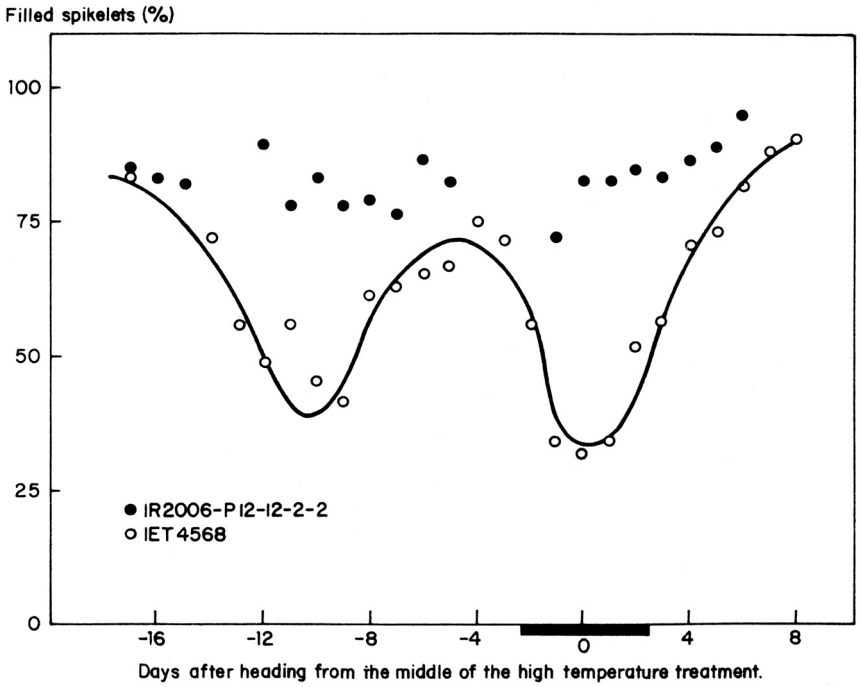
Growth chamber and field experiments have shown that rice plants are susceptible to high temperatures at reproductive stage. Studies at IRRI have shown that rice plants are most sensitive to high temperature during anthesis, and are slightly less sensitive about 10 d before flowering (booting or meiotic stage). Several varieties with tolerance for high temperature during anthesis have been identified. The most common tolerance mechanism appears to be the ability to maintain high anther dehiscence and pollen shedding at high temperatures. The relation between tolerance at anthesis and tolerance at meiotic stage has not been determined. We compared tolerance at those growth stages.

Four rice varieties were planted in 3.8-litre pots in the IRRI phytotron on 2 dates in 2 replications. Treatments were control (29ºC day/21ºC night), 35ºC/27ºC for 5 d during flowering, and 35ºC/27ºC for 5 d beginning about 12 d before flowering. Each pot had 20 plants, tillers of which were trimmed to leave 1 main culm per plant. Flowering dates of each panicle were recorded.

Because it was difficult to time the heat treatment during meiotic or booting stage, only two varieties gave sufficient data over all dates of the experiment. The average percentage of filled grains for panicles flowering on different dates is shown in the figure. Data from both high temperature treatments were combined. At least three panicles were used for each average. Those flowering after the temperature treatment are on the negative side of 0 in the figure (treated before flowering) and those flowering before the treatment are on the positive side.

IET4568 was moderately tolerant in a previous study, but was relatively susceptible in this study. The two most susceptible stages were anthesis and about 10 d before anthesis, which confirms previous results. IR2006-P12-12-2-2 was highly tolerant of high temperature at anthesis in previous studies. In this study, it was tolerant at anthesis and meiotic stages.

In control treatments, IET4568 had an average fertility of 74% and IR2006 had an average of 92%, confirming earlier studies showing that heat-tolerant varieties have higher fertility even under control conditions. It is not clear if the tolerance mechanism is the same for both stages. It may be that the high anther dehiscence of IR2006 allows it to overcome the high temperature damage caused during the meiotic stage, as well as at anthesis. This line should be an excellent donor of high temperature tolerance for breeding programs for semi-arid countries where temperature is high during flowering. □



Average filled spikelets percentage for panicles flowering on different days in relation to a high temperature treatment. The 5 d treatment of 35/27°C was given on days -2 to 2, and is shown by the shaded bar.

Genetic Evaluation and Utilization
COLD TOLERANCE

Assessment of cold tolerance of Korean rice varieties by chlorophyll fluorescence analysis

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Visual assessment of cold injury based on chlorosis, browning, leaf rolling, and necrosis of rice leaves is subjective and time-consuming, especially because some of the symptoms appear only after prolonged cold or when temperatures rise. We evaluated the potential of chlorophyll fluorescence analysis for quantitative assessment of cold damage because it is quick and can detect damage before visual symptoms appear.

When a leaf is illuminated, the chlorophyll in the membranes of the chloroplasts emits a red fluorescence of which a part, the variable chlorophyll fluorescence, is responsive to photosystem II activity. Any stress such as cold, frost, drought, or pollutants that affects photosynthetic metabolism is likely to change the fluorescence. We measured fluorescence with a plant productivity fluorimeter. The machine uses a probe that is placed on the adaxial surface of the leaf to provide the illumination and collect the fluorescent light.

In the experiment, we chilled 11 Korean rices with a range of chill sensitivity for 8 d at 10°C, 85% relative humidity, under a 12-h day cycle at 30,000 lux. The plants were 60 d old and were grown in the glasshouse in Jul and Aug. For each variety, 5 flag leaves were randomly selected and 3 readings made at the leaf base, middle, and tip. The values are the mean of 15 readings. Fluorescence measurements were made after 5 h dark acclimation at 27°C for the controls and at 10°C for the chilled plants.

Changes in fluorescence emission occurred during the first 3 s after illuminating a dark-adapted leaf (Fig. 1). Light caused the chlorophyll fluorescence to rise immediately to 0 and this initial level is termed F_0. Fluorescence slowly increased to a peak F_{max}, which is attained at p. For quantifying cold injury, the rate of rise of variable chlorophyll fluorescence (F_R) is the most important parameter and can be calculated by drawing a straight line to

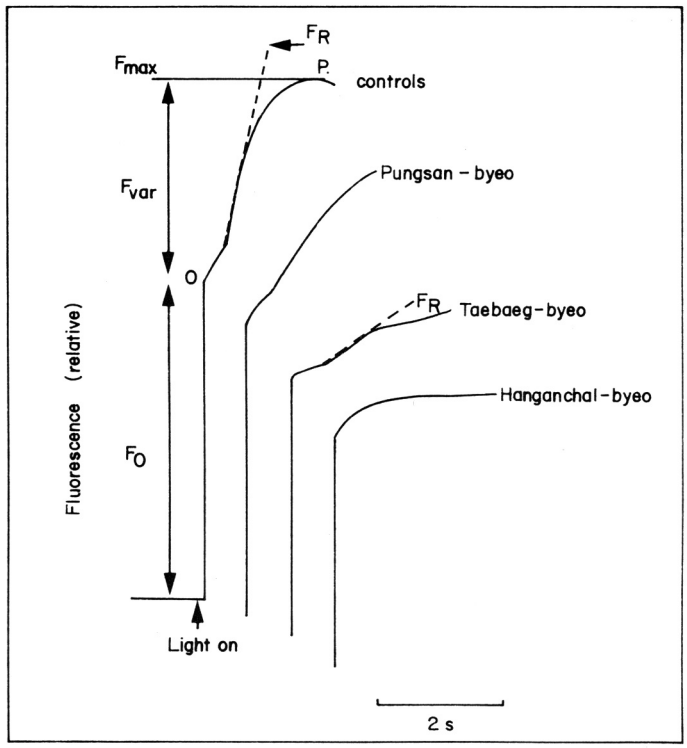
the linear part of the fluorescence rise as indicated by the dashed line in Figure 1. Figure 1 also shows that both the rate of F_R and maximum fluorescence yield (F_{var}) declined after 8 d chilling at 10°C in the varieties Pungsan-byeo, Taebaeg-byeo, and Hanganchal-byeo.

Figure 2 compares the changes in chlorophyll fluorescence (as a percentage of the control at 27°C) after 8 d chilling at 10°C with the visual estimation of cold damage made on a 1 to 9 scale at the end of chilling. The japonica varieties Samnam-byeo (10) and Sangpung-byeo (11) were the most cold tolerant. Their fluorescence increased 23-34% during chilling. In contrast, indica/japonica varieties Taebaeg-byeo (l), Milyang 77 (9), Hanganchal-byeo (6), and Chupung-byeo (4) were the most susceptible to cold and F_R decreased 77, 89, 95, and 98% compared to the controls. The more cold-tolerant indica/japonica varieties tested had smaller decreases in chlorophyll fluorescence, which agreed with visual observations of injury (Fig. 2).

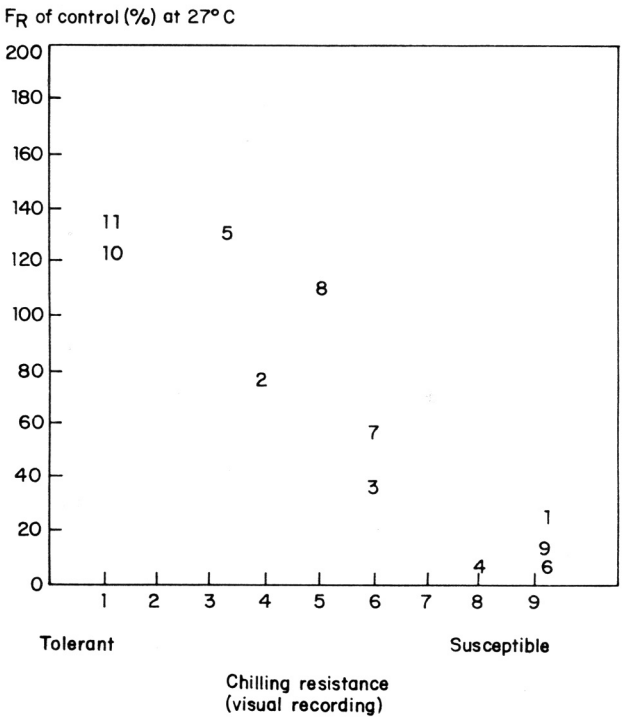
The increases in fluorescence of the more cold tolerant varieties Milyang 23 (7), Baegyang-byeo (8), Samnam-byeo (l0), and Sangpung-byeo (11) after chilling are unusual and have not been reported. The increases can be interpreted as indicating acclimation or hardening to low temperatures and may be the result of increased chlorophyll content of the leaves at 10°C.

The agreement between changes in fluorescence and visual symptoms of cold injury indicates that chlorophyll fluorescence analysis could help plant breeders quickly screen large numbers of plants for cold tolerance. It is a sensitive, rapid, reproducible, nondestructive, and inexpensive technique.

Further evaluation of the chlorophyll fluorescence technique is needed in relation to plant development stage, sensitivity to other environmental factors, and different temperature treatments. The ability to detect cold damage to the thylakoid membranes by chlorophyll fluorescence analysis should not only be useful to plant breeders but also provide plant physiologists with insight into the causes and mechanisms of cold injury and hardening. □



1. Changes in the chlorophyll fluorescence kinetics of rice leaves of 3 varieties after 8 d chilling at 10°C, 85% relative humidity. The results are the mean measurements of 15 replications.



2. Changes in the rate of rise of variable fluorescence (F_R) of the leaves of 11 rice varieties (expressed as a percentage of the control at 27°C) after 8 d chilling at 10°C, 85% relative humidity compared with a visual assessment of injury on a 1 to 9 scale. 1) Taebaeg-byeo (I/J), 2) Chung-chung-byeo (I/J), 3) Pungsan-byeo (I/J), 4) Chupung-byeo (I/J), 5) Milyang 23 (I/J), 6) Hangan-chalbyeo (I/J), 7 Manseog-byeo (I/J), 8) Baeuang-byeo (I/J), 9) Milyang 77 (I/J), 10) Samnam-byeo (J), 11) Sangpung-byeo (J). I or J indicates whether variety is an indica or japonica or a cross between the 2.

A modified technique of screening for cold tolerance in rice

R. N. Kaw and G. S. Khush, IRRI

At IRRI, we measure cold tolerance by the degree of discoloration of 10-d-old seedlings treated with 12°C water for 10 d. Although this screening method quickly discriminates between cultivars that remain green and those that turn yellow and die, it does not allow breeding materials to be ranked in relative order of hardiness, nor does it consider variations

Correlation coefficients between tolerance index and other attributes. IRRI, 1985.

Character	TI based on recovery 5 DAT	TI based on recovery 10 DAT	TI based on survival at second treatment	Recovery 5 DAT (% of resistant check)	Recovery 10 DAT (% of resistant check)	Survival on recovery 10 DAT (% of resistant check)	Cold tolerance score at first treatment
TI based on recovery 10 DAT	0.9960**						
TI based on survival at second treatment	0.7373**	0.7476**					
Recovery 5 DAT (% of resistant check)	0.8837**	0.8840**	0.6493**				
Recovery 10 DAT (% of resistant check)	0.8818**	0.8936**	0.6669**	0.9898**			
Survival on recovery 10 DAT (% of resistant check)	0.7305**	0.7404**	0.9474**	0.6753**	0.6898**		
Cold tolerance score at first treatment	–0.9677**	–0.9691**	–0.7117**	–0.8308**	–0.8410**	–0.7030**	
Cold tolerance score at second treatment	–0.8183**	–0.8283**	–0.9497**	–0.7275**	–0.7443**	–0.9427**	0.7865**

between tests. Cultivars rated tolerant (1-3) commonly vary in survival and recovery from cold. Survival or recovery is proportional to the condition of crop growth and inversely proportional to cold duration and intensity.

