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Contents

Guidelines and Style for IRRN Contributors

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

Style

- Use the metric system in all papers. Avoid national units of measure (such as cavans, rai, etc.).
- Express all yields in tons per hectare (t/ha) or, with small-scale studies, in grams per pot (g/pot) or grams per row (g/row).
- Define in footnotes or legends any abbreviations or symbols used in a figure or table.
- Place the name or denotation of compounds or chemicals near the unit of measure. For example: 60 kg N/ha; not 60 kg/ha N.
- The US dollar is the standard monetary unit for the IRRN. Data in other currencies should be converted to US$.
- Abbreviate names of standard units of measure when they follow a number. For example: 20 kg/ha.
- When using abbreviations other than for units of measure, spell out the full name the first time of reference, with abbreviations in parenthesis, then use the abbreviation throughout the remaining text. For example: The efficiency of nitrogen (N) use was tested. Three levels of N were .... *or* Biotypes of the brown planthopper (BPH) differ within Asia. We studied the biotypes of BPH in ....
- Express time, money, and measurement in numbers, even when the amount is less than 10. For example: 8 years; 3 kg/ha at 2-week intervals; 7%; 4 hours.
- Write out numbers below 10 except in a series containing some numbers 10 or higher and some numbers lower than 10. For example: six parts; seven tractors; four varieties. *But* There were 4 plots in India, 8 plots in Thailand, and 12 plots in Indonesia.
- Write out all numbers that start sentences. For example: Sixty insects were added to each cage; Seventy-five percent of the yield increase is attributed to fertilizer use.

Guidelines

- Contributions to the IRRN should generally be based on results of research on rice or on cropping patterns involving rice.
- Appropriate statistical analyses are required for most data.
- Contributions should not exceed two pages of double-spaced, typewritten text. Two figures (graphs, tables, or photos) per contribution are permitted to supplement the text. The editor will return articles that exceed space limitations.
- Results of routine screening of rice cultivars are discouraged. Exceptions will be made only if screening reveals previously unreported information (for example, a new source of genetic resistance to rice pests).
- Announcements of the release of new rice varieties are encouraged.
- Use common — not trade — names for commercial chemicals and, when feasible, equipment.
- Do not include references in IRRN contributions.
- Pest surveys should be quantified with data (% infection, degree of severity, etc.).

Genetic evaluation and utilization

OVERALL PROGRESS

Bhindeshwari, a new rice variety for rainfed wetland areas in Nepal

B. B. Shahi, National Rice Coordinator, National Rice Improvement Programme, Parwanipur Agricultural Station, Birgunj, Nepal

Bhindeshwari (IET1444), obtained through a TN1 / CO 29 cross in India, was introduced in Nepal through the International Upland Rice Yield Nursery in 1975. In tests under wetland conditions, it averaged 3.6 t/ ha at 6 irrigated sites and 3.5 t/ ha at 7 rainfed sites. Under rainfed dryland conditions at 3 sites over 3 years, it averaged 2.7 t/ ha. In farmers' fields, it averaged 3.2 t/ ha.

Disease resistance was high, with ratings (Standard Evaluation System for Rice scale) of 3 for bacterial blight, 5 for brown spot, and 3 for blast. Bhindeshwari matures in 105 days and is 85 cm high. Protein content is 8%.

The variety release committee of the Department of Agriculture, Nepal, has released Bhindeshwari for areas at altitudes of 914 m under varying growth conditions. Because almost all previous varieties were recommended for irrigated conditions and high inputs, a large area is expected to be planted to Bhindeshwari in the future. ■

Induced rice mutants in Haryana

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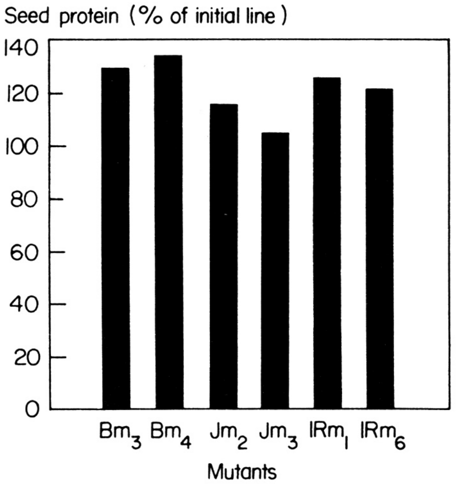
Using doses of physical (r rays) and chemical (DES, EMS) mutagens, singly and in combination, we rectified some of the genetic defects in three most commonly cultivated rices: Basmati 370, Jhona 349, and IR8. Plant progeny performance of 40 mutants led to the selection of 2 mutants of Basmati that are earlier maturing and higher yielding than the initial line (see table). But grain fineness is much reduced.

Two Jhona mutants with much

Characteristics of rice mutants in Haryana.[a]

	Shoot ht (cm)	Maturity in days	Grain yield (g)	Grain fineness (length:breadth)	Protein content (%)
Basmati 370 (control)	147.1	148.98	16.1	3.61	7.6
	± 0.67	± 0.91	± 0.36	±0.02	±0.08
Bm_3	122.1	132.15	21.4	2.82	7.4
	± 0.90	± 0.95	± 0.55	±0.01	±0.05
Bm_4	116.7	130.69	21.3	2.76	7.7
	± 0.59	± 0.88	± 0.52	±0.02	±0.04
CD at 5% level	4.79	6.34	1.25	0.05	0.05
Jhona 349 (control)	132.5	125.16	20.4	3.00	7.3
	± 0.54	± 0.71	± 0.59	±0.02	±0.04
Jm_2	128.7	124.72	22.8	3.51	7.7
	± 0.69	± 0.82	± 0.61	±0.02	±0.09
Jm_3	137.2	123.29	20.6	3.52	7.7
	± 0.70	± 0.75	± 0.61	±0.02	±0.08
CD at 5% level	4.69	5.78	1.25	0.05	0.06
IR8 (control)	87.8	150.90	20.6	2.38	7.1
	± 0.04	± 1.38	± 0.36	±0.01	±0.04
IRm_1	118.2	124.19	22.6	2.82	8.2
	± 0.80	± 1.85	± 0.36	±0.02	±0.06
IRm_6	85.7	131.68	20.8	2.62	8.7
	± 0.40	± 1.48	± 0.26	±0.01	±0.05
CD at 5% level	5.43	7.42	1.03	0.04	0.07

[a]Mean values of 360 plants, M_5-M_7 generations. ±: standard error.



Total seed protein production of rice mutants. Haryana, India.

higher grain yield and whose fineness matches that of Basmati 370 have been developed. A recombinant with super-fine grain is being tested. Two early, fine-grained, higher yielding mutants of IR8 also have been obtained.

Seed protein production of all these mutants is much higher than that of their corresponding initial lines (see figure). The mutants have been tested for performance, stability, and adaptability for four generations. ■

Improvement of local rice varieties by pureline selection in Afghanistan

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Rice is the third most important cereal crop in Afghanistan, covering 2 10,000 hectares, 16.6% of the total cropped area. Rice cultivation is concentrated in two zones — Nangarhar in the East with 34% and Baghlan in the North with 43% of the total rice area.

Almost all the rice area is planted to indigenous varieties of high quality with long slender translucent grains, but they seem badly mixed. Local varieties are tall growing with weak stems and are prone to lodging. They respond poorly to fertilization, with the result that the average rice yield is stabilized at about 2 t/ ha.

The important, good quality commercial rice varieties are Barah, Mahin, Lawangin, Basmati, and Dehraduni.