We screened 102 hybrids and their 23 parents for cold water tolerance at seedling stage. Objectives were to rank them by cold hardiness and to develop a way to quantify rice cold tolerance.

Twelve presprouted seeds, 1 row per culture, were grown in the greenhouse in porcelain trays for 10 d, then put in 12°C water tanks for 10 d. Every tray had 1 row each of susceptible IR8 and resistant Fujisaka 5. There were three replications. Plants per row were recorded before treatment. After 10 d, plants were scored, based on discoloration, by the *Standard evaluation system for rice.*

Plants were placed in the greenhouse and scored for recovery at 5 and 10 d after treatment (DAT) using a 0-1 scale (0 = dead, 0.5 = severely damaged but living, 1 = slight or no damage). The sum of scores on about 12 plants/test culture per replication was converted to a percentage of the average score of Fujisaka 5. Most F_1 hybrids recovered rapidly.

The test cultures underwent a second 10-d cold water treatment and were again rated for survival. Green seedlings had variable survival. It was difficult to discriminate cold tolerance of test cultures by leaf discoloration score alone and to rate them by cold hardiness as many cultures and Fujisaka 5 scored the same.

We developed a tolerance index (TI) to express leaf discoloration and survival/recovery percentage relative to the resistant check as a measure of cold tolerance:

$$TI = \frac{gi2}{gi\ 1} \times \frac{100}{Ld\ 1} \Big/ \frac{C2}{C1} \times \frac{100}{Ld2}$$

where gi 1 = number of plants before treatment,
gi 2 = number of plants after treatment,
Ld 1 = leaf discoloration score of the test culture,
Ld 2 = leaf discoloration score of the resistant check,
C1 = number of plants in the resistant check before treatment, and
C2 = number of resistant check plants that survived or recovered.

The formula can be rewritten as:

$$TI = \frac{gi\ 2 \times Ld\ 2 \times C1}{gi\ 1 \times Ld\ 1 \times C2}$$

Correlation coefficients between TI and other components and among the components are in the table. Associations between all attributes were highly significant. The highest correlation (0.996) was between TI at recovery 5 DAT and TI at recovery 10 DAT, followed by a strong association of cold tolerance score at first treatment with TI based on recovery at 10 DAT (–0.9691) and recovery 5 DAT (–0.9677). TI based on survival at second treatment was highly correlated with cold tolerance score at second treatment (–0.9497) and with survival on recovery 10 DAT (0.9474).

We found that TI is a good indicator of cold tolerance stability, and concluded that one cold-water screening of seedlings based on TI would adequately rank the cultivars for cold tolerance.

Computation of TI values would eliminate variations between flats treated alike, and would also allow comparison between tests. The TI will equal unity if leaf discoloration scores and survival rates of the test cultivars and the resistant check are the same. A value > 1 will denote better cold tolerance than the check. TI data can be analyzed by analysis of variance and LSD. The TI may be appropriate for evaluating varieties and breeding lines for reaction to other stresses. □

Genetic Evaluation and Utilization
DEEP WATER

Effect of stem borer (SB) at different internodes of deep water rice

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We studied the effect of SB *Scirpophaga incertulas* on growth and yield of deep water rice. The crop was grown on a 0.2-ha field that was thoroughly plowed before planting in 1983 kharif.

Photoperiod-sensitive Jaladhi 1 was direct-seeded in early Jun. Soil was a clay loam with pH 7.0-7.5. Farmyard manure at 10 t/ha was applied at land preparation, and standard cultivation was practiced. Weekly water level was recorded. Maximum depth was 160 cm in mid-Oct. The crop was harvested in late Dec and plant samples were collected.

SB damage was determined based on borer infestation at different internodes and their effect on growth and yield of the infested shoot. Plants were divided into three groups

- those without SB damage,
- those with SB damage only on the terminal internode, and
- those with SB at the 2d to 12th internodes.

For each group, 20 plants were randomly selected from the deep water plot and uprooted. Main stem performance was analyzed.

Growth and yield of healthy and SB-infested deep water rice plants, West Bengal, India.

Character	Healthy	Infested plants		CD at 5%
		Terminal internode	Other internodes	
Plant height (cm)	315	303	305	ns
Stem length (cm)	289	268	279	ns
Internodes (no.)	15	16	15	ns
Panicle length (cm)	26	26	25	ns
Spikelets (no.)	181	175	147	25
Grain sterility (%)	19	100	30	3
100-grain weight (g)	2.1	–	2.1	ns
Grain yield (g)	3.1	–	2.2	0.7
Fresh weight (g)	24.4	33.2	24.4	7.8
Dry weight (g)	9.5	9.4	8.2	ns
Water content (g)	14.9	23.8	16.2	6.3

Although plants without SB damage had better plant height, stem length, internode number, and dry weight, they were not significantly different from infected plants. Fresh weight and water content were significantly different at different infestation levels (see table). Panicle emergence and length did not vary significantly between infestations.

SB infestation significantly affected most yield characters. Plants with infestation between the 2d and 12th internodes yielded some grain, but with infestation of the terminal internode there was no yield. Infestation reduced the number of filled grains per panicle, not 100-grain weight (see table).

Feeding in the inner tissues of terminal internodes stopped grain filling and withered apical plant parts. When submerged lower internodes were infested, reproductive growth, vigor, dry matter accumulation, and grain yield declined, but results were not so serious as with later infestation.

The thick cortex and enlarged parenchymatous cells in lower internodes prevent SB from boring into the vascular tissue and appreciably disturbing the ascent of sap and translocation of solutes. Additionally, infestation of lower internodes causes development of aquatic roots that absorb nutrients. □

Genetic Evaluation and Utilization
RAINFED

Early rices for rainfed uplands

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At NDUAT we have identified three new rice lines with good production potential. NDR84 (IET7988) and NDR85 (IET7989)

Table 1. Performance of some elite lines at Faizabad under direct seeded rainfed upland culture in wet season 1981 to 1983.

Line, variety	Maturity (d)	Plant height (cm)	Grain type	Yield (t/ha)			
				1981	1982	1983	Mean
NDR84	99	78	Long slender	3.4	3.4	4.6	3.8
NDR85	93	87	Long slender	4.2	3.2	3.7	3.7
NDR118	95	83	Longslender	–	3.8	4.7	4.2
N22 (local tall check)	85	100	Short bold	2.4	2.1	3.5	2.7
Cauvery (semidwarf check)	99	84	Short bold	2.2	2.8	2.7	2.6
CD 0.05				0.8	0.3	0.6	
Rainfall (mm)				1488	1169	1261	
Sowing date				1 Jul 81	21 Jun 82	9 Jul 83	

Table 2. Performance of some elite lines in AICRIP trials under direct seeded rainfed upland conditions in India in 1982 and 1983 wet season.

Location	Yield (t/ha)					CD 0.05	Wet season rainfall (mm)
	NDR84	NDR85	NDR118[a]	Akashi	Cauvery		
			1982				
Faizabad, Uttar Pradesh	5.2	4.8		4.6	3.5	0.7	1082
Varanasi, Uttar Pradesh	4.1	4.6		4.2	4.0	1.2	851
Nagina, Uttar Pradesh	4.6	3.8		1.2	4.3	1.2	948
Ranchi, Bihar	1.7	2.8		1.2	1.9	0.8	794
Hazaribagh, Bihar	3.1	2.6		2.9	2.8	0.5	774
Jabalpur, Madhya Pradesh	4.5	4.3		3.9	4.4	1.2	–
Jeypore, Orissa	3.4	5.1		3.0	1.2	1.5	1417
Mean	3.8	4.0		3.0	3.16		
			1983				
Faizabad, Uttar Pradesh	5.8	3.6	5.4	2.5	3.1	0.61	1261
Nagina, Uttar Pradesh	2.5	4.2	4.9	2.4	0.7	1.57	599
Ranchi, Bihar	2.3	3.4	2.1	2.0	0.9	0.64	1108
Hazaribagh, Bihar	1.8	2.7	2.4	1.7	1.2	0.12	914
Jabalpur, Madhya Pradesh	2.9	2.6	3.5	2.7	1.7	1.00	1504
Rewa, Madhya Pradesh	2.0	2.7	2.6	1.7	1.2	0.48	1263
Bhuwaneshwar, Orissa	2.4	1.5	1.9	1.2	1.1	1.15	–
Bankura, West Bengal	1.9	2.1	1.2	1.2	1.5	0.18	916
Hathwara, West Bengal	2.0	2.9	2.9	–	1.3	1.03	898
Karimganj, Assam	4.5	3.7	2.8	2.6	1.9	0.55	
Titabar, Assam	1.7	1.2	1.3	0.7	1.6	0.73	293
Karjat, Maharastra	3.4	1.5	2.7	1.4	2.0	0.52	–
Dhaulakuwan, Maharastra	2.4	3.0	2.8	1.3	1.7	1.12	–
Mean	2.7	2.7	2.8	1.8	1.5		

[a] Not grown in 1982.

are sister selections from N22/IR2071-625-252 (IR36), and NDR118 (IET8681) is a selection from IR2071- 625-252/Hansraj 'A'. The lines have semidwarf stature and long slender grains. They consistently outyielded the tall local check N22 and the semidwarf national check Cauvery at Faizabad from 1981 to 1983 (Table l), and are resistant to most foliage diseases. They also were tested at other locations in 1982 and 1983 wet seasons under the All-India Coordinated Rice Improvement Program (AICRIP), and performed better than varieties Akashi and Cauvery (Table 2).

NDRll8 is a 95-d variety and thus suitable for rotation with wheat, potato, mustard, and vegetables in north central India. □

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Screening rices for rainfed direct-seeded upland cultivation

R. Ghosh, A. Ghosh, C. Kundu, and S. Biswas, Rice Research Station, Chinsurah, India

In West Bengal, upland rice depends mostly on premonsoon rain. The cropping season is from Mar to Sep, depending on the onset of premonsoon rains. Average yield is 1.4 t/ha because of the harsh environment and lack of suitable varieties. The following limit crop growth and productivity:

- drought during vegetative phase or ripening,
- weeds,
- difficult fertilizer management because of rapid water percolation, and
- poor recovery after drought.

We screened 18 varieties, with Dular as trial check, for performance under different climatic conditions in 1982–83.

In 1982, most study sites had frequent, severe drought spells in vegetative and

Mean yield and frequency distribution of yield, West Bengal, India.

Variety	Frequency distribution of yield in t/ha						Mean yield (t/ha)
	<1.0	<1.5	<2.0	<2.5	<3.0	>3.0	
				1982			
BG367-4	3	2	0	1	1	0	1.3
BG367-7	4	0	0	2	0	1	1.4
B9c-Md-3-3	3	1	1	1	1	0	1.5
BKNLR75091 CNT-B3-RST-40-2-2	3	1	1	1	0	1	1.4
BW242-5-5	3	1	0	2	1	0	1.5
CR237-1	3	2	1	1	0	0	1.2
Dular	2	2	1	2	0	0	1.5
IET7255	4	1	1	0	1	0	1.2
IET7259	3	0	1	1	1	1	1.8
IR50	2	2	3	0	0	0	1.1
IR9209-47-1-1-6-2	3	1	0	2	1	0	1.4
IR9279-67-3	3	1	0	2	1	0	1.5
IR9708-51-1-2	4	0	1	2	0	0	1.2
IR8608-189-2-2-1-3	3	1	0	1	2	0	1.5
IR13204-24-1-6	3	1	2	1	0	0	1.2
Kiran	2	0	1	3	1	0	1.8
Panke	3	0	1	0	2	1	1.9
Suweon	287 3	1	2	0	1	0	1.4
Mean							1.4
CD at 5%							0.4
				1983			
BG 367-4	0	1	3	3	1	1	2.2
BG367-7	1	1	3	1	1	2	2.5
B9c-Md-3-3	1	2	1	2	1	2	2.0
BKNLR75091 CNT-B3-RST40-2-2	0	3	2	0	1	3	2.3
BW242-5-5	2	2	1	4	0	0	1.7

Cont'd

Variety	Frequency distribution of yield in t/ha						Mean yield
	<1.0	<1.5	<2.0	<2.5	<3.0	>3.0	(t/ha)
CR231-1	1	3	3	0	2	1	1.9
Dular	2	1	1	2	2	1	2.1
IET7255	2	2	2	0	2	1	1.8
IET7259	2	1	2	2	0	2	2.0
IR50	1	1	5	0	0	2	1.8
IR9209-47-1-1-6-2	2	1	3	2	0	1	1.7
IR9729-67-3	2	0	2	2	1	2	2.2
1R9708-51-1-2	1	3	1	4	0	0	1.8
IR8608-189-2-2-1-3	2	1	3	1	1	1	1.7
IRl3204-24-1-6	1	3	2	2	1	0	1.7
Kiran	1	3	2	1	0	2	2.1
Panke	1	1	5	0	0	2	2.0
Suweon 287	1	2	3	1	1	1	1.8
Mean							2.0
CD at 5%							0.2

reproductive phases. Panke, an indigenous genotype, yielded an average 1.9 t/ha (see table).

In 1983, the environmental conditions were more favorable. BG367-7 yielded highest, 2.5 t/ha followed by BKNLR-75091 and BG367-4 (see table). Of the varieties tested, Panke, Kiran, and IET7259 had the most stable yields. □

Genetic Evaluation and Utilization

HYBRID RICE

Evaluation of F_1 hybrids on the Cuu Long Delta, Vietnam

Nguyen Van Luat, Bui Ba Bong, and J. Chandra Mohan, Cuu Long Delta Rice Research Institute (CLRRI), Omon, Hau Giang, Vietnam

We evaluated six F_1 hybrids developed at CLRRI in 1984 dry season in a randomized block design with three replications. There were eight 4-m-long rows per plot. Plants were transplanted at 20- × 15-cm spacing, and received 75-26-25 kg NPK/ha.

The F_1 hybrids had negative heterobeltiosis in plant height, panicles/m^2, grains/panicle, and sterility and positive heterobeltiosis in 1,000-grain weight (Table 1).

Table 1. Standard heterosis and heterobeltiosis in yield of F_1 hybrids, Omon, Vietnam, 1984.

Hybrid	Standard heterosis (compared with NN3A)	Heterobeltiosis
V20A/NN4B	+16.45	+33.19
Zhen Shan 97A/NN4B	+0.54	+17.57
Zhen Shan 97 A/NN3 A	–12.53	–12.53
V20A/NN3A	–33.39	–33.39
Zhen Shan 97A/IR54	–51.75	–51.99
V20A/IR54	–55.81	–58.97

Only V20A/NN4B and Zhen Shan 97A/NN4B performed better than the best parents. They yielded 6.5 and 5.6 t/ha (Table 2). These hybrids had positive standard yield heterosis and heterobeltiosis (Table 1) compared with commercial NN3A. V20A/NN4B and Zhen Shan 97A/NN4B yielded 46% more. Other hybrids did not yield well. Generally, the F_1 hybrids yielded poorly because of a genetic defect in cytoplasmic male sterile (cms) lines used.

Table 2. Performance of F_1 hybrids in Oman, Hau Giang, Vietnam, 1984 dry season.

Hybrid and check varieties	Duration (d)	Plant ht (cm)	Pan/m^2	Grains /pan	Sterility (%)	1000-g wt (g)	Yield (t/ha)
V20A/NN3A (IR36)	93	69	265	76	20.3	31	4.0
Zhen Shan 97 A /NN3A	93	78	263	86	23.2	28	4.9
NN3A	105	90	412	101	17.9	23	5.6
V20A/NN4B (IR42)	97	83	276	77	19.6	30	6.5
Zhen Shan 97 A /NN4B	97	76	277	121	11.5	27	5.6
NN4B	135	86	375	107	16.6	22	4.8
V20A/IR54	95	75	299	79	20.9	31	2.5
Zhen Shan 97 A /IR54	95	76	291	89	22.8	29	2.9
IR54	122	91	361	112	15.8	26	6.0
V20B	97	71	284	74	16.5	30	2.3
97B	103	74	269	97	26.1	28	2.8
CV%		9	17	14	24		15
LSD 5%		10	72	19	6.6		1.1

NN4B was a better restorer than NN3A and IR54 for the cms lines V20A and Zhen Shan 97A in Vietnam. □

Harvest index and straw weight of some experimental F_1 rice hybrids

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Crop grain yield is the product of harvest index (HI) and total dry matter. Theore-

Table 1. Grain weight, straw weight, and HI of F_1 hybrids and check varieties, IRRI.[a]

Variety and F_1 hybrid	Grain weight (g/plant)	Straw weight (g/plant)	HI
	Experiment 1		
IR36	33.6 ab	23.3 bcde	0.590 ab
IR50	32.4 abc	20.9 def	0.608 a
IR56	31.6 abc	23.7 abcd	0.571 bc
IR58	34.4 a	22.0 cdef	0.609 a
IR60	28.2 c	21.0 def	0.573 bc
IR29708-41-2-2-3	34.7 a	25.6 ab	0.575 bc
Average	32.5	22.8	0.588
IR747B2-6-3A/IR50	35.1 a	26.3 a	0.572 bc
V20A/IR2307-247-2-2-3	27.9 c	19.2 f	0.593 ab
IR46828A/Suweon 294	29.1 bc	20.6 ef	0.583 ab
IR19799A/IR13429-6-3-3-1	30.5 abc	24.8 abc	0.551 c
V20A/IR13420-6-3-3-1	32.0 abc	24.5 abc	0.564 bc
Average	30.9	23.1	0.572
	Experiment 2		
IR36	34.9 ab	22.6 cd	0.606 ab
IR50	33.4 abc	22.5 cd	0.597 abc
IR56	30.6 cd	22.8 cd	0.574 cde
IR58	32.9 bcd	21.2 d	0.608 a
IR60	32.7 bcd	23.5 bcd	0.582 cde
IR29708-41-2-2-3	34.7 ab	26.5 a	0.568 de
Average	33.2	23.2	0.589
MR365A/IR13524-21-2-3-3-2-2	36.4 a	25.9 ab	0.585 bcde
MR365A/Milyang 46	32.5 bcd	22.8 cd	0.588 abcd
IR46826A/IR15795-232-3-3-3-2	35.7 ab	30.2	0.542 f
MR365A/Milyang 57	33.1 abcd	24.6 abc	0.573 de
MR365A/Suweon 287	29.9 d	23.1 cd	0.563 ef
Average	33.5	25.3	0.570
	Experiment 3[b]		
IR36	32.5 abc	21.2 e	0.605 ab
IR50	35.1 a	22.0 e	0.614 a
IR56	32.7 abc	24.4 de	0.572 d
IR58	33.0 abc	21.6 e	0.604 ab
IR60	34.5 ab	23.8 de	0.592 abcd
IR29708-41-2-2-3	33.6 ab	23.5 de	0.588 bcd
Average	33.6	22.8	0.596
IR46828A/IR13524-21-2-3-3-2-2	36.3 a	24.4 de	0.598 abc
IR19799A/IR2797-125-3-2-2	33.0 abc	23.4 de	0.586 bcd
V20A/IR54	26.5 d	13.7	0.659
IR46826A/IR13419-113-1	27.6 cd	28.4 cd	0.493 fg
IR46828A/IR54	35.8 a	26.5 de	0.574 cd
IR46828A/IR10781-143-2-3	34.5 ab	25.7 de	0.572 d
Average	32.3	23.7	0.580
IR42	33.9 ab	36.1 ab	0.484 g
IR29723-143-3-2-1	34.5 ab	37.9 a	0.477 g
IR24588-34-2-2-3-3	29.2 bcd	27.8 cd	0.512 ef
IR28150-84-3-3-2	34.3 ab	31.7 bc	0.520 e
Average	33.0	33.4	0.498

[a] In a column in each experiment, figures with a common letter are not significantly different at 5% level. [b] h experiment 3, IR42, IR29723-143-3-2-1, IR24588-34-2-2-3-3, and IR28150-84-3-3-2 are late maturing. The other varieties and F_1 hybrids are early maturing.

tically, high yield is achieved by increasing HI, total dry matter, or both.

The goal of hybrid rice breeding is to get an F_1 hybrid with HI and total dry matter higher than those of pureline varieties (checks). We compared HI and total dry matter production (grain plus straw weights) of some IRRI experimental F_1 hybrids with those of pureline varieties.

In 1984 dry season, 3 experiments were conducted in 2- × 5.8-m plots in a randomized complete block design with 4 replications. At harvest, 1-m^2 plots were sampled.

F_1 hybrids had high grain weight in each experiment (Table 1), but they did not significantly outperform all the checks. In experiment 1, IR747-B2-6-3A/IR50 grain weight was highest but only significantly higher than that of IR60. In experiment 2, MR365A/IR13524-21-2-3-3-2-2 yielded significantly more than IR56, IR58, and IR60. In experiment 3, IR46828A/IR13524-21-2-3-3-2-2 grain weight was highest but only significantly higher than IR24588-34-2-2-3-3.

The increased grain weight was associated with increased straw weight (Table 1). HI of F_1 hybrids with high grain weight was the same as or slightly lower than that of the checks, indicating that high dry matter production was responsible for high grain yield.

Grain weight did not correlate with HI (Table 2). Straw weight positively correlated with grain weight, especially for the F_1 hybrids. There was a negative correlation between straw weight and HI.

Although F_1 hybrids included in this study accumulated more dry matter, they tended to have lower HI than pureline varieties do. This explains why their grain weight was not significantly higher than

Table 2. Relations among grain weight, straw weight, and HI, IRRI.

Correlation between	Correlation coefficient[a]										
	Experiment 1			Experiment 2			Experiment 3				
	Check	F_1	Check and F_1	Check	F_1	Check and F_1	Check	F_1	Check and F_1	Check	F_1
Grain weight and straw weight	0.565 ns	0.903*	0.694*	0.377 ns	0.740 ns	0.599 ns	0.106 ns (0.149 ns)	0.481 ns	0.413 ns (0.321 ns)	0.406 ns (0.240 ns)	0.634**
Grain weight and HI	0.433 ns	–0.456 ns	0.156 ns	0.270 ns	–0.062 ns	0.018 ns	0.387 ns (0.124 ns)	–0.010 ns	–0.062 ns (0.002 ns)	0.391 ns (0.096 ns)	–0.065 ns
Straw weight and HI	–0.497 ns	–0.792 ns	–0.601 ns	–0.789 ns	–0.715 ns	–0.788**	–0.875* (–0.961**)	4.881*	–0.881** (–0.934**)	–0.680** (–0.940**)	–0.809**

[a] Correlation coefficient in parentheses includes the late maturing varieties. ** = significant at 1% level, * = significant at 5% level, ns = not significant.

that of the checks. The results of the present experiment suggest that improvement of parental lines is needed for F_1 hybrids to show further superiority over checks. □

Yield depression in F_2 hybrids of rice *Oryza sativa* L.

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We evaluated four F_2 rice hybrids and their corresponding F_1 parents with IR54, a recommended pureline variety, as check in a replicated yield trial in 1983 dry season at IRRI. Twenty-oneday-old seedlings were transplanted at 20- × 20-cm spacing and one seedling per hill, in 5.0- × 3.4-m plots, NPK was applied at 120-50-30 kg/ha.

The F_1 hybrids and IR54 flowered relatively earlier and were more uniform in flowering and plant height than the F_2. Flowering took about 15 d between 99 and 114 d after sowing in IET3257/IR2797 and 12 d for the 3 other F_2, hybrids. Uneven F_2 plant height, flowering, and maturity were due to segregation of genes for those traits.

Grain yield was determined from 5 m^2. Because of staggered F_2 maturity, plants were harvested on two dates. Grain yield was adjusted to 14% moisture, and reported in t/ha. Yield depression in F_2 was computed as $(F_2 - F_1) \div F_1$ and expressed as a percentage. Statistical significance of the difference was tested using LSD.

Yield and yield depression in F_2 rice hybrids and the corresponding F_1 hybrids.

Hybrid, check	Yield (t/ha)		Yield depression[a] (%) in F_2
	F_1 hybrid	F_2 hybrid	
IET3257/IR2797-105-2-2-3	8.3	6.6	–21**
IET3257/IR54	8.3	6.8	–19**
IR11248-242-3-2/IR15324-117-3-2	7.7	6.6	–14**
IRl124&242-3-2/IR19672-19-3-3-1	8.2	6.8	–18**
IR54 (check)	6.7		

[a] ** = significant at 1% level.

Yield depression (see table) in F_2 ranged from 14 to 21% and was significant in all the hybrids. However, the F_2 yields were comparable with those of IR54. The highest yield depression in F_2 was observed in the combination IET3257/IR2797. The same combination had also expressed the highest yield heterosis in F_1. Therefore, to exploit the yield advantage of F_1 rice hybrids, it would be necessary to sow fresh F_1 seed every year. Sowing F_2 seed (harvest made from F_1 rice hybrid) would significantly reduce yield. □

Genetic Evaluation and Utilization

TISSUE CULTURE

Response of rice anthers to callus induction and plant regeneration

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Anther culture can speed genetic improvement of crops by increasing selection efficiency within a short time. We studied the response of anthers to culture medium.

Cold shocked anthers of 40 boro varieties, breeding lines, and F_2 plants were cultured in N6 (for japonica) and modified H5 and SK-8 (for indica and indica/japonica) media at early to mid-uninucleate stage of microspore development. Of the 18 lines that produced calli, 2 were japonicas, 1 was indica/japonica, and 15 were indicas. Anther

Rice anther variability in inducing callus and plant differentiation, Dhaka, Bangladesh.

Variety or line	Type	Anthers inoculated (no.)	Induction		Differentiation[a] (%)		
			No.	%	Roots only	Albino plants	Green plants
Zhing hua-2	japonica	270	60	22	50	18	0
Zhing hua-5	japonica	600	222	37	30	37	25
BG96-3/J2	indica	311	23	7	33	33	17
BR161-2B-58	indica	262	6	2	60	0	0
Guichao No. 2	indica	368	2	0	100	0	0
Habiganj Boro-VI	indica	155	39	25	50	30	0
Habiganj Boro VIII	indica	162	56	35	45	10	0
IR40	indica	330	11	3	57	14	0
IR19660-11	indica	215	3	1	33	0	0
IR19660-311	indica	404	68	13	70	15	5
IR19090-24-5-3-1-1	indica	230	1	0	100	0	0
Pajam	indica/japonica	1825	82	4	48	27	11
Zenith	indica	230	3	1	67	0	0
BR4228 (F_2)	indica	840	54	6	37	35	10
BR4229 (F_2)	indica	295	8	3	60	40	0
BR4249 (F_2)	indica	480	15	3	50	20	0
BR4251 (F_2)	indica	455	3	1	100	0	0
BR4252 (F_2)	indica	575	12	2	50	20	0
Total (induction)		8007	668	8.34	–	–	–
Weighted av (differentiation)[a]		–	–	–	48.3	23.1	7.7

[a] Based on number of calli transferred for differentiation.

response ranged from 0.4 to 37.0%. Zhing hua #5 and Habiganj Boro VIII had the best response (see table).

Two wk after induction, the anther calli were transferred to MS regeneration medium supplemented with 0.5 mg IAA/litre and 1.0 mg kinetin/litre. The percentage of root development was 30.8 to 100%. Albinism was higher than green plant regeneration (see table).