Performance of promising strains developed by pureline selection from local varieties at the Sheesham Bagh Agricultural Research Station, Jalalabad.

Commercial variety	Strain no.	Av yield (t/ha) 1975-78	Increase over bulk	
			kg/ha	%
Barah	5	3.3	801	31.5
	12	3.0	436	17.2
	Bulk	2.5	–	–
Mahin	2	2.8	68	2.5
	15	2.8	65	2.4
	27	3.1	311	11.3
	Bulk	2.8	–	–
Lawangin	11	3.1	549	17.7
	16	3.5	438	14.1
	Bulk	3.1	–	–
Basmati	3	2.9	32	1.1
	6	3.5	692	23.8
	Bulk	2.9	–	–
Dehraduni	8	2.5	357	16.5
	12	3.0	826	38.1
	21	3.5	1311	60.5
	Bulk	2.2	–	–

They have been grown since time immemorial without attempts to bring about varietal improvement. Each variety is a mixture of a number of morphologically similar lines. Systematic pureline selection work was initiated in 1972 at the Sheesham Bagh Agricultural Research Station, Jalalabad, Nangarhar.

Single plant progenies were compared with bulk varieties. Pure breeding and promising strains were further tested in 2-4 year replicated varietal trials 1975-1978. Two to three best quality and yield strains have been selected in each variety.

The new strains yielded an average 32 kg/ha (1.12%) to 1311 kg/ha (60.51%) more than their respective bulk varieties (see table). Strains No. 5 in Barah, No. 27 in Mahin, No. 11 in Lawangin, No. 6 in Basmati, and No. 21 in Dehraduni have been selected for further multiplication to replace local commercial varieties. ■

Performance of direct-sown photoperiod-sensitive rices at varying nitrogen levels under shallow-deep water at North Bihar, India

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A field trial during the 1980 wet season at the Rajendra Agricultural University Farm, Pusa, was laid out in a split plot design with three replications. Three nitrogen levels (0, 20, and 40 kg/ ha) were assigned to main plots and 7 varieties (64-117, 62-68, 62-31, 62-10, BR14, Parwapankh, and Akalbir) were assigned to subplots. Soil type was clay loam with 0.7% organic carbon, 11.2 kg available P_2O_5/ha, and 208 kg available K_2O/ ha. The pH was 8.4 and the EC 0.35 mmho/cm.

Seeds were drilled 21 May in rows 20 cm apart, at a rate of 80 kg seed/ha. After weeding the first week of July, nitrogen through urea was applied as top-dressing. Rainwater from catchments started accumulating the last week of July and maximum water depth went to 81 cm in late August. Harvest was in early December.

64–117 and Parwapankh had significantly higher yields than other varieties (see table). High yields were due to more panicles and a higher grain weight (resulting in heavier panicles) in 64–117, and a higher number of spikelets per panicle and higher spikelet fertility in Parwapankh. Maximum plant height was recorded in Akalbir, indicating it may be suitable for medium-deepwater areas.

Neither grain yield nor any other plant characteristics were influenced sig-

Grain yield and plant characteristics of photoperiod-sensitive rices by variety and nitrogen level under shallow-deepwater conditions in north Bihar, India.

Treatment	Plant ht (cm)	Panicles (no./m²)	Panicle wt (g)	Spikelets (no./panicle)	Spikelet fertility (%)		1,000-grain wt (g)	Grain:straw ratio	Grain yield (t/ha)
					Original value	Transformed value			
Variety									
64-117[a] (Chenab)	169	198	2.0	85.9	94.4	76.4	30.0	0.4	2.6
62-68[a] (Kabara)	156	147	1.4	101.7	92.4	74.0	21.9	0.3	1.6
62-31[a] (Bajara)	166	185	1.6	74.1	90.7	72.4	27.4	0.3	2.0
62-10[a] (Barogar)	171	174	1.6	81.6	91.4	73.1	27.8	0.3	1.9
BR14[a] (Jessaria A)	178	133	1.3	74.8	90.7	72.4	24.0	0.2	1.4
Parwapankh[b]	168	184	2.0	95.8	95.7	78.1	27.0	0.3	2.3
Akalbir[b]	199	171	1.7	100.3	94.1	76.0	28.3	0.3	1.9
S.Em. ±	4.3	8.8	0.09	3.2	–	0.54	0.41	0.02	0.14
C.D. 5%	12.3	25.2	0.26	9.2	–	1.54	1.18	0.05	0.39
Nitrogen level (kg/ha)					*Av for all varieties*				
0	171	176	1.61	83.4	92.5	74.4	26.7	0.3	2.0
20	172	170	1.67	93.1	92.9	74.7	27.3	0.3	2.0
40	174	165	1.69	86.7	92.8	74.6	25.3	0.3	1.9
S.Em. ±	4.8	4.2	0.08	4.0	–	0.18	0.25	0.03	0.05
C.D. 5%	ns	ns	ns	ns	–	ns	ns	ns	ns

[a]Selected from local variety in parentheses. [b]Local variety. ns = not significant.

nificantly by nitrogen levels. However, plant height tended to increase with nitrogen level. A trend toward reduction in panicle number per square meter and grain-straw ratio with increasing levels of nitrogen was discernible. This indicates a need to evolve nitrogen-responsive varieties for shallow-deepwater conditions.

Variety by nitrogen interaction was not significant. ■

Rice germplasm collection in North Bihar, India

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The 807 specimens from 13 districts represent a wide spectrum of tolerance for such conditions as moisture stress in early vegetative phase; waterlogging in lowland, semideep, and deep water conditions; and reactions to brown spot and rice tungro virus. Screening against stem borer, brown spot, rice tungro virus, brown planthopper, whitebacked planthopper, and waterlogged and deep water conditions has begun. A method to reject duplicates is being developed.

Farmers usually grow photoperiod-sensitive aman rices. Bakol, a long bold type with straw color husk and red to white pericarp, can be grown from transplanted mid-land sites to semi-deepwater (10-80 cm water depth). It tolerates submergence for a few days at the stem elongation stage.

The highly prized Basmati rice from Champaran district is a fragrant, medium slender type. Other scented types are Kamod, Tulsi manjari, Tulsi phool, Katarni, and Baharani.

Anandi is preferred for in Champaran district for parched or popped rice (muree or murmura).

Flaked rice is more common in North Bihar. The widely grown Maricha is mildly scented and palatable. Among the high yielding varieties, Pankaj is more preferred.

Semideep and deepwater rices are direct-seeded in low-lying depressions during March-April. Varieties grown under these conditions yield only 0.5-0.6/ ha. Damage is caused by stem borers, rice tungro virus, water-birds, and nocturnal animals.

Rice is grown to a maximum water depth of 5 m in Kursela (Purnea), Kanwarlake in Charia-Bariarpur (Begusarai), Satanpur-Hasanpur in Dalsingsarai (Samastipur), Kusheshwar Asthan (Darbhanga), and Barailachaur (Vaishali). Some widely grown varieties are Borogar, Salmot, Lattipakar, Darmi, Singara, Jagar, and Parwapankh.

Sathi, a cleistogamous variety, is being grown as an aus rice, followed by a second crop of aman rice. The variety is poor yielding and highly susceptible to sheath rot.

Over 80% of the area is still under tall indicas. Farmers practice late transplanting up to the middle of August. In flood affected areas, transplanting continues to late September, depending upon flood recession. Double transplanting or 60-80-day-old seedlings are used. ■

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 abridgement to meet space limitations. Authors will be identified by name, title, and research organization.