High callusing ability of varieties indicates their potential to be cultured in a nutrient medium, which indicates the need for screening rice germplasm for callusing ability. □

Culture conditions and callus-forming ability of rice anthers

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More efficient anther culture techniques, especially for indica rices, are needed to speed varietal development through anther culture.

The callusing ability (CA) of anthers of 3 indica and indica/japonica varieties, and 4 F_2 lines in 5 different media ranged from 0 to 25.0% (Table 1). IR19660-311 and Pajam responded to five media and an F_2 line of BR7/Basmati 370 responded to two. The CA of the anthers of these varieties or lines was different in different media, but N6, a medium developed in China for japonica varieties, did not perform as well as the other media, especially for the pure indicas. The CA of the anthers of these varieties or lines differed significantly when cultured in the five media, indicating the existence of genotypic variability among them (Table 1).

CA of Pajam anthers ranged from 0.0 to 6.9 under light (mean 2.2%) and 4.0 to 9.0% in darkness (mean 7.0%) (Table 2). The difference between these two means was significant, indicating that the CA may be increased by manipulating incubation conditions. Similarly, the differentiation of calli into green plants was comparatively higher with anthers obtained from modified H5 medium and dark incubation. However, regeneration into albino plants was more frequent than into green plants (Table 2). □

Table 1. Response of anthers of indica, indica/japonica varieties, and F_2 lines to callus induction in different media, Dhaka, Bangladesh.

Varieties and lines	Callus-forming ability [a] (%) in the media					
	N6	Modified N6	H5	Modified H5	SK-8	Mean [b]
BG96-3/J2	0.0	10.0	7.1	11.1	12.5	8.1 b
IR19660-311	6.9	12.3	22.7	25.0	14.1	16.2 a
Pajam	3.2	2.6	3.8	8.3	5.7	4.7 bcd
IR3249-19-1-3/Hbj. Boro IV (F_2)	0.0	5.0	7.0	12.2	5.7	6.1 bc
IR2003-P3-3-1-2/Amboro II (F_2)	0.0	1.3	1.0	2.4	5.3	3.2 ale
BR7/Baimati 370 (F_2)	0.0	0.0	0.0	2.1	1.2	0.7 e
Dymsia/IR424-2-1-57414 (F_2)	0.0	1.3	3.2	3.8	1.8	2.0 de
Mean	0.5	4.4 a	3.7 a	6.8 a	5.4 a	–

[a] Callus-forming ability (%) = $\frac{\text{no. of anthers producing callus}}{\text{no. of anthers inoculated}} \times 100$.

[b] Means followed by different letters are significantly different at P0.05 level.

Table 2. Effect of media and incubation condition on callus-forming ability and differentiation of Pajam, Dhaka, Bangladesh.

Medium	Incubation[a] condition	Anthers inoculated (no.)	Callus produced		Differentiation[b] (%)		
			No.	%	Roots only	Albino plants	Green plants
N6	Light	180	3	1.7	66.7	33.3	–
	Dark	160	8	5.0	60.0	20.0	–
Modified N6	Light	110	0	0.0	–	–	–
	Dark	200	8	4.0	33.3	33.3	–
H5	Light	150	1	0.7	100.0	–	–
	Dark	115	9	7.8	66.7	22.2	11.1
Modified H5	Light	145	10	6.9	66.7	16.7	16.7
	Dark	290	26	9.0	56.7	13.3	20.2
SK-8	Light	175	3	1.7	33.3	33.3	–
	Dark	300	24	8.0	50.0	21.4	7.1
Total	Light	760	17	2.2 b	61.5	23.1	7.7
	Dark	1065	75	7.0 a[c]	51.0	20.4	10.2

[a] Light = inoculated anthers were incubated under light for 13 h/d (about 2500 lux) at 26±1 °C. Dark = inoculated anthers were initially incubated in darkness for 15 d and then under light for 13 h/d at 26±1°C for the rest of the period. [b] Calculated on the basis of number of calli transferred for differentiation in M.S. medium supplemented with 0.5 mg IAA and 1.0 mg kinetin/litre. [c] Significantly different at P0.05 level.

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.

Pest Control and Management
DISEASES

A comparative study of six isolates of *Cochliobolus miyabeanus* in rice from USA

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We studied the morphology of conidia of six isolates of *Cochliobolus miyabeanus,* the causal organism of rice brown spot (BS), cultured on rabbit food agar (RFA), and tested the isolates for pathogenicity on four cultivars to identify physiologic races of the fungus.

The cultivars were inoculated 45 d after sowing by spraying an aqueous spore suspension of each isolate, adjusted to 4×10^4 spores/ml, on the 2 uppermost fully extended leaves from 3 tillers. The reaction of each inoculated leaf was determined 10 d after inoculation by measuring the lesion size and counting the number of lesions on 20 cm^2 of leaf surface. Average disease ratings, scored on a 0-9 scale, are in Table 1. The conidia produced by the fungus on RFA were measured. The dimensions and number of septa of 100 conidia on each isolate were determined (Table 2).

Reaction, as expressed by lesion size, lesion number, and disease rating indicated that probably no physiologic specialization exists among the isolates tested. Average conidia size ranged from 60 × 10 µm to 150 × 24.5 µm, and number of septa per conidia ranged from 5 to 12. Although the isolates had significantly differed in morphology and pathogenicity, and cultivars showed different susceptibilities, the isolate-by-variety interaction was insufficient to designate distinct physiologic races of the pathogens. □

Table 1. Average diaease rating for varieties inoculated with 6 isolates of *C. miyabeanus.* Zaria, Nigeria, 1985.

Isolate	Disease rating[a] on				$\bar{X}$[b]
	Dular (A)	Nova 76 (B)	Saturn (C)	Taichung Native 1 (D)	
LR579	4.58	3.62	3.45	2.16	3.45 bc
LR979	5.83	3.66	3.29	2.25	3.76 cd
LR1379	3.45	2.45	2.16	1.41	2.37 a
LR1979	3.62	2.33	1.83	1.58	2.34 a
LR2072a	7.33	6.00	6.54	5.20	6.27 d
LR2779	5.62	2.58	2.04	1.75	3.00 b
Means[b]	5.07 c	3.44 b	3.22 b	2.38 a	

[a]Based on 0-9 scale for disease rating. [b]Overall means for isolates and varieties followed by the same letter do not differ significantly at the 5% level by Duncan's multiple range test.

Table 2. Variation in length, width, and number of septa of conidia from 6 isolates of *C. miyabeanus* cultured on RFA.

Isolate	Mean[a]	Range
	Length	
LR579	88.15 c	60.00-110.00
LR979	89.51 c	60.00-125.00
LR1379	95.65 b	65.00-115.00
LR1979	88.80 c	60.00-120.00
LR2072a	105.75 a	70.00-150.00
LR2779	86.20 c	65.00-130.00
	Width	
LR579	16.15 c	11.50-19.50
LR979	16.05 c	10.00-22.00
LR1379	15.80 c	12.00-19.00
LR1979	15.80 c	10.00-20.00
LR2072a	17.79 a	13.00-24.50
LR2779	16.80 b	11.50-22.50
	Number of septa	
LR579	7.77 b	6.00-11.00
LR797	7.51 b	5.00-10.00
LR1379	7.49 b	6.00-11.00
LR1979	7.39 b	5.00-10.00
LR2072a	8.59 a	6.00-12.00
LR2779	7.77 b	5.00-12.00

[a]Means for length, width, and number of septa of conidia, respectively, followed by the same letter do not differ significantly at the 5% level by Duncan's multiple range test.

Differentiation between the bacteria causing bacterial blight (BB), bacterial leaf streak (BLS), and bacterial brown blotch on rice

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We studied the causal agents of 34 *Xanmonas campestris* pv. *oryzae* strains (causing BB), 14 *X. campestris* pv. *oryzicola* strains (causing BLS), and 6 brown blotch strains of diverse geographic origins. We examined biochemical and enzymatic reactions and resistance patterns against different chemicals and conducted growth tests on C and N sources.

The three pathogens are separate, phenotypically different biological entities (see table). Four tests allow the differentiation of *X. campestris* pv. *oryzae* from *X. campestris* pv. *oryzicola:* acetoin production (–, +), growth on L-alanine as sole C source (–, +), growth on 0.2% vitamin-free casamino acids (–, +), and resistance to 0.001% $Cu(NO_3)_2$ (+,-). *X. campestris* pv. *oryzicola* strains are nutritionally less exacting than those from pv. *oryzae.* Adding 1% D-glucose or 1% cellobiose to 0.3% vitamin-free casamino acids enhanced growth of all strains. Neither pathovar utilized ammonium as a sole N source with D-glucose or cellobiose as a C source, even with an added mixture of growth factors. This explains why Kado and Heskett's selective medium D5 (containing 1% cellobiose + 0.3% K_2HPO_4+ 0.1% NaH_2PO_4+ 0.1% NH_4Cl + 0.03% $MgSO_4.7H_2O$ + 1.5% agar) is unsuitable for isolating *X. campestris* pv. *oryzae* or pv. *oryzicola.* SX selective medium (1% soluble potato starch + 0.1% meat extract + 0.5% NH_4Cl + 0.2% K_2HPO_4 + 0.002% methylgreen + 0.001% methylviolet 2B + 0.025% cycloheximide + 1.5% agar) also

did not support pathovar growth up to 10 d incubation. *X. campestris* pv. *oryzicola* is generally less susceptible to antibiotics such as 0.001% amoxycillin, 0.001% ampicillin, or 0.005% neomycin than *X. campestris* pv. *oryzae.* None of the phenotypic features was correlated with the virulence of the strains. It was not possible to phenotypically differentiate the pathogenic races or groups of *X. campestris* pv. *oryzae.*

Brown blotch strains share many features with *X. campestris* pv. *oryzae* and pv. *oryzicola.* They are singly-occurring gram-negative rods; they metabolize glucose oxidatively; they are catalase positive, indole negative, urease negative, nitrate reductase negative; they produce acid from D-glucose, are strictly aerobic, and do not utilize L-asparagine as sole C and N source. However, there are some striking differences between BB and BLS pathogens (see table). Besides those features, the following tendencies for differentiation exist: brown blotch isolates are gelatinase negative against 49% positives for *X. campestris* pv. *oryzae* and 100% for *X. campestris* pv. *oryzicola,* do not hydrolyze arbutin (91% and 67% positives), and are erythromycin resistant (0% and 7%). Furthermore, they grow luxuriantly on Döbereiner N-free medium. DNA:rRNA hybridizations and % G+C determination) showed that brown blotch isolates definitely do not belong in *Xanthomonas.*□

Differentiation between the bacteria causing BB, BLS, and brown blotch on rice, RUG-IRRI.

	BB (*X. campestris* pv. *oryzae*)	BLS (*X. campestris* pv. *oryzicola*)	Brown blotch
Acetoin production	–	+	–
Oxidase	–	–	–
H_2S from peptone	+	+	–
Hydrolysis of TWEEN 60 and 80	+	+	–
Growth on L-alanine as sole C source	–	+	+
Growth on glycerol or sodium propionate as sole C source	–	–	+
Growth on 0.2% vitamin-free casamino acids	–	+	+
Growth on Kado and Heskett's selective medium	–	–	+
Resistance towards			
0.001% $Cu(NO_3)_2$	+	–	+
0.001% 8-hydroxyquinoline	–	–	+
0.001% ZnO	–	–	+

Severe ufra outbreak in transplanted rice in Bangladesh

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The transplanted rice crop in the 5,000-ha Dhaka-Narayanganj-Demra (DND) irrigation project area, about 20 km southeast of Dhaka, was badly infested by the stem nematode *Ditylenchus angustus,* which causes ufra disease. Transplanted rice is continuously cropped in the project area except in some high elevation fields where mustard is grown in dry season. Symptoms were white-splash pattern chlorosis, brown spots on leaves and culms at the growing points, and delayed panicle emergence.

Sporadic ufra attacks were first reported in early 1979. Disease incidence has gradually increased, with occasional severe outbreaks (see table). In Sep 1984 almost all fields were affected, with 5-100% infestation. Severity ranged from mild chlorosis to panicle nonemergence. Some plots were destroyed and farmers cut the plants for hay.

Most farmers used no ufra control, although a few used furadan at one-third the recommended dose of 33 kg/ha or 1.0 kg ai/ha. Fields previously planted to mustard were least affected. About 7.5% of production (7,000-8,000 t) may be lost. Preliminary results of experiments with potted plants indicate that recommended doses of furadan, disulfoton, or fenamiphos applied to soil or as a foliar spray may cure infested plants.□

Estimated ufra severity and yield loss over several years in the DND project area, Bangladesh.

Year	Crop [a]	Infested fields (%)	Severity as % infested plants	Yield loss (%)
1978	T. aman	20-30	10-40	10
1981	Born	10-15	10-20	5
	T. aman	10-15	10-20	5
1982	Boro	10-15	10-20	5
	T. aman	20-25	10-40	10
1983	Boro	20-25	10-20	5
	T. aman	40-50	30-100	50
1984	Born	40-50	30-40	40
	T. aman	90-100	60-100	60-75

[a] T. aman = transplanted aman.

Bacterial leaf streak (BLS) incidence in Nellore, Andhra Pradesh

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In late kharif 1983-84, a serious BLS outbreak, caused by *Xanthomonas campestris* pv. *oryzicola,* occurred at Nellore for the first time. We surveyed farmers fields from Sep to Dec 1983 to assess disease severity.

The first BLS symptoms were observed the first week of Oct on 50- to 80-d-old , NLR9672, although all varieties developed typical symptoms. Varieties grown on smaller areas include NLR9674, NLR27999, and BCP.1. All the varieties

cultivated were susceptible, scoring 9 on the Standard evaluation system for rice 0-9 scale. At the end of Oct, the disease was widespread, with rice in many fields showing coalesced lesions on the leaves and blighting. Disease incidence was severe in Nov, when round beads of bacterial ooze were observed on badly infected leaves. Disease incidence declined in Dec, probably because of relatively lower temperatures (27°C-21°C).

There was 323 mm rainfall in Sep and 148.8 mm in Oct, with favorable temperatures and humidity for disease development. □

Pest control and Management
INSECTS

Deterrent effects of seed oil and extracts of some meliaceous plants on rice gall midge (GM) oviposition

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We evaluated seed oil of neem *Azadirachata indica,* and seed oil and methanol (M) and petroleum ether (PE) extracts of chinaberry *Melia azedarach* and *M. toosendan* as oviposition deterrents of GM *Orseolia oryzae,* a serious rice pest in China and tropical Asia.

Egg laying decreased in choice and no-choice tests when gravid GM females were caged on rice seedlings sprayed with seed oils or extracts. In the no-choice test, a 2% M-extract of *M. toosendan* and *M. azedarach* reduced egg laying by 96% and 71% (Table 1). In the choice test, a 1% M-extract of *M. toosendan* and *M.* azedarach seed kernel reduced oviposition by 96% and 83%. The PE-extract of chinaberry seed kernels also deterred oviposition. In the no-choice test, a 2% spray application of neem oil or *M. toosendan* oil reduced oviposition by 47% and 85%, but oil application was not as effective in the choice test. However, both M- and PE-extracts sprayed at 1 to 3% concentration significantly reduced the incidence of silvershoots (Table 2). Preliminary investigations showed that neem and chinaberry oils and extracts at 3% concentration had little ovicidal action.

Table 1. Repellent effect of a spray application of 2% emulsified seed oil or extract of chinaberry and neem on GM oviposition, Guangzhou, China, Sep 1983.[a]

Treatment (T)	Eggs laid/ replication (no.)	Unlaid eggs[b]/ female (no.)	Oviposition deterrence[c] (%)
M. toosendan oil	93 b	4 ab	30
M. toosendan PE-extract	52 c	20 a	61
M. toosendan M-extract	6 d	11 ab	96
M. azedarach oil	20 cd	13 ab	85
M. azedarach PE-extract	15 d	10 ab	88
M. azedarach M-extract	39 c	19 a	71
A. indica oil	44 c	2 ab	67
Control (C) (solvent only)	133 a	0 b	0

[a]No-choice test conducted in 6 × 6 cm plastic cups using 12-d-old rice seedlings. Av of 10 replications for each treatment; means followed by a common letter are not significantly different at 5% level by DMRT. [b]The number of unlaid eggs was determined by dissecting GM females shortly after they died. [c]Deterrence (%) = $\frac{C-T}{C}$ X 100; T = eggs laid in the treatment, C = eggs laid in the control.

Table 2. Effect of spray application of 3% emulsified seed oil and extracts of chinaberry and neem on the incidence of silvershosts caused by GM, Guangzhou, China, Oct 1983.[a]

Treatment	Seedlings/ replication (no.)	Silvershoots/ replication (no.)	Silvershoots (%)
M. toosendan oil	75	4	5 b
M. toosendan PE-extract	81	2	2 b
M. toosendan M-extract	76	3	4 b
M. azedarach oil	95	5	5 b
M. azedarach PE-extract	82	3	4 b
M. azedarach M-extract	88	4	4 b
A. indica oil	77	5	6 b
Control (solvent only)	67	18	27 a

[a] Trial conducted on 21-d-old rice seedlings grown in a greenhouse. Av of 7 replications for each treatment; means followed by a common letter are not significantly different at 5% level by DMRT.

Field trials are underway to evaluate the potential of these plant derivatives in rice insect pest management. □

Integrated control of rice gall midge (GM)

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To follow up earlier experiments, we conducted confirmatory field trials on integrated control of GM *Orseolia oryzae* at the Regional Research Institute, Chiplima, in 1979 and 1980 wet seasons. Susceptible Jaya and resistant Shakti were planted the first week of Jul and fertilized with 100-50-50 kg NPK/ha. Promising chemical control schedules were tested in 100-m^2 plots. Untreated control plots were also maintained.

The maximum protection treatment comprising seedling root dip in 0.02% ai isofenphos + 1% urea for 3 h; phorate granules broadcast at 1 kg ai/ha at 20, 40, and 60 d after transplanting (DT) followed by quinalphos spray at 0.5 kg ai/ha at 85 DT gave excellent GM control (Table 1).

A seedling root dip in 0.02% isofenphos followed by phorate G broadcast at 1 kg ai/ha or implanted 0.75 kg ai/ha as mudballs at 25 DT performed equally well. A foliar spray of quinalphos at 0.5 kg ai/ha 15, 30, and 45 DT was significantly inferior to the other treatments, but control was superior to that in the unprotected Jaya crop.

To keep GM incidence below the economic injury level on susceptible varieties, it is necessary to combine a seedling root dip with a granular insecticide applied 25 DT. Additional insecticide applications were not economical. Resistant Shakti yielded >4 t/ha with no plant protection.

An economic evaluation of GM control methods showed that on Jaya all controls produced more profit than no treatment (Table 2). Including phorate G in the control schedule gave > $300 profit/ha compared to $86 with quinalphos alone. The benefit-cost ratio indicated that seedling root dip followed by broadcast phorate G at 25 DT gave maximum profit. The second best treatment was phorate applications at 25 and 45 DT. Phorate G implanted in mudballs at 25 DT following seedling root dip was effective and economical, but is a cumbersome process and may be less acceptable to farmers.

Maximum protection cost more than $100/ha, which was high for a farmer of marginal land. Seedling root dip followed by phorate G at 25 DT gave the maximum benefit-cost ratio of 8.78:1 and cost only $39/ha.

Table 1. Integrated GM control on Jaya, Bhubaneswar, India.

Insecticide treatment	Silvershoot (%)[a]		Grain yield (t/ha)	
	1979	1980	1979	1980
Maximum protection[b]	4.7	5.4	4.9	4.5
Seedling root dip + phorate G broadcast at 25 DT	6.9	8.0	3.9	3.9
Seedling root dip + phorate G mudball at 25 DT	8.5	11.5	4.4	4.2
Seedling root dip + phorate G broadcast at 20 and 45 DT	11.4	7.6	4.1	4.2
Foliar spray of quinalphos at 15, 30, and 45 DT	32.8	45.9	2.9	2.0
Untreated check	42.0	63.2	1.7	0.8
Untreated check (Shakti)	2.3	4.3	4.4	4.1
SE (m) ±	1.4	1.8	0.2	0.2
CD (0.05)	4.2	5.5	0.5	0.5

[a] Mean of 3 replications at 50 DT. [b] Seedling root dip in 0.02% isofenphos for 3 h with 1% urea + phorate G 1 kg ai/ha at 20, 40, 60 DT + quinalphos spray 0.5 kg ai/ha at 85 DT. Phorate G was applied at 1.0 kg ai/ha per application and mudballs at 0.75 kg ai/ha.

Table 2. Economics of rice GM control on Jaya, Bhubaneswar, India.

Insecticide treatment	Yield[a] (t/ha)	Gross profit[b] (US$/ha)	Cost of insecticide applicatione (US$/ha)	Net gain[d] (US$/ha)	Gain from insecticide[e] (US$/ha)	Benefit cost[f]
Maximum protection[g]	4.71 a	612	115	497	333	3.89
Seedling root dip + phorate G broadcast	3.90 b	504	39	466	302	8.78
Seedling root dip + phorate mud ball at 25 DT	4.3 ab	562	61	501	337	6.51
Phorate G broadcast at 20 and 45 DT	4.1 b	536	54	481	318	6.87
Foliar spray of quinalphos at 15, 30, and 45 DT	2.4 c	317	67	250	86	2.24
Untreated check	1.3 d	164	0	164	–	–
Untreated check (Shakti)	4.2 ab	547	0	547	–	–

[a] Av yield in 1979 and 1980 wet seasons at 13% moisture. Separation of means by Duncan's multiple range test at the 5% level. [b] Cost of yield calculated at $0.13/kg paddy. [c] Cost of insecticide + labor calculated at rates prevailing at the time of the experiment. [d] Cross profit of treatment minus gross profit of control + cost of insecticide application. [e] Net gain of treatment minus net gain of control. [f] Gain from insecticide + cost of insecticide application. [g] Details of maximum protection in Table 1.

GM-resistant Shakti, with no insecticide treatment, gave a $547 profit/ha. □

Influence of planting date on rice whorl maggot (RWM) infestation

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To study the effect of planting time on RWM *Hydrellia* spp incidence in kharif, Jaya was planted every 2 wk in 40-m^2 plots with 5 replications beginning Jun and ending in Jul for 3 seasons – 1979-81. No insecticide was applied.

Total leaves and RWM-damaged leaves on 10 randomly selected hills from each plot were counted 15 and 30 d after transplanting and percent damage was calculated (see table). The early planted crop had significantly less damage than the late planted crop. □

Influence of planting date on RWM incidence at Goa, India. [a]

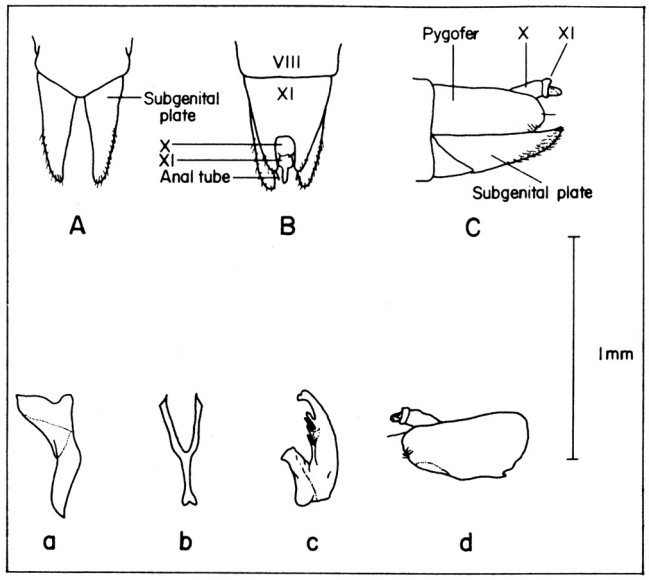
Planting date	Mean leaf damage (%)					Grain yield (t/ha)		
	15 DT		30 DT					
	1980	1981	1979	1980	1981	1979	1980	1981
7 Jun	6.1 b	0.8 a	0.0 a	0.0 a	0.7 a	4.2 a	6.9 a	5.1 a
22 Jun	8.2 b	5.4 ab	5.5 b	4.2 b	2.3 b	3.6 b	6.2 a	4.7 b
7 Jul	3.7 a	8.0 b	25.8 c	9.0 c	2.3 b	2.8 c	4.7 b	3.2 c
22 Jul	17.2 c	12.5 b	30.1 c	18.5 d	3.8 b	2.6 c	4.2 b	1.6 d

[a] In a column, means followed by a common letter are not significantly different at 5% level. DT = days after transplanting.

Comparative morphometrics of male and male genital and abdominal characters *Nephotettix virescens* (Distant) populations from Bangladesh and the Philippines

R. C. Saxena, principal research scientist, International Centre of Insect Physiology and Ecology, Nairobi, Kenya, and entomologist, IRRI; A. A. Barrion, research fellow; and M. V. Soriano, research aide, IRRI

Differential reactions of resistant rice varieties to populations of the green leafhopper (GLH) *Nephotettix virescens* (Distant) in Bangladesh and the Philippines prompted us to study morphological-morphometric variations between males and females of the two populations.



1. Abdominal and genitalic characters of *N. virescens* male. A = ventral, B = dorsal, C = lateral views. a = paramere, b = basal plate, c = aedeagus, d = pygofer.

Table 1. Morphometric mean[a] of genital and abdominal characters of male GLH populations from Bangladesh and the Philippines, IRRI, 1984.

Character	Spotted corium			Nonspotted corium		
	Bangladesh	Philippines	Difference[b]	Bangladesh	Philippines	Difference[b]
Anal tube setae (no.)	8.4	9.0	–0.6[ns]	8.9	9.1	–0.2[ns]
Anal tube length (mm)	0.0982	0.0946	0.0036[ns]	0.1082	0.0990	0.0092[ns]
Pygofer spines (no.)						
Left	4.0	3.6	0.4[ns]	4.5	4.1	0.4[ns]
Right	4.2	4.1	0.1[ns]	4.5	4.0	0.5[ns]
Pygofer length (mm)	0.6222	0.6211	0.0011[ns]	0.6285	0.6314	–0.0029[ns]
Subgenital plate length (mm)	0.5939	0.6036	–0.0097[ns]	0.5956	0.6193	4.0237**
Abdominal segment X width (mm)	0.0521	0.0468	0.0053[ns]	0.0560	0.0493	0.0067 ns
Abdominal segment XI width (mm)	0.1014	0.0858	0.0156**	0.1120	0.0928	0.0192**
Aedeagal setae (no.)	4.5	3.4	1.1**	4.46	4.0	0.46[ns]
Aedeagal length (mm)	0.5078	0.5141	–0.0063[ns]	0.5286	0.5500	–0.0214[ns]
Basal plate length (mm)	0.4150	0.4057	0.0093[ns]	0.4164	0.4136	0.0028[ns]
Paramere length (mm)	0.5157	0.5478	–0.0321*	0.5621	0.5614	0.0007[ns]
Paramere width (mm)	0.2166	0.2054	0.0112[ns]	0.2256	0.2055	0.0201*
Subgenital plate setae (no.)						
Left	8.4	9.2	4.8[ns]	8.8	10.5	–1.7*
Right	8.4	9.5	–1.1**	8.8	9.7	–0.9[ns]

[a]Av based on observations made on 20 individuals of each color morph.[b] **, * signifcant at 1% and 5% level, and ns = not significant by the t-test.