Disease resistance

Varietal resistance to *Xanthomonas campestris* pv. *oryzae* in Guangdong, China

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Sixty isolates of *Xanthomonas campestris* pv. *oryzae* of different virulence were inoculated into 46 rice varieties. Results showed that varietal resistance to bacterial blight may be grouped into three categories: broad spectrum, nonbroad spectrum, and no resistance.

Most introduced cultivars belonged to the broad spectrum group (see table). Varieties Tsai-Ye-Ching 8, Foo-Bao-Ai 22, Jiao-Jin-Fung 5, Qiu Er Ai 1-3, Teng Pu-Ai, Tetep, and Zenith belonged to the nonbroad spectrum group. Improved plant type and high-yielding varieties such as IR8, Zhen-Zhu-Ai 11, Quang-Liu-Ai 4, Quang-Er-Ai No. 5-3, and Jing-Gong 30 belonged to the no resistance group.

To incorporate bacterial blight resistance into breeding materials, the most promising results will be obtained by using varieties with broad-spectrum resistance and virulent strains of the predominant pathogenic group 4 of Guangdong province for screening tests. ■

Rice varietal resistance to 60 isolates of *Xanthomonas campestris* pv. *oryzae* in China.[a]

Type of resistance	Variety	Origin	Disease scale	Resistant (%)		Moderate (%)		Susceptible (%)	
				HR	R	MR	MS	S	HS
I	3303	China	HR	100.00					
	IR2161	Philippines	HR-R	98.33	1.67				
	IR2061-522-6-9	Philippines	HR-R	93.33	6.67				
	G.E. 456	USA	HR-R	93.33	6.67				
	VPR-70-3-7	–	HR-R	91.38	8.62				
	DV85	India	HR-R	86.67	13.33				
	IR26	Philippines	HR-R	64.41	35.59				
	BG-35-2	Sri Lanka	HR-MR	81.67	15.00	3.33			
	IR30	Philippines	HR-MR	28.37	70.00	1.67			
	Hai-ching 130	China	HR-MS	81.30	13.60	1.73	3.37		
	IR36	Philippines	HR-MS	73.37	23.33	1.67	1.67		
	IR32	Philippines	HR-MS	50.94	39.62	7.55	1.89		
	IR22	Philippines	HR-MS	68.33	25.00	1.67	3.33	1.67	
	IR1545	Philippines	HR-MS	23.33	68.33	3.33	5.00		
	IR28	Philippines	HR-MS	7.85	68.63	13.72	9.80		
	Hai 42	China	HR-MS	61.67	28.33	3.33	1.67	5.00	
II	Lan Xian 1	China	HR-HS	43.33	46.67	3.33	5.00	0	1.67
	1388	China	HR-HS	38.33	40.00	8.33	0	5.00	8.33
	74-105	China	HR-HS	33.33	46.67	5.00	8.33	1.67	5.00
	Fei-Yan (076)	Philippines	HR-HS	28.33	26.67	15.00	10.00	6.66	13.33
	Unnamed (Zhung San)	China	HR-HS	15.00	41.67	21.67	10.00	3.33	8.33
	2150	China	HR-HS	5.00	38.33	25.00	11.66	8.33	11.66
	IR661	Philippines	HR-HS	1.67	21.67	41.67	11.67	15.00	8.33
	Ai-Tong-Zhu	China	R-HS		25.00	48.33	15.00	5.00	6.67
	Xai-Tan-Gu 4882	Indonesia	R-HS		25.00	43.00	20.00	8.33	3.33
	Tsai-Ye-Ching 8	China	R-HS		23.73	40.68	16.95	10.17	8.47
	Foo-Bao-Ai 22	China	R-HS		23.73	28.81	30.51	3.39	13.55
	Tetep	IndoChina	R-MS		10.00	38.33	33.33	8.33	10.00
	BTO-MO-3-3		R-HS		18.97	41.38	29.31	5.17	5.17
	Teng-Pu-Ai	China	R-HS		8.33	18.33	46.67	18.33	8.33
	Jiao-Jin-Fung 5	China	R-HS		11.86	27.12	30.51	18.64	11.86
	IR24	Philippines	R-HS		9.09	38.18	30.91	10.91	10.91
	Qiu-Er-Ai 1-3	China	R-HS		5.00	31.67	38.33	16.67	5.00
	Guai-Chao-2	China	R-HS		5.00	20.00	40.00	20.00	15.00
	Er-Bai-Ai	China	R-HS		1.67	11.67	60.00	15.00	11.67
	co 22	India	R-HS		1.67	20.00	41.67	23.33	13.33
	Zenith (dwarf)	USA	R-HS		1.75	5.26	29.82	31.58	31.58
	Zenith (purple)	USA	R-HS		1.67	11.66	36.67	38.33	11.56
III	Tadukan	Philippines	MR-HS			17.24	46.55	20.69	15.51
	Bao-Tai-Ai	China	MR-HS			5.00	48.33	26.67	20.00
	9101	China	MR-HS			5.00	55.00	16.67	23.33
	Guang-Er-Ai 5-3	China	MR-HS			3.00	26.67	28.33	41.67
	Jing-Gong 30	China	MR-HS			1.67	23.33	46.67	28.33
	IR8	Philippines	MR-HS			3.33	33.34	43.33	20.00
	Zhen-Zhu-Ai 11	China	MS-HS				30.00	51.67	33.33
	Quang-Liu-Ai 4	China	MS-HS				3.33	30.00	66.67

[a]HR = highly resistant, R = resistant, MR = moderately resistant, MS = modcrately susceptible, S = susceptible, HS = highly susceptible.

Pale yellow and kresek symptoms caused by *Xanthomonas oryzae* isolates

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Pale yellow symptom caused by bacterial blight organism *Xanthomonas campestris* pv. *oryzae* was not observed in Bangladesh until mid-1980. Early attempts to develop pale yellow symptom by artificial inoculation with *X. oryzae* isolated from blight-affected leaves and kresek-affected plants failed even at low temperatures. Failure could be due to lack of specific temperature requirements, relative humidity, solar radiation, or the specific strain.

In 1980 aus, 8 *X. oryzae* isolates were tested on 10-day-old seedlings of 19 varieties (3 seedlings/pot and 8 pots/variety). The seedlings were inoculated at 45 days age by the clipping method. They were scored twice, 15 days and 21 days after inoculation.

Results (see table) show pale yellow symptom was produced by BXO 5 collected from Rajshahi, a drier district of Bangladesh; by BXO 8 collected from Mirzapur, Tangail; by BXO 9A and BXO 9B collected from BRRI farm; by BXO 10 collected from Comilla; and by BXO 11 collected from Rangpur.

Development of pale yellow and kresek symptoms by *Xanthomonas oryzae,* BRRI, Bangladesh, 1980 aus.