Table 2. Morphometric means[a] of genital and abdominal characters of female GLH populations from Bangladesh and the Philippines, IRRI, 1984.

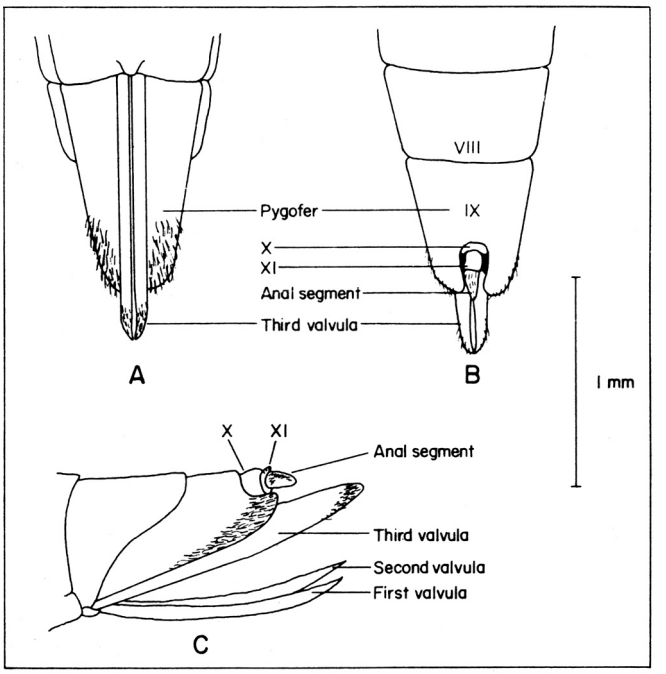
Character	Spotted corium			Spotted corium		
	Bangladesh	Philippines	Difference[b]	Bangladesh	Philippines	Difference[b]
Anal lobe setae (no.)	12.0	12.5	–0.5[ns]	12.9	13.8	–0.9*
Anal lobe length (mm)	0.1460	0.1455	0.0005[ns]	0.1448	0.1450	–0.0002[ns]
Pygofer spines (no.)						
Left	18.2	15.2	3.0**	17.8	15.6	2.2**
Right	18.0	15.8	2.2*	17.4	15.8	1.6*
Pygofer length (mm)	1.2545	1.2470	0.0075[ns]	1.2712	1.2528	0.0184[ns]
Subgenital plate length (mm)	0.6175	0.6208	–0.0033[ns]	0.6182	0.6178	0.0004[ns]
Abdominal segment X width (mm)	0.2433	0.2592	–0.0159**	0.2450	0.2655	–0.0205**
Abdominal segment XI width (mm)	0.1610	0.1570	0.0040[ns]	0.1590	0.1562	0.0028[ns]
1st valvula length (mm)	1.9845	2.0318	–0.0473[ns]	2.0658	0.0358	0.0300[ns]
2d valvula length (mm)	1.8315	1.8378	–0.0063[ns]	1.8990	1.8455	0.0535[ns]
3d valvula setae (no.)						
Left	8.0	9.0	–1.0*	8.6	9.4	–0.8[ns]
Right	8.2	8.8	–0.6[ns]	8.7	9.4	–0.7[ns]
3d valvula length (mm)	1.7292	1.7333	–4.0041[ns]	1.7602	1.7285	0.0317[ns]

[a]Av based on observations made on 20 individuals of each color morph. [b]**,* = significant at 1% and 5% levels, and ns-not significant by the t-test.

Males. GLH males were taken from stock cultures at the Bangladesh Rice Research Institute (BRRI) and IRRI and preserved in 70% ethanol. Visual comparison of the insects showed two distinct color morphs: one with black-spotted corium on tegmen and the other with uniformly green tegmen. The spotted morph occurred more frequently in both populations. Most of the nonspotted insects had relatively higher morphometric values for genital and abdominal characters than the spotted GLH.

Morphological dimensions and setal counts (Table 1) of genital components (Fig. 1) of spotted and nonspotted GLH from Bangladesh and the Philippines were similar, but those from Bangladesh had wider terminal abdominal segments and parameres, and more aedeagal setae. GLH males from the Philippines had more setae on the subgenital plate and anal tube. Spotted Philippine males had significantly longer parameres than those from Bangladesh. Also, the subgenital plate of nonspotted GLH males from the Philippines was significantly longer.

Females. GLH females were taken from stock cultures at BRRI and IRRI and preserved in 70% ethanol. Like the males, they had two distinct color morphs: one with black-spotted corium on the tegmen and the other with uniformly green tegmen. The spotted morph occurred more frequently in both populations, but had relatively lower morphometric values (Table 2) in most genital and abdominal characters (Fig. 2).



2. Abdominal terminalia of *N. virescens* female. A = ventral, B = dorsal, C = lateral views.

GLH populations from both countries were similar in most morphological dimensions, except for the 10th abdominal segment.

Differences were particularly distinct in chaetotaxy. There were significantly more spines on the left and right pygofers of GLH females from Bangladesh than on those from the Philippines. Philippine GLH had significantly more setae on the anal segment and the third valvula of their ovipositor.

The genital and abdominal dimensions and chaetotaxy of the two populations were stable morphological characters adequate enough to differentiate allopatric GLH populations from Bangladesh and the Philippines. □

A single-hole paper punch for dislodgeable pesticide residue on plant leaves

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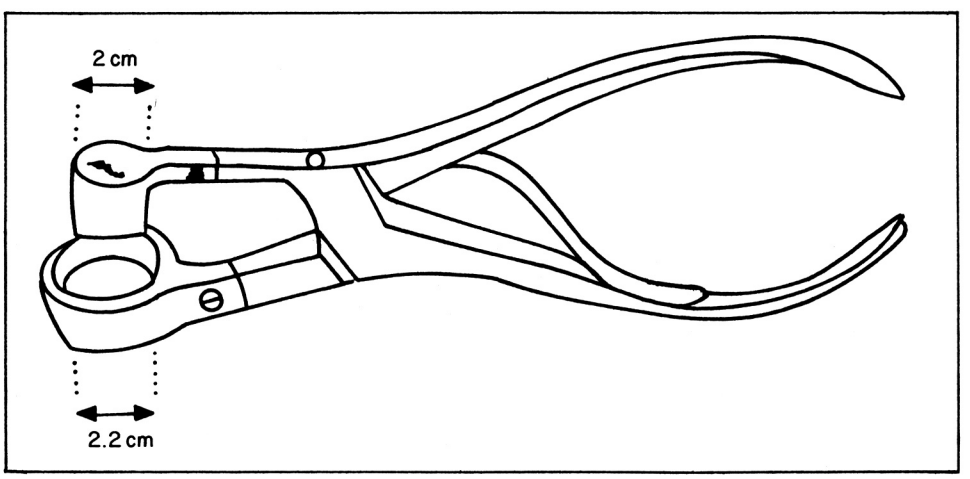
The traditional dislodgeable residue sampler used in most of the Western laboratories is not available in India. We sought to develop a simple, economical, dislodgeable residue sampler (see figure).



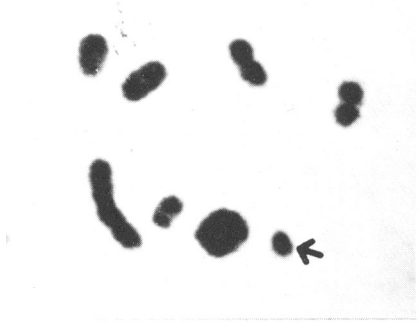
A simplified dislodgeable residue sampler.

We attached a stainless steel cup-and-hold block to the main assembly of a single-hole paper punch. The diameter of the punch can be varied by using different sized cup and hole blocks. The punch costs about US$10. □

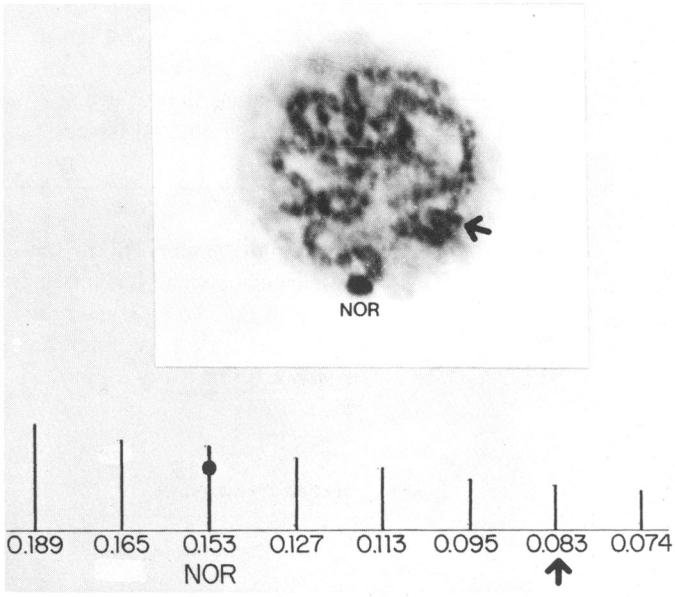
Meiotic chromosomes of male green leafhoppers (GLH)

R. C. Saxena, principal research scientist, International Centre of Insect Physiology and Ecology, Kenya, and entomologist, IRRI; and A. A. Barrion, insect geneticist, University of the Philippines at Los Baños

We studied the meiotic chromosomes of GLH *Nephotettix virescens.* Newly emerged, insectary-reared GLH males were fixed in Carnoy's fluid for 24 h. Later, their testes were macerated on glass slides with a drop of 2% lacto-aceto-orcein and 45% acetic acid. Chromosome examinations showed that GLH spermatogonia divided mitotically and spermatocytal processes followed the conventional reductional-equational meiotic divisions. The primary spermatocytes at diakinesis (Fig. 1) had 7 bivalent autosomes and a univalent X-chromosome making the genomic complement 2n=15 (7IIA + XO).



1. Chromosomes of male *N. virescens* at diakinesis showing 2n=15 (7IIA+XO). The sex chromosome is indicated by an arrow. Magnification, 1500X (oil immersion). IRRI, 1984.



2. *N. virescens* pachytene chromosomes comprising autosomes, chromosome with nucleolar organizing region (NOR), and sex chromosome and idiogram showing the relative mean lengths. Sex chromosome is indicated by an arrow. Magnification, 1500X (oil immersion). IRRI, 1984.

At pachytene (Fig. 2), relative mean chromosome length was 0.074-0.189. The sex chromosome measured 0.083 and the autosome with the nucleolar organizing region (NOR) had a relative mean length of 0.153. These chromosomes condensed maximally during premetaphase into dumbbells of bivalents measuring as follows: 4, 3, 3, 2.5, 2.5, 2.5, 1.9, and 1. The sex chromosome measured 1 μ while the chromosome with NOR measured 3 μ.

The insemination potential of male GLH as determined by the mean meiotic index was approximated to be 0.84.

Spontaneous chromosomal aberrations in individual GLH included 0.77% hypoploidy or reduction in chromosome number and 0.47% agmatoploidy or increase in number. □

Host plants of rice leaffolder (LF) *Marasmia patnalis* Bradley

R. C. Joshi, E. B. Medina, and E. A. Heinrichs, IRRI

Simultaneous damage to rice leaves by two LF species, *Marasmia patnalis* Bradley and *Chaphalocrocis medinalis* Guenée, was observed on the IRRI experimental farm from Oct 1983 to Mar 1984. *C. medinalis* commonly feeds on alternative hosts, but no information is available on the ability of *M. patnalis* to survive rice-free periods on alternative hosts. We tested *M. patnalis* survival on nine rice-field weeds (see table) in a no-choice trial

Weeds tested as host plants to the LF *M. patnalis,* [a] IRRI, 1984.

Family, plant [b]	Survival from 1st instar to pupa [c] (%)	Remarks on feeding of larvae
Poaceae (Gramineae)		
Leersia hexandra	48 a	Severe scraping
Leptochloa chinensis	14 b	High scraping
Echinochloa glabrescens	4 bc	Low scraping
Echinochloa colona	0 c	Scraping was observed, but larvae did not live to pupate.
Cyperaceae		
Cyperus difformis	2 c	Two adjacent leaves near the tip of the inflorescence were folded.

[a]Ten replications/plant species, 5 larvae/plant. [b]Identified by R. T. Lubigan, IRRI. [c]Means followed by a common letter are not significantly different (P = 0.05) by Duncan's multiple range test. There was no survival on *Fimbristylis littoralis, Monochoria vaginalis, Ipomoea aquatica,* and *Sphenoclea zeylanica.*

under greenhouse conditions. Individually caged test plants were infested with newly hatched 1st-instar larvae from a *M. patnalis* greenhouse colony.

M. patnalis survived on four of the weed species. Survival was highest (48%) on *Leersia hexandra,* with a 17-d larval period. *Echinochloa colona* leaves were scraped, but the larvae did not live to pupate. Survival was poor and larval period extended (25 d) on *Cyperus difformis,* which may cause the larvae to migrate to the young transplanted rice crop early in the growing season. □

Rice whorl maggot (RWM) effect on yield loss

S. L. Valencia, senior research assistant, and O. Mochida, entomologist, IRRI

RWM usually attacks irrigated rice plants and retards their growth from seedbed stage to about 40 d after transplanting (DT). In hot, lowland conditions in the Philippines, plants usually recover from RWM damage, and exhibit no yield loss even with heavy infestation. However, scientists suspect there has been some yield loss from RWM in the IRRI maximum yield trials (MYT). We evaluated the effect of RWM damage with 2 insecticide treatments on 10 cultivars or lines planted in the MYT (Table 1) in Mar-Jul 1984.