Variety	Disease development[a] due to indicated isolate							
	BXO 2	BXO 5	BXO 7	BXO 8	BXO 9A	BXO 9B	BXO 10	BXO 11
IR8	–	–	–	K_5P	K_5P	K_6	–	–
IR20	–	–	–	K_7	K_5	K_7	–	–
IR1545-339	–	P	–	K_6P	K_5	K_4	–	–
DV85	–	P	–	–	P	–	–	–
Cempo selak	–	–	–	K_3	K_7	K_3	–	–
Cas 209	–	–	–	K_3P	K_9	K_7	P	–
Kogyoku	–	–	–	–	–	–	–	–
Rantai emas-2	–	–	–	K_4	K_6	K_4	–	–
Chugoku 45	–	–	–	–	–	–	–	–
Kinmaze	–	–	–	–	–	–	–	–
Java 14	–	–	–	–	K_5	–	–	–
Wase ai Koku	–	–	–	–	–	–	–	P
Milyang 23	–	–	–	K_4	K_7	K_6P	–	–
Yushin	–	–	–	K_1	K_6	K_3	–	–
Suweon 281	–	–	–	K_3	K_7	K_3	–	–
Tongil	–	–	–	K_3	K_7	K_6	–	–
Shitkisaita	–	–	–	K_5P	K_5	K_4P	–	–
BR160-19-2-1	–	–	–	K_4P	K_8	K_5P	–	–
Purbachi/Rayada 16-02	–	K_7P	–	K_6	K_8	K_7P	K_7P	–

[a]The number following K indicates severity of kresek on a 0-9 scale, P = pale yellow symptom.

Kresek symptom was developed by BXO 5 and BXO 10 on Purbachi /Rayada 16-02 and by BXO 8, BXO 9A, and BXO 9B on all IRRI varieties except DV85 and Kogyoku, a Japanese differential.

BXO 8 appeared most virulent for pale yellowing and BXO 9A for kresek development.

DV85 possessing *xa 5* and *Xa 7* (one recessive and one dominant resistance genes) and holding its resistance in many countries, showed pale yellow symptom caused by isolates BXO 5 and BXO 9A. BXO 2 collected from Sandwip, an island of Chittagong District, and BXO 7 collected from Noakhali produced neither pale yellow symptom nor kresek. Purbachi/ Rayada 16-02 appeared most susceptible. All its isolates but three produced kresek and three produced both kresek and pale yellow.

Temperatures for 1979 and 1980 were similar, but solar radiation and relative humidity were different, which may have had some effect on the development of pale yellow symptom. ■

GENETIC EVALUATION AND UTILIZATION

Insect resistance

Increasing the level of resistance to yellow stem borer through male sterile facilitates recurrent selection in rice

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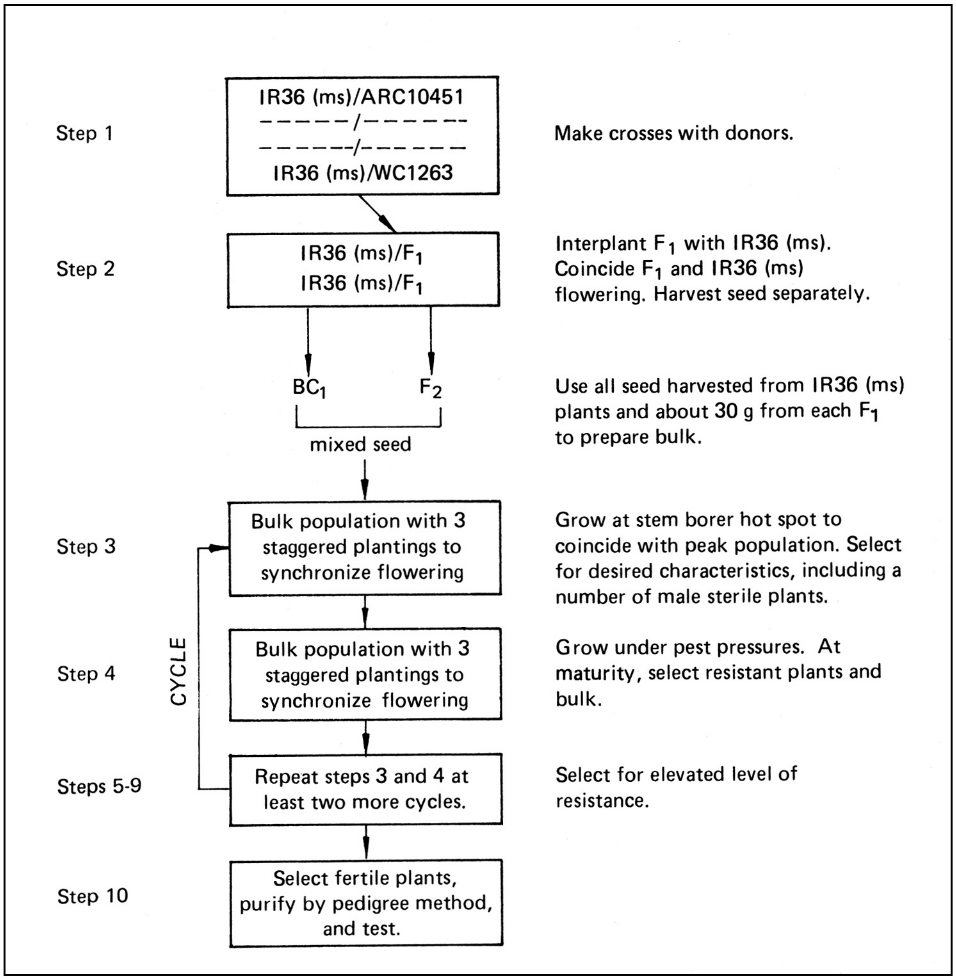
The level of genetic resistance to yellow stem borer has not been satisfactory and known donors have not been worth exploiting through existing breeding programs. Some wild rices are resistant, but are genetically distantly-related and difficult to cross with *Oryza sativa.* Increasing the level of resistance in existing donors is one technique for creating suitable donors.

Population breeding by recurrent selection has been used in cross-pollinated crops such as maize, sugar beet, and sunflower. Rice, a self-pollinated crop, could not be handled in this manner. But, with the availability of male sterile IR36, it is now possible to use a breeding scheme similar to recurrent selection. Because resistance to stem borer is governed by a polygenic system, it should be possible to obtain breeding lines with levels of resistance higher than those of present donors.

A 10-step procedure was used (see figure). Twenty-six donors screened against stem borer were crossed with the male sterile IR36 to build a new breeding population (see table).

All seed produced on BC and 30 g of each F_2 seed are mixed to prepare the starting population. This bulk seed is interplanted at stem borer hot spots in 3 plantings at 10-day intervals. Supplementary pollination is done by such methods as rope pulling to allow maximum outcrossing. Seeds are grown



Procedure for increasing yellow stem borer resistance.

Origin and seed source of lines and varieties with moderate resistance to stem borers. IRRI, 1981.

Line or variety	Origin	Seed source
ARC10451	India	Acc. 20925
ARC12171	India	Acc. 21959
ARC12387	India	Acc. 22023
Aus Balam	Bangladesh	Acc. 25832
Biplab	Bangladesh	Acc. 26952
CO 18	India	Acc. 6331
CO 21	India	Acc. 6396
CR34-73-200	India	CRRI, Cuttack
CR94-13	India	CRRI, Cuttack
CR157-392-4	India	CRRI, Cuttack
Donangnouan	Laos	Acc. 29953
IARI 5829	India	Acc. 14423
IET5121	India	AICRIP, Hyderabad
IR18 20-52-2-4-1	Philippines	IRRI breeding line
IR3941-97-1	Philippines	IRRI breeding line
IR13639-34	Philippines	IRRI breeding line
IR13641-18	Philippines	IRRI breeding line
IR19362-183	Philippines	IRRI breeding line
Lepgu	Philippines	Acc. 11261
Liberian Coll. Y-082	Liberia	Acc. 30848
MTU 15	India	Acc. 6365
Ratna	India	Acc. 12890
RP887-46-1	India	AICRIP, Hyderabad
TKM6	India	Acc. 6216
Warangal Culture 1253	India	Acc. 11055
Warangal Culture 1263	India	Acc. 11057

under normal condition without protection.

At maturity, plants are selected for desired characteristics, making sure that a number of male sterile plants are included.

The bulk seed of the selected plants is grown at hot spots as in an earlier season and artificially reared stem borers are released to provide pest pressure. At maturity, resistant plants free of deadhearts and whiteheads are selected.

This selection for elevated level of resistance is done for three cycles.

Finally, fertile plants of the desired phenotype are grown in the pedigree nursery.

To select more resistant lines, stem borer pressure may be increased either by growing at hot spots or by hand-infesting plants with first-instar larvae reared from egg masses collected in the field. Seeds from other such developed populations also can be added at any step. This process may continue as long as desired, but fully fertile and resistant segregants may be extracted and tested for level of resistance at desired agronomic bases. Step 10 and onwards may be handled by rapid generation advance system wherever facilities are available. ■

Varietal screening for resistance to brown planthopper and its biotype in Bangladesh

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The first brown planthopper (BPH) outbreak in Bangladesh occurred in 1976. Screening against the BPH and its biotype was done in the greenhouse at BRRI. Of 450 rices screened, only 10 were found highly resistant and 27 resistant (see table).

IRRI has reported that Mudgo is resistant to biotype 1 and ASD7 to biotype 2. In Bangladesh, both are susceptible. Ptb 33 was reported resistant in India but showed variable reaction in this screening.

From the differential reaction of Mudgo, ASD7, and Ptb 33 to BPH, it is now clear that the biotype in Bangladesh is not biotype 1 or 2, but is either 3 or 4. ■

List of BPH-resistant materials. BRRI, 1980.

Variety or line	Origin	Reaction [a] to BPH
ARC6650	India	HR
ARC10550		HR
ARC14529		HR
Sinna Sivappu	Thailand	HR
BR.593-1-1-5	Bangladesh	HR
BR593-46-8-2-1		HR
BR593-46-8-2		HR
BR593-46-8-2-4		HR
IR19661-347	IRRI	HR
IR19661-372	IRRI	HR
BG367-9	Sri Lanka	R
BG379-1		R
BG379-3		R
BR593-1-1-2	Bangladesh	R
BR593-1-1-3		R
BR593-48-8-2-5-3		R
IR13240-10-1	IRRI	R
IR13240-39-3		R
IR13240-1-B		R
IR13240-6-3		R
IR13240-10-1		R
IR13240-83-1		R
IR13426-19-2		R
IR13427-60-1		R
1314632-31-3		R
IR14632-272		R
IR19660-121		R
IR19660-189		R
IR19660-53		R
IR19660-161		R
IR19660-253		R
IR19660-192		R
IR19660-315		R
IR19661-13		R
IR19661-163		R
IR19661-364		R
Hondarwala	Sri Lanka	R

[a] HR = highly resistant, R = resistant.

GENETIC EVALUATION AND UTILIZATION

Adverse soils tolerance

Varietal response to growth regulators under saline conditions

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A pot culture study during the 1974 wet season evaluated the effects of two growth regulators, 2-chloroethyl trimethyl ammonium chloride (CCC) and benzyl adenine (BA), on grain yields of rice varieties Getu and Madhu under induced salinity.

Three hills were grown in each pot. One set of pots was irrigated with saline water (NaCl + $CaCl_2$ in 4 to 1 ratio), bringing soil EC_e to around 8 mmho/cm. Another set was irrigated with good quality water (EC-0.95 mmho/ cm). CCC at 2,000 ppm and BA at 10 ppm were applied to pot sets as foliar sprays twice between primordial initiation and panicle emergence. Each treatment was replicated three times. Grain yield data indicate significant differences due to variety, salinity level, and growth regulator (see table). Under unsprayed saline conditions, Getu, with a 37.5% reduction from normal conditions, yielded more than Madhu with a 70.2% reduction from normal. However, the extent of reduction varied under salinity in combination with growth regulator. In Getu, the yield was reduced further (72.4%) with BA but increased slightly (31.7%) with CCC. On the other hand, Madhu showed marked response to growth regulators under salinity, with a 55.3% yield reduction under BA and a 36.2% reduction under CCC. The apparent increase in yield could be attributed to increased grains per panicle and reduced spikelet sterility.

The results suggest that care be exercised in selecting varieties as well as growth regulators for improving productivity under saline situation. Getu, a salt-tolerant variety, did not better its performance when supplemented with growth regulators. ■

Effect of growth regulators and salinity on grain yield and associated characteristics of 2 rice varieties. Karnataka, India, 1974 wet season.

Treatment [a]	Grain yield (g/pot)		Productive tillers (no./ pot)		Grain (no. panicle)		Spikelet sterility (%)		1,000-grain wt (g)	
	Getu	Madhu	Getu	Madhu	Getu	Madhu	Getu	Madhu	Getu	Madhu
Control normal	32.8	32.8	24.0	25.0	87	95	24.2	32.9	21.1	18.4
Control saline	19.9	9.5	20.7	16.0	69	61	34.6	35.8	17.5	15.3
BA normal	35.8	31.7	26.0	21.3	82	101	29.1	26.5	21.5	18.1
BA saline	8.8	13.6	16.3	17.3	41	74	46.2	31.0	15.3	14.1
CCC normal	27.8	31.4	18.7	22.0	83	100	28.9	30.1	21.5	18.2
CCC saline	22.0	28.9	19.3	18.7	73	83	29.3	32.3	20.0	14.1
Mean	23.0		20.4		79.1		31.7		17.9	
C.D. 5%										
Variety	1.4		ns		2.8		ns		0.5	
Salinity	1.4		1.5		2.8		1.6		0.5	
Growth regulator	1.7		ns		3.5		2.0		0.6	

[a] BA = benzyl adenine. CCC = chloroethyl trimethyl ammonium chloride.

GENETIC EVALUATION AND UTILIZATION

Deep water

Effect of seedling age on total plant elongation and internode elongation of deepwater rice

H. A. Quayyum, scientific officer, A. R. Gomosta, principal scientific officer,and M. Z. Hoque, head, Plant Physiology Division, Bangladesh Rice Research Institute, Dacca, Bangladesh

Five recommended deepwater rice varieties were grown in wooden screening boxes (30 × 30 × 24 cm) for 10, 20, 30, and 40 days. Seedlings were then submerged in 100-cm deep water in concrete tanks for 7 days. The boxes were adjusted so that leaf tips were about 50 cm below water level.

The internodes of all varieties elongated as early as 20 days, but plant elongation occurred as early as 10 days. The percentage increase in plant elongation had no positive relation with the total length of internodes produced. Total plant elongation decreased with seedling age, but the number of internodes and their total length increased. The greatest plant elongation was observed in 10-day-old seedlings and the

Elongation ability of deepwater rice as affected by age of seedlings. BRRI, Dacca, Bangladesh.

Seedling age (d)	% increase in plant ht	Internode length (cm)	Internodes (no.)
	Habiganj Aman II		
10	216	0	0
20	160.5	51.8	3.2
30	130.1	61.8	4.6
40	76.8	48.9	3.8
	Habiganj Aman III		
10	177.8	0	0
20	112.8	43.6	2.5
30	134.2	63.0	4.6
40	134.2	49.9	3.6
	Habiganj Aman V		
10	203.4	0	0
20	186.8	44.5	2.5
30	140.0	67.0	4.2
40	112.1	56.9	4.6
	Habiganj Aman VI		
10	189.1	0	0
20	165.1	49.4	2.5
30	140.9	55.1	3.9
40	104.5	53.0	3.9
	Habiganj Aman VII		
10	222.3	0	0
20	145.4	60.6	3.6
30	121.2	68.4	4.2
40	105.9	55.8	4.2

greatest internode length was recorded in 30-day-old seedlings.