RWM damage ranged from 1.8 to 6.5% in the insecticide-treated plots and 11.4 to 43.5% in check plots (Table 2). The correlation coefficient between RWM damage and yield loss was 0.57 (n = 10) and not significant, indicating that RWM infestation at the levels in this study did not affect yield.

Similarly, percent deadhearts caused by stem borers in early stages did not significantly correlate with yield loss (r = 0.02). In contrast, percent of tungro-infected plants was highly correlated with yield loss (r = 0.98**). □

Table 1. Insecticide treatments.

Wk after transplanting	Highly protected	Rate (kg ai/ha)	Check	Rate (kg ai/ha)
1	Diazinon 5G and monocrotophos	1.0 + 1.5		
2	Deltamethrin 2.5EC	0.0125		
3	Diazinon 5G and carbaryl 85WP	1.0 + 1.5		
4	Acephate 75SP	0.75		
5	MIPC 50WP	0.75		
6	Monocrotophos 30EC	0.75	Monocrotophos 30EC	0.75
7	Acephate 75SP	0.75	Acephate 75SP	0.75
8	Diazinon 20EC	0.75	Diazinon 20EC	0.75
11	Acephate 75SP	0.75	Acephate 75SP	0.75

Table 2. Effect of RWM infestation on the yield of 10 rice varieties and lines used in the IRRI MYT.[a]

Cultivar/line	RWM damaged leaves (%) on 20 hills/plot		Deadhearts (%) on 160 hills/plot		Hills (%) with tungro virus disease on 160 hills/plot, 40 DT[d]		Grain yield (t/ha)	
	Highly protected[b]	Check[c]	Highly protected	Check	Highly protected	Check	Highly protected	Check
IR5 8	3.40 bcd	18.82 abc	1.14 bc	0.56 ab	0.00 a	0.00 a	3.73 b	3.38 b
IR31847-67-2-1-1-2	2.65 bc	29.75 c	1.38 bc	0.64 ab	0.00 a	0.00 a	4.36 b	4.50 c
IR36	2.64 abcd	27.39 c	2.66 d	0.38 ab	2.03 a	42.65 b	4.20 b	2.20 ab
IE29725-3-1-3-2	3.10 bcd	27.39 c	1.28 bc	0.52 ab	0.00 a	0.00 a	3.78 b	4.10 c
IR31851-6-3-3-3-2	4.09 cd	15.22 ab	0.47 a	0.43 ab	0.16 a	0.00 a	4.53 b	4.26 c
IR8	6.48 d	40.52 cd	0.00 a	0.00 a	100.00 c	97.50 c	0.00 a	0.00 a
IR42	3.31 bcd	43.58 d	0.64 ab	0.00 a	13.03 b	93.75 c	3.45 b	0.00 a
IR21840-154-3-2-2-3	1.81 a	11.43 a	1.34 bc	0.64 ab	0.00 a	0.00 a	3.41 b	3.85 c
IR29723-143-3-2-1	1.89 b	25.08 c	1.67 cd	0.91 b	0.00 a	0.00 a	4.51 b	4.97 abcd
IR25587-133-3-2-2-2	3.00 bc	21.06 bc	1.20 bc	1.16 b	0.00 a	0.00 a	3.61 b	3.37 b

[a] In a column, means followed by a common letter are not significantly different at the 5% level by DMRT. [b] Highly protected from 1 wk to 11 wk after transplanting. [c] Protected only after 6 wk to 11 wk after transplanting. [d] Days after transplanting.

Sensitivity levels of green leafhopper (GLH) populations to insecticides at IRRI in 1983-84

L. T. Fabellar, research assistant, and O. Mochida, entomologist, IRRI

We suspected that GLH at IRRI were becoming less sensitive or resistant to insecticides because of frequent application. GLH were collected from tungro-infected IR22 in Dec 1983 and reared on TN1 in the greenhouse. Insecticide sensitivity of the F_2 GLH populations was compared to that of a greenhouse culture that had not been exposed to insecticide treatments. We used a Burkard microapplicator to apply 0.2 µl each of 5 insecticides, diluted by acetone, on CO_2 anaesthesized 2- to 5-d-old GLH adults.

The LD_{50} values of the greenhouse population ranged from 0.99 to 8.23; that of field-collected GLH was from 2.40 to 26.47. The estimated resistance ratio

Comparison of insecticide reaction of greenhouse and F_2 populations of field-collected GLH, IRRI, Feb 1984.

Insecticide	LD_{50}[a] (μg/g 24 h)		Difference (F-GH)	ERR[c]
	Field-collected population (F)	Greenhouse population (GH)		
BPMC	5.11	2.86	2.25 ns	1.79
Carbaryl	7.01	4.40	2.61 ns	1.59
Carbofuran	2.40	0.99	1.41 ns	2.42
Diazinon	26.41	8.23	18.24*	3.22
Monocrotophos	9.16	6.25	2.91 ns	1.47

[a] Av of 3 replications (20 adult females/replication). [b] * = significant at 5%, ns = not significant.
[c] Estimated resistance ratio = $\frac{LD_{50}\text{ value for F}}{LD_{50}\text{ value for GH}}$.

was from 1.47 to 3.22. This indicates that the field-collected GLH may be developing resistance to the tested insecticides. Only the diazinon-treated field-collected population was significantly more resistant than the greenhouse culture (see table). □

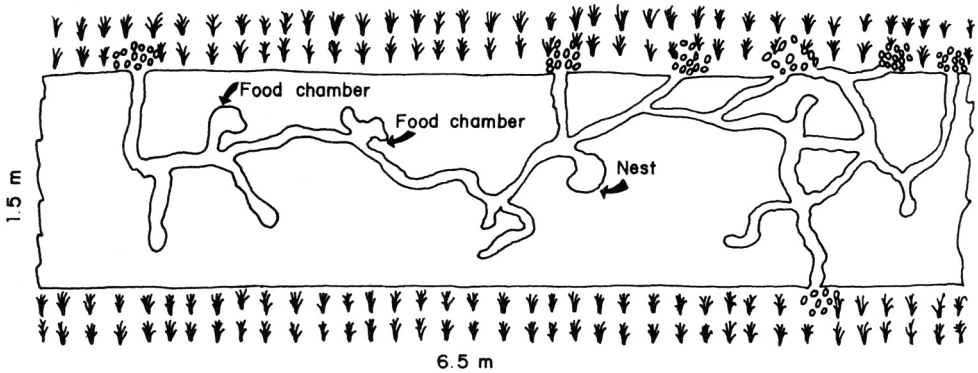
Pest Control and Management

OTHER PESTS

Alternate foods of bandicoot rats in deep water rice areas of Bangladesh

Md. Sayed Ahmed, Entomology Division, Bangladesh Rice Research Institute, and E. Haque and J. E. Brooks, Bangladesh Agricultural Research Institute, Joydebpur, Dhaka, Bangladesh

While conducting rodent control experiments in deep water rice areas of Tangail district in 1983, we found that rats ate snails, water lily fruit, and water hyacinth stems. In early 1984, we visited the same area to record rodent damage to boro rice. There were many bandicoot rat burrows near the dike of the boro rice field, but there was little rodent damage. To determine what the rats were eating, we excavated a burrow system (see figure) and found 68 modified stems of *Nymphaea lotus* (715 g) and 32 snail shells (*Pila globosa* and *Viviparous bengalensis*) in the food chamber. In laboratory tests we found that bandicoot rats can easily live on *P. globosa* and tubers of *N. lotus* (see table). Farmers often use the tubers of *N. lotus* as food during crisis, and 1 kg costs about $0.25 during the season. Snails are fed to ducks. We also found eight rat litters in the same burrow system. □



Bandicoot rat burrow system in a dike during boro season in a deep water rice are in Bangladesh.

Body weight increase of *Bandicota indica* after 5 d feeding on snails and tubers. Bangladesh Agricultural Research Institute, 1984.

Food[a]	Amount consumed (g/d)			Body weight (g)		Increase (%)
	Min	Max	Mean	Prefeeding	Postfeeding	
Snail	28.0	96.0	61.8	442.0	451.0	2
Tuber	37.0	49.0	42.2			
Snail	0.0	80.0	34.6	287.0	287.0	0
Tuber	5.0	37.0	26.2			
Snail	31.0	90.0	64.0	242.0	277.0	14
Tuber	45.0	69.0	56.8			

[a] Snail = *Pila globosa,* tuber = modified stems of *Nymphaea lotus.*

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.

Soil and Crop Management

Effect of planting method and fertilizer combination on deep water rice yield on the Cuu Long Delta

Nguyen Van Luat, B. K. Singh, N. M. Chau, and T. V. Hoa, Cuu Long Delta Rice Research Institute, Omon, Hau Giang, Vietnam

We studied transplanted or broadcast-seeded Nang Tay Dum (floating rice) at 4 fertilizer levels — 0 fertilizer, 40 kg N/ha, 40-18 kg NP/ha, or 40-18-33 kg NPK/ha — in 1983 wet season at Thot Not. The trial was in 3 replications in a split-plot design with planting method in main plots and fertilizer combinations in 18-m^2 subplots. Soil was a Sulfaquept with pH 4.5,0.178% N, 0.067% P_2O_5, 0.067% SO_4, 2.88 meq Al^{3+}/100 g, and 0.56 meq H^+/100 g. Plots reached 120-cm water depth in mid-Oct.

Yields of Nang Tay Dum under different planting methods and fertilizer combinations,[a] Hau Giang, Vietnam, l983.

Planting method	Yield (t/ha)				
	F0	F1	F2	F3	Mean
Broadcast	1.6	1.3	1.9	2.0	1.73
Transplanted	0.7	0.3	1.8	1.7	1.11
LSD 5%					
Planting method					ns
Fertilizer combinations					0.28
Fertilizer combinations at same planting method					0.40
Planting methods at same fertilizer combinations					1.16

[a] F0 = no fertilizer, F1= 40 kg N/ha, F2 = 40-18 kg NP/ha, F3 = 40-18-33 kg NPK/ha.

Seeds were broadcast at 100 kg/ha or 35-day-old seedlings were transplanted at 25- × 25-cm spacing. N was applied 30 d after broadcasting or 10 d after transplanting. PK was applied basally.

The effect of fertilizer combinations and interaction between fertilization and planting method were significant (see table). Fertilizers did not significantly increase yield of broadcast-seeded rice. For transplanted rice, NP gave best results and N alone did not increase yield over that of the control. Acid sulfate conditions may have decreased response to fertilizer N. □

Effect of planting method and fertility levels on floating rice grown on acid-sulfate soils on the Cuu Long Delta, Vietnam

B. K. Singh, Nguyen Minh Chau, and Tran Van Hoa, Cuu Long Delta Rice Research Center, Omon, Hau Giang, Vietnam

Floating rice on the Cuu Long (Mekong) Delta is broadcast seeded on dry soil in May and Jun and the crop is not fertilized. Soil pH is from 3.7 to 5.0 early in the cropping season and increases steadily as floodwater accumulates. We studied the effect of stand establishment and fertilizer application on floating rice yield in a farmer field in Thot Not District of Hau Giang Province.

The trial was in a split-plot design with planting treatments in main plots and fertilizer combinations in subplots (Table 1,2). Soil was clay acid-sulfate with 0.178% total N, 0.029% total P, 0.067% SO_4^{2-}, and 2.889 meq Al^{3+} and 0.586 meq H^+/100 g soil. Seeds of floating rice Nang Tay Dum were broadcast on dry soil at 100 kg/ha on 7 Jun 1983. Seeds fix transplanting were sown in the nursery on the same day. Forty-five-day-old seedlings were transplanted at 25- × 25-cm spacing when enough rain for puddling the soil had fallen. P and K were applied at transplanting as superphosphate and muriate of potash. N was applied 15 d after sowing the broadcast crop and at puddling in the transplanted crop. Maximum field water depth reached 100 cm in early Nov, which

Table 1. Plant characters of floating rice as influenced by planting method and fertilizer interaction in an acid-sulfate soil in Hau Giang, Vietnam.[a]

Plant character	Broadcast					Transplanted				
	F_0	F_1	F_2	F_3	Mean	F_0	F_1	F_2	F_3	Mean
Height (cm)	105	184	189	189	187	170	170	175	175	173
Maturity (d)	175	175	170	170	173	180	180	170	170	175
Panicles/m^2	93	87	82	95	89	49	42	70	74	59
Panicle length (cm)	18	19	19	20	19	18	18	20	21	19
Panicle weight (g)	2.7	2.5	3.4	3.9	3.1	2.9	2.4	4.4	4.4	3.5
Filled grains/panicle	108	117	124	191	135	103	79	145	180	127
Unfilled grains (%)	28	36	24	21	27	51	48	35	18	38
1,000-grain weight (g)	22.4	22.3	21.7	22.7	22.3	21.0	21.5	22.4	22.4	21.8

[a] F_0 = no fertilizer, F_1 = 40 kg N/ha, F_2 = 40-17.5 kg NP/ha, F_3 = 40-17.5-22.5 kg NPK/ha.

Table 2. Grain yield of floating rice as influenced by planting method and fertilizer application in an acid-sulfate soil of the Cuu Long Delta, Vietnam.

Planting method	Grain yield (t/ha) [a]			
	F_0	F_1	F_2	F_3
Broadcast	1.6	1.3	1.9	2.0
Transplanting	0.7	0.3	1.8	1.7
CD at 5%				
Method of stand establishment				ns
Fertility level				0.28
Fertility level at a constant level				0.41
Method of stand establishment at a constant level of fertility or at different levels of fertility				1.16

[a] F_0 = no fertilizer, F_1 = 40 kg N/ha, F_2 = 40-17.5 kg NP/ha, F_3 = 40-17.5-22.5 kg NPK/ha,

is about 50 cm lower than normal.