It appears that total plant elongation ability and internode elongation ability are different physiological phenomena, although equally important in varietal adaptation to flood-prone areas. ■

GENETIC EVALUATION AND UTILIZATION

Temperature tolerance

Effect of ash on the cold tolerance of rice at seedling stage

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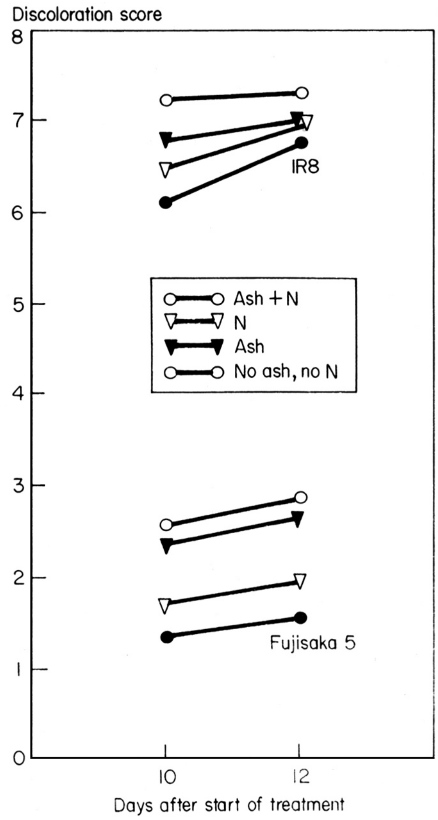
In China, ash is applied either as basal or topdressing to seedbeds during the first cropping season before the onset of low temperature to increase cold tolerance and decrease cold injury at the seedling stage. The potassium-rich ash probably increases cold tolerance, and the dark color of the ash probably absorbs heat and raises water temperature. Two kinds of ash are used: from burnt stove firewood and from burnt straws or grasses with some soil added. Potassium (K_2O) content is 64%. Ash from burnt straw has more nitrogen.

Three trials were conducted to evaluate whether application of ash could prevent or alleviate discoloration and death of rice seedlings subjected to cold water.

The first experiment tested two varieties — IR8, which is susceptible to low water temperature, and Fujisaka 5, which is resistant. Pulverized rice straw ash and ammonium sulfate were used in four treatments.

Ten rows of IR8 and Fujisaka 5 were sown alternately in each treatment tray. Ten days after soaking, the trays were placed in a circulating-cold-water (12° C) tank with water 2 cm above the soil surface.

The cold tolerance of IR8 and Fujisaka 5 measured by leaf discoloration is shown in the figure. The order of cold tolerance in all treatments was: ash + N > N > ash > no ash, no N.



Discoloration scores of IR8 and Fujisaka 5 seedlings grown with different combinations of ash and nitrogen, at different days after start of cold water treatment. IRRI, 1981.

The succeeding two trials used only IR8 and added potash in two additional treatments. The order of cold tolerance for the six treatments was K + N > ash + N > K > ash > no ash, no N, no K > N. Leaf discoloration was observed after a day of cold water treatment in plants grown with no ash, no N, no K; with ash and with K. Plants grown in ash + N and K + N did not develop yellowing until 4 or 5 days after the start of the treatment.

Plant height increased despite low water temperature, with significantly higher percentage increases in K+N, and ash + N.

Application of ash or potassium mixed with nitrogen in the seedbed increased plant height, promoted growth, and slowed leaf discoloration, and thus increased cold tolerance during the seedling stage. The treatment is effective both with cold water-susceptible and tolerant varieties. ■

A method for screening rice cultivars for cold tolerance at early seedling stage

J. Dome, rice breeder, BP 29 Adrao-West African Rice Development Association, Richard Toll, Senegal; G. Pateña, research assistant, and B. S. Vergara, plant physiologist, Plant Physiology Department, International Rice Research Institute

In temperate areas, high-elevation areas, or some newly-cultivated tropic areas, low temperatures may kill, retard, or weaken the growth of pregerminated seeds.

This method is proposed to test cold tolerance of rice cultivars at the early seedling stage.

For each rice to be screened, put 20 germinated seeds in each of 3 vials or small bottles lined with moistened tissue paper. When seedlings have a coleoptile of 5 mm, subject to 4°C cold treatment for 10 days. Allow the seedlings to recover for 10 days at ambient temperature in a greenhouse. Then, score for cold tolerance at early seedling stage (see chart).

Score	Criteria: Vigor	Criteria: Density
I	Seedling height more than 10 cm, green leaves.	All seedlings alive.
3	Seedling height generally 8-10 cm,	Less than 30% seedlings dead.
5	Seedling height generally 5-7 cm,	30-50% seedlings dead.
7	Seedling height generally 3-4 cm,	More than 50% seedlings dead.
9	All seedlings dead, seedling height < 1 cm.	All seedlings dead.

The reactions of germinated seeds to cold treatment vary considerably with stage of development. Discrimination between cold-tolerant and susceptible cultivars is more obvious if seeds subjected to cold treatment have a well-developed coleoptile of about 5 mm and traces of chlorophyll. Less-developed seedling of a susceptible rice could show little effect of the cold treatment and be mistaken for a tolerant cultivar.

Rices also differ in developmental habits. Generally, most indicas reach the optimum stage of development after 72 hours of incubation. Japonica varieties take longer. It is advisable to divide a collection according to the rates of development of the types and subject seedlings to cold treatment only when they have arrived at the correct stage.

To prevent drying of the seedlings, check moisture content of the vials regularly. Include a fungicide in first watering to avoid fungus damage.

Score samples for both seedling vigor and density of surviving plants and take the mean of the two scores.

With this method, Barkat (K78-13), Baekgogna, and Jo Do were found tolerant (score 1 to 3) at the early seedling stage; Taichung Sen Yu 229, Dumai, Suweon 287, and IR8 were sensitive (5 to 9). ■

Rice pollination characteristics related to high temperature tolerance

D. J. Mackill, research fellow, International Rice Research Institute

High temperature-induced sterility has not been an important problem in traditional cropping patterns. However, with the development of irrigation systems for dry season cropping of rice and the expansion of rice production in semiarid countries, high temperature tolerance may become an important breeding objective. Several rice cultivars and breeding lines differing in reaction to high temperature at the anthesis stage were studied for their ability to shed pollen on the stigma.

Spikelets of each variety or line were collected in the afternoon of the day of anthesis. The number of pollen grains on the stigma was counted and stigmas with more than 100 pollen grains were scored as 100. Plants from the 29°/21° and 38°/27°C glasshouse rooms of the IRRI phytotron and from the field at IRRI were sampled in the 1980 dry season and the 1981 wet season. Percentage of fertility or filled grains was measured on plants grown in the phytotron. The number of pollen grains per anther was measured on plants growing in the field.

Percent fertility, pollen grains per stigma, and pollen grains per anther for 6 rices grown in the phytotron and in the field at IRRI, 1980 wet season and 1981 dry season.

Variety or line	Phytotron: Fertility (%) 29°/21°C[a]	Phytotron: Fertility (%) 38°/21°C	Phytotron: Pollen grains (no./stigma) 29°/21°C	Phytotron: Pollen grains (no./stigma) 38°/27°C	Field: Pollen grains (no./stigma) 1980 WS	Field: Pollen grains (no./stigma) 1981%	Field: Pollen grains (no./anther), 1981 DS
Heat tolerant							
N22	88.9 bc	30.0 ab	65.4 b	65.6 a	*b*	85.7 a	1085 b
IR2006-P12-12-2-2	97.9 a	31.8 a	84.9 a	68.2 a	86.8 a	80.8 a	1908 a
IET4658 (UPR96-1-1-1)	88.1 bc	19.5 bc	66.3 b	63.0 a	76.8 a	72.9 a	1255 b
Heat susceptible							
IR28	71.4 d	3.6 d	33.1 c	12.5 b	60.9 b	70.7 a	1800 a
IR1561-228-3-3	94.8 ab	4.3 d	32.6 c	19.6 b	54.0 bc	40.8 b	1705 a
IR52	84.1 cd	3.1 d	17.3 c	1.8 b	42.4 c	38.2 b	1750 a

[a]Within a column means followed by the same letter are not significantly different at the 5% level. [b]No measurement was made for N22 in the wet season of 1980.

In the phytotron fertility was greatly reduced in plants at 38° / 27° C during flowering. Three heat-tolerant rices had higher fertility at 38° /27° C. This was apparently not related to the fertility at 29° /21° C, because the heat-susceptible line IR1561-228-3-3 had high fertility at this temperature. Heat-tolerant rices had more pollen grains per stigma than susceptible rices at both temperatures. In tolerant rices, high temperature had little effect on the number of pollen grains per stigma. In susceptible rices, high temperature greatly reduced the number of pollen grains per stigma (see table).

Pollen shedding on the stigma in field-grown plants showed the same trend as in phytotron-grown plants. The amount of pollen shed on the stigma was not related to the number of pollen grains per anther; two tolerant rices, N22 and IET4658, had significantly less pollen grains per anther than the other lines.

It appears that the amount of pollen shed on the stigma is related to the time of anther dehiscence in relation to filament elongation. This trait, which distinguishes heat-tolerant from heat-susceptible rices, is expressed under field conditions even in the absence of high temperature. ■

Pest management and control DISEASES

Rice bacterial blight status in the Punjab, India

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Bacterial blight (BB) caused by *Xanthomonas campestris* pv. *oryzae* has been known to occur in Punjab State of India since the 1940s. The disease, first observed in Gurdaspur district, was called *purarh* or *pansukh* in the local language, which means blighting or leaf-drying. It was considered to be due to some physiological disorder, and only in 1965 was its etiology established.

BB has been found to appear every year in varying degrees in different areas. During 1980 kharif (dry season), BB assumed an epiphytotic form and caused considerable yield loss throughout the state, in some areas as high as 60-70%. The kresek phase of the disease was also recorded in some fields for the first time.

Increase in BB incidence and severity may be attributed to higher nitrogen applications, very early transplanting, and conducive macro- and microclimatic conditions. The possibility of pathogenic variability also exists.

In the Punjab, the rice season lasts from May to October. Because almost all rice straw is burnt in the fields, there does not seem to be any chance for the bacterium to be carried over to the next crop season through infected rice straw. The possibility of pathogen survival in the stubble of infected plants is not ruled out, although harvested rice fields are immediately replanted to wheat.

Incidence of bacterial blight in Punjab, India.

Year	BB incidence
1975	Moderate to severe
1976	Low to severe
1977	Low to severe
1978	Low to severe
1979	Moderate to severe
1980	Severe

The speculation is that BB bacterium carries over to the next crop season through infected seed. It is also possible that the pathogen survives in the rhizosphere of wheat and other nonhost plants during winter. Studies are being initiated to identify the source of carry-over. Studies on variability also are in progress. Some resistant donors have been identified and are being used in the breeding program. Progeny will be screened under artificial inoculation conditions. Attempts are being made to develop differentials and to test bacterial isolates from all over the state.

In vitro inhibition of rice fungal pathogens by extracts from higher plants

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Leaves of *Polyalthea longifolia, Parthenium histerophorus,* and *Cymbopogan* sp. were macerated. The aqueous extracts were mixed at varying concentrations with potato dextrose agar and tested for antifungal activity by poison-food technique. Rhizomes of *Zingiber officinale* (ginger) and *Curcuma longa* (turmeric) were also tested for antifungal activity. Fungal pathogens tested were *Rhizoctonia solani, Sclerotium oryzae, Sclerotium rolfsii, Acrocylindrium oryzae, Helminthosporium oryzae,* and *Pyricularia oryzae.*

Extracts from plants inhibited the growth of most fungal pathogens tested. The growth inhibition was greater in *R. solani* and *S. oryzae* than in other pathogens.

Extracts from *Azadirachta indica, Catharanthus roseus, Calotropis gigantea, Allium cepa, A. sativum, Eichhornia crassipes,* and *Clerodendron sp.* showed poor growth inhibition of the fungal pathogens tested. ■

Nilaparvata bakeri transmission of rice ragged stunt virus

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Rice ragged stunt virus transmission abilities of *Nephotettix virescens, Recilia dorsalis, Sogatella furcifera,* and *Nilaparvata bakeri* were tested. Nymphs of *N. virescens* and adults of *R. dorsalis* and *S. furcifera* were allowed feeding access on diseased rice plants for one day. Each insect was tested for transmission ability by serial daily transfers onto a test plant, Taichung Native 1, in a test tube.

Nilaparvata bakeri nymphs were allowed feeding access on diseased rice plants for 17 hours (overnight), and were reared on a host, *Leersia hexandra,* for 7 days (incubation period). Transmission ability was tested by alternately putting the insect for 16 hours on a test rice plant and 8 hours on *Leersia hexandra. N. bakeri* would die if fed only on rice plants.

N. virescens, R. dorsalis, and *S. furcifera* did not transmit rice ragged stunt virus but *N. bakeri* did. ■

Resistance of *Xanthomonas campestris* pv. *oryzae,* the rice bacterial blight pathogen, to phenazine

Sunetra Eamchit, Nongrat Nilpanit, and Wichit Sirisantana, Rice Pathology, Division of Plant Pathology and Microbiology, Agriculture Department, Bangkok, Thailand

The bacteriostatic effect of phenazine on *Xanthomonas campestris* pv. *oryzae,* the rice bacterial blight pathogen, under laboratory conditions was confirmed.

Phenazine-resistant variants of the bacterial strains were easily obtained by the paper disc method on peptone sucrose agar plates (Tab1e 1). The number of phenazine-resistant variants was not correlated with virulence. Variants derived from strains of pv. *oryzae* that had lost their virulence seemed to be more virulent to RD1, a susceptible rice cultivar than the parent strains. Some variants obtained from other virulent strains were similar to and others different from parental strains.

Two days after RD1 was inoculated with both wild type parental strains and variants derived from them, derivative variants produced longer lesions than parental strains (Table 2). Variants derived from different groups appeared to increase in virulence in most strains tested, but only a few were similar to the parental strains.

Since it is relatively easy to obtain the phenazine-resistant variants, the efficiency of the chemical *in vitro* should be monitored before a recommendation is made under field conditions. ■

Table 1. Inhibition effect of phenazine on strains of *Xanthomonas campestris* pv. *oryzae* and phenazine-resistant variants from the inhibition zone. Bangkok, Thailand.