The interaction between planting method and fertilizer application significantly influenced grain yield (Table 2). Adding NP or NPK increased yield of broadcast seeded rice over the control and N alone.

For transplanted rice, adding NP or NPK significantly increased yields above the control and N alone. Applying N alone decreased yield 64% below that of the control as there was a significant reduction in panicle number and filled grains/panicle.

Adding N alone appeared to aggravate Al toxicity, which reduced root growth. Adding P appeared to enhance root development and therefore nutrient absorption. Adding K did not affect yield.

The adverse effect of N alone on grain yield was less pronounced in the broadcast crop because it had higher plant density than the transplanted crop. Results suggest that closer spacing and P application are essential to improve density of the transplanted crop and therefore grain yield. □

Factors affecting critical P level for rice

A. Samiei and B. Singh, Soils Department, Punjab Agricultural University, Ludhiana 141004, India

We conducted greenhouse and laboratory studies on soils with different texture, Olsen's extractable P, and $CaCO_3$ content. Olsen's P was higher in submerged soils than in air-dried soil (Table 1). Rice grain yield was significantly correlated with Olsen's extractable P. Critical Olsen's P level for rice was calculated by quadratic regression equations. Critical P depended upon soil texture, $CaCO_3$ content, and period of submergence (Table 2). □

Table 2. Effect of submergence and soil type on critical Olsen's level. Ludhiana, India.

Soil texture and type	Critical Olsen's P [a]			
	Air-dried soil	Submergence period (d)		
		1	3	7
Coarse (sand-sandy loam)	7.4 (0.89**)	12.5 (0.85**)	19.2 (0.75**)	19.9 (0.61**)
Medium (loam)	8.0 (0.99**)	11.1 (0.91**)	10.6 (0.88**)	10.5 (0.69**)
Fine (silty loam-silty clay loam)	8.4 (0.99**)	10.6 (0.82**)	13.4 (0.86**)	15.1 (0.91**)
High $CaCO_3$ (loamy-sand-clay)	7.8 (0.71**)	19.0 (0.60**)	20.9 (0.54**)	22.7 (0.52**)

[a] Figures in parentheses indicate the R^2 value. ** = significant at 1% level.

Table 1. Effect of submergence on Olsen's extractable P, Ludhiana, India.

Soil texture type	Air dried	Extractable P (ppm)[a] after submergence for			
		1 d	3 d	7 d	15 d
Coarse (sand-sandy loam)	0.5-8.5	1.5-19.5	2.5-22.5	5-20.5	5-20
Medium (loam)	1-10.5	2.5-13.5	3.5-14	4.2-13.5	4.5-16.5
Fine (silty loam-silty clay loam)	4-10.5	5-13.5	7.5-16	11-19	13-22
High $CaCO_3$ (loamy sand-clay)	4.2-8.5 (5.6)	8.5-21.5 (13.8)	10-24 (15.2)	11.5-25.5 (16.6)	12.5-27.5 (18.8)

[a] Figures in parentheses indicate the mean value.

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

Causes for different response to and availability of P in rice and wheat ecosystems

Ali Samiei and Bhajan Singh, Soils Department, Punjab Agricultural University, Ludhiana 141004, India

We studied rice and wheat response to applied P in the greenhouse on soil with different texture, Olsen's P, and $CaCO_3$. We also noted the effect of temperature and moisture on Olsen's P.

Bray's percent yield was higher for rice than for wheat (Table 1). $CaCO_3$ soil content did not affect Bray's percent

Table 1. Effect of soil type on Bray's yield of rice and wheat, Ludhiana, India.

Soil	Soils (no.)	pH[a]	Olsen's P[a] (ppm)	Bray's yield[b] (%)	
				Rice	Wheat
Coarse	5	7.5-8.9 (8.2)	0.5-8.5 (4.1)	85.3	60.0
Medium	5	8-9.1 (8.4)	1-10.5 (4.5)	85.0	64.6
Fine	4	7-8.3 (7.9)	4-10.5 (6.6)	94.6	75.7
High $CaCO_3$ (>8%)					
Fine	2	8-8.1 (8.1)	4.3-8.5 (6.4)	95.2	58.7
Coarse	2	8-8.2 (8.1)	4.5-5.5 (5)	84.4	64.7

[a] Numbers in parentheses are the mean.

[b] Bray's percent yield = $\frac{\text{yield without P}}{\text{yield with 30 ppm P}} \times 100$.

yield for rice, but caused it to decline drastically in wheat planted in fine-textured soil, indicating that P release in fine-textured soils is adversely affected by $CaCO_3$ under dryland cropping.

Differences in P release may be caused by temperature and soil moisture conditions. Submerging the soil released the P due to CO_2 pressure by converting $CaCO_3$ to $CaHCO_3$ and H_2CO_3, which makes insoluble P soluble. Higher temperatures also increased P solubility. The effects of temperature and submergence are illustrated by the multiple regression equations for loam and sandy loam soils in Table 2. □

Table 2. Olsen's extractable P related to temperature and period of submergence, Ludhiana, India.

Soil	Multiple regression equation	*R* value[a]
Loam	$y = 0.1064\ x_1 + 0.7615^{**}\ x_2 - 0.0023\ x_1x_2 - 25.545$	0.89**
Sandy loam	$y = 0.314^{**}\ x_1 + 1.075^{**}\ x_2 - 0.00884^{**}\ x_1x_2 - 35.961$	0.88**

[a] **Significant at 1% level. y = Olsen's extractable P (ppm), x_1 = period of submergence (d), x_2 = av max soil temp (°C).

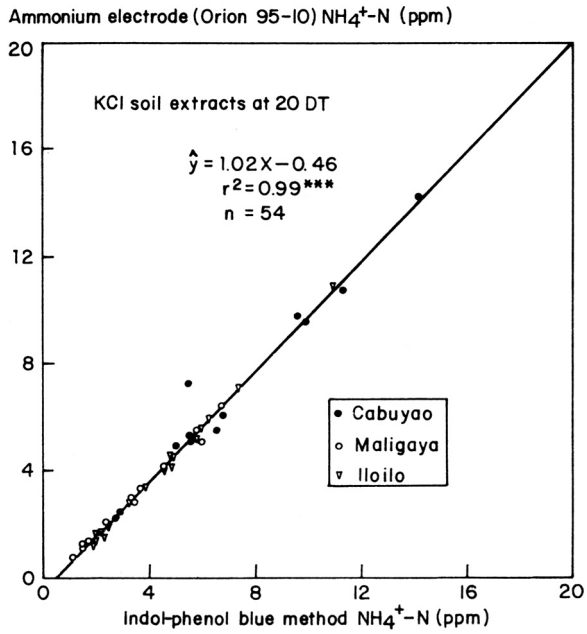
Determining ammonium content in wetland soil extracts using an ammonia electrode

G. Keerthisinghe, K. Mengel, and S. K. De Datta, IRRI

We studied whether an ion-specific electrode could be used to determine the ammonium concentration in soil extracts, because the method is faster than conventional ones. We tested 1.0 N KCl extracts (soil:solution = 1:10) of 54 soil samples from 3 main rice growing areas of the Philippines – Maligaya, Cabuyao, and Iloilo.

Soil samples were taken 20 d after transplanting (DT). Ammonium concentration was measured with an ammonia electrode (Orion model 95-10) connected to a digital pH/mV meter calibrated for ammonium analysis. For low ammonium concentrations, the electrode was filled with a relatively dilute internal filling solution containing 5 mM NH_4Cl and 0.5 M $NaNO_3$. Sodium nitrate was added to inhibit osmotic interference. Instead of adding l ml of l0 M NaOH to l00ml of samples as indicated in the instruction manual to convert ammonium to ammonia, we added 2 ml of 0.25 M NaOH, which was enough to raise the pH above 11, as needed for the conversion.

To test the method's accuracy, aliquots of the same soil extracts were analyzed by the Indolphenol blue method, a highly sensitive colorimetric method for detecting ammonium. The positive correlation between results of the two methods was highly significant (see figure). □



Relationship between indol-phenol blue method and ammonia electrode method of determining ammonium content of wetland soil extracts, IRRI.

Rice-Based Cropping Systems

Effect of rice straw mulching on wheat productivity

A. Motaleb Bhuiyan and Nur E-Elahi, Division of Rice Cropping Systems, Bangladesh Rice Research Institute (BRRI), Joydebpur, Gazipur, Bangladesh

Farmers in Daudkandi, Bangladesh, broadcast wheat following deep water rice. Wheat seeds often are eaten by birds, germination tends to be low, and during later plant growth, particularly flowering, moisture stress reduces grain yield. Using straw mulch can reduce these problems. In 1982-83, we studied the effect of rice straw mulching in a farm trial at the Rainfed Deepwater Rice-based Cropping Systems Research site in Daudkandi. Broadcast or line-seeded wheat was mulched with deep water rice straw. Although the field was not weeded, mulch substantially reduced weeds. Unmulched plots had to be weeded twice. Mulched wheat yielded 2.9-3.0 t/ha and gave a higher net return, irrespective of planting method (see table). Mulching conserved

Effect of mulching on wheat yield under line and broadcast seeding, Daudkandi, Bangladesh, 1982-83.

Treatment	Yield (t/ha)	Return [a] ($/ha)	Total variable cost [b] ($/ha)	Net return ($/ha)
Line seeding, mulch	3.0	381	147	234
Line seeding, no mulch	2.5	317	145	172
Broadcast, mulch	2.9	368	144	224
Broadcast, no mulch	2.3	292	143	149

[a] Wheat price = $127/t. [b] Price of straw-mulch ($17/ha) was also included in the economic analysis. Design: randomized complete block, 3 replications; variety Sonalika. Fertilizer rate = 80-26-33 kg N-P-K/ha. Seed rate = 120 kg/ha.

soil moisture, protected seeds from birds, and reduced weed growth. Planting method had little effect on yield. □

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

Announcements

Azolla newsletter

IRRI will begin publishing in August 1985 a semi-annual *Azolla Newsletter* for workers interested in azolla, blue-green algae, and biological N furation. The newsletter will help workers to share information, to keep abreast of developments in the field, and to maintain current information on azolla specimen collections throughout the world.

The newsletter will include 1) abstracts of azolla publications, 2) current issues in azolla research and use, 3) reports and recommendations of azolla meetings, 4) news of live and herbaria specimen collections, and 5) specimen accession announcements.

The *Azolla Newsletter* was recommended at the International Workshop on Azolla Use at Fuzhou, China, 31 Mar to 5 Apr 1985. For a free subscription to the newsletter, write: Dr. Iwao Watanabe, Soil Microbiology Department, IRRI, P.O. Box 933, Manila, Philippines.

Contributions to the *Azolla Newsletter* should be sent to any of the five regional editors. They are Liu Chung-chu (Asia), Vice President, Soil and Fertilizer Institute, Fujian Academy of Agricultural Sciences, Fuzhou, Fujian, China;

T. A. Lumpkin (North and South America), Department of Agronomy, Washington State University, Pullman, WA 99164-6420, USA

Elizabeth G. Cutter (Europe), Department of Botany, University of Manchester, Manchester M13 9PL, United Kingdom;

B. W. Norton (Australia), Department of Agriculture, University of Queensland, St. Lucia, Queensland, Australia 4067; or

H. F. Diara (Africa), West Africa Rice Development Association, B.P. 96, Saint Louis, Senegal.

Rice straw as cattle feed

The National Livestock Development Board, Mahaweli Authority of Sri Lanka Draft Animal Program, Animal Science Department of the University of Peradeniya, and the Sri Lanka-Netherlands Livestock Development Program are planning an international seminar for extension workers and research fellows working with rice straw as cattle feed. For further information regarding the seminar, tentatively scheduled for mid-1985, write the Coordinator, Straw Utilization Project, P. O. Box 138, Kandy, Sri Lanka. □

Watanabe receives Japanese soil science award

I. Watanabe, head of the IRRI Soil Microbiology Department, received the 30th award of the Japanese Soil Science Society on 7 Apr 1985 for his research on N fixation in tropical rice fields.

Watanabe graduated from the University of Tokyo in 1955 and received his D Agr in 1961. He has published more than 150 papers on N fixation and transformation and mineral nutrition. □

Conservation of crop germplasm — an international perspective

Conservation of crop germplasm — an international perspective, edited by W. L. Brown, T. T. Chang, M. M. Goodman, and Q. Jones, is a collection of six papers presented at a symposium on crop germplasm sponsored by the Crop Science Society of America. Subject matter ranges from a detailed description of the essential elements of successful plant exploration to the broadly defined goals and operations of national and international germplasm programs. The gene resource programs of two international agricultural research centers and germplasm conservation as practiced at the National Seed Storage Laboratory, Fort Collins, Colorado, also are described.

Price is US$11 plus $0.75 for all orders from outside the United States. Payment must accompany the order. For further information, write: CSSA Headquarters Office, Attn. Book Order Department, 677 S. Segoe Road, Madison, WI 53711, USA. □

New IRRI publications

New publications are available for purchase at the Communication and Publications Department, Division R, IRRI, P. O. Box 933, Manila, Philippines:

IRRI highlights 1984

Illustrated guide to integrated pest management in rice in tropical Asia, by W. H. Reissig, E. A. Heinrichs, J. A.

Litsinger, K. Moody, L. Fiedler, T. W. Mew, and A. T. Barrion

International rice research: 25 years of partnership

Biotechnology in international agricultural research

Field problems of tropical rice, French, Tagalog, and Waray editions

ERRATUM

S. M. Haroon Usmani, A. Ghaffar, and S. Hussain. Polyethylene mulching to control sheath rot (ShR). 10 (1) Feb 1985:

Page 10: The title should read "Polyethylene mulching and increase in yield of rice."

In line 3, paragraph 1, "ShR" should read "stem rot (SR)."

In the table title, "ShR" should read "SR."

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