Strain	Virulence group	Inhibition zone [a] (cm)	Colony variants [a] (no.)
TB7535	0	6.6	2.6
TB7612	0	5.5	0.2
TB7618	0	4.2	22.7
TB7803	0	6.2	124.7
TB7811	0	6.1	0.7
TB7817	0	8.1	4.8
TB7824	0	8.4	5.1
TB7615	I	5.4	43.7
TB7804	I	4.5	31.3
TB7810	I	5.0	5.1
TB7837	I	8.5	187.9
TB7212	II	7.5	28.8
TB7536	II	6.1	1.9
TB7805	II	4.2	6.3
TB7834	II	7.7	79.6

[a]Mean of 9 plates.

Table 2. Effect of phenazine application on bacterial blight of RDI caused by wild type parental strains and phenazine-resistant variants Bangkok, Thailand.

Strain	Lesion[a] (cm) Phenazine treated		Check	
	Wild type	Variant	Wild type	Variant
TB7535	0.9	5.9	1.4	5.8
TB7672	0.3	7.6	1.0	2.1
TB7678	1.8	27.5	3.4	24.4
TB7803	1.5	28.0	3.4	26.0
TB7811	0.6	13.4	5.9	20.9
TB7817	1.1	17.8	5.0	22.6
TB7824	0.2	0.8	3.5	9.0
TB7615	3.0	23.5	12.1	24.2
TB7804	0.9	23.3	8.7	27.5
TB7810	10.3	13.2	11.3	22.5
TB7837	1.1	22.8	26.2	29.3
TB7212	0.2	17.1	17.9	22.5
TB7536	16.5	16.9	27.9	29.9
TB7895	20.4	22.5	24.8	25.7
TB7834	1.2	23.9	27.1	26.8

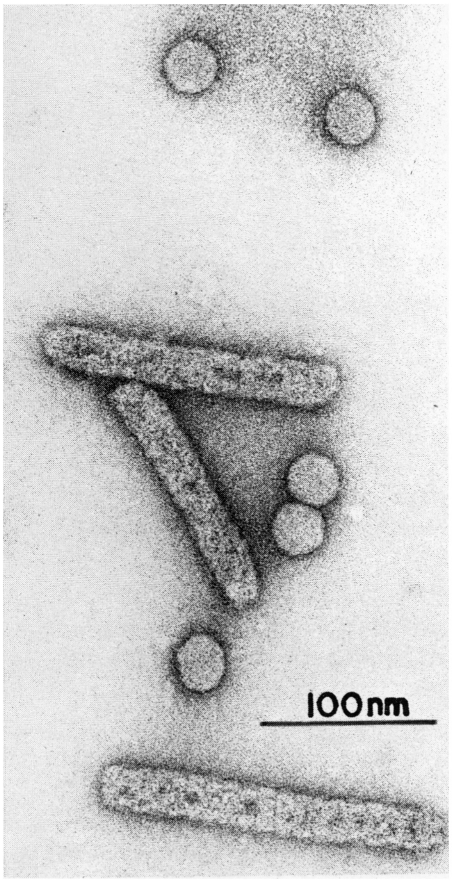
[a]Mean of 3 replications.

Electron microscopy of particles of rice tungro virus complex

R. G. Milne and G. Boccardo, Istituto di Fitovirologia applicata del Consiglio Nazionale delle Ricerche, Turin, Italy; and K. C. Ling, International Rice Research Institute

Rice plants infected with ragged stunt virus at IRRI were homogenized in Turin. Two types of particles, apparently those of rice tungro virus complex, were found by electron microscopy, in addition to particles of ragged stunt virus, indicating that the diseased plants were multiple infected (IRRN 3[2]:9, 1978).

The viruses were purified from the sap of the infected plants using Freon, Nonidet P40, ultracentrifugation through sucrose cushions, and density gradient centrifugation in cesium sulfate. After negative staining, the preparation was examined under an electron microscope whose magnification was calibrated with a diffraction grating replica.



Isometric and bacilliform particles of rice tungro virus complex.

The presumed tungro complex particles were isometric and bacilliform (see figure). The isometric particles were 27-28 nm in diameter when negatively stained in 2% uranyl acetate (UA) and 30 nm in diameter in 1% neutral sodium phosphotungstate (PTA). The bacilliform particles were 23 nm in diameter in UA and 31-33 nm in diameter in PTA. The length of the bacilliform particles was variable in both stains. Apparently undamaged particles with both ends rounded were 110-190 nm long in UA, although no particular modal length was detected.

Hibino and associates reported in Phytopathology 68:1412, 1978, on the negatively stained appearance and dimensions of particles of the tungro complex. They used PTA only on crude preparations. Our results in PTA confirm their measurements of particles in the same stain. However, we note that the bacilliform particles particularly appeared damaged in our PTA preparations. We think that the substantially greater diameter compared to that in UA was due to artifactual swelling or flattening. ■

A new insect vector of rice dwarf virus

Xie Lian-hui, Lin Ji-ying, and Guo Jing-rong. Fujian College of Agriculture, Shaxian, China

Rice dwarf virus (RDV) is transmitted in a persistent manner with transovarial passage by *Nephotettix cincticeps, N. nigropictus,* and *Recilia dorsalis.*

N. virescens and *N. cincticeps* were collected 1974-1977 from rice fields in Fujian. Infectivity was tested on variety Zhin Zhuai 11 at the 3-leaf stage. Of 988 *N. virescens* and 969 *N. cincticeps* tested, 4.3% and 4.9% of the insects, respectively, were capable of causing RDV infection in rice plants, indicating that infective insects of both species exist under natural conditions.

After an acquisition feeding of 3-4 days and a latent period of about 9 days both species transmitted the RDV (see table). RDV was persistent in the insect vector.

There was transovarial passage of RDV in both species. When viruliferous females were crossed with nonviruliferous males of *N. virescens,* the progeny became infective at 8% for the first generation and 4% for the second. When viruliferous females were crossed with nonviruliferous males of *N. cincticeps.* the progeny became infective at 19% for the first generation and 12% for the second. When nonviruliferous females were crossed with nonviruliferous males of both species, none of the progeny became infective.

These results indicate that *N. virescens* is also a vector of RDV, transmitting the virus in a persistent manner with transovarial passage. ■

Transmission of rice dwarf virus by two species of *Nephotettix,* Shaxian, China.

Species	Insects tested (no.)	Infective insects (%)	Latent period (days)			
			In insect		In plant	
			Av	Range	Av	Range
N. cincticeps	544	35	9.4	6-32	10.6	7-48
N. virescens	567	31	9.0	7-21	12.4	8-38

Survey of rice diseases in the Vietnamese Mekong delta from 1978 to 1980

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Rice diseases in the Vietnamese Mekong delta were surveyed from 1978 to 1980, with 69 cooperators of the PPD, faculty of Agriculture, University of Can Tho. The results showed 25 diseases in rice fields and 6 fungi on stored grain. Blast, sheath blight, bacterial blight, and ufra were the most important diseases (see table).

Blast and sheath blight appeared everywhere in the delta, but were most severe in three regions.

Blast was severe in Tiengiang region and the southern part of Haugiang region (Fig. 1). In Tiengiang, blast was important in January, February, March, and July, with highest peaks in January and July every year. Node blast occurred in March.

In the southern part of Haugiang province, node blast was common in December-January, and leaf blast, in July. An epidemic of leaf blast in July 1978 destroyed more than 300 ha of seedling nurseries in the main season crop.

Severe sheath blight occurrence was observed in two regions — the northwestern region of the delta encompassing the whole of Angiang province and the northern part of Haugiang province, and in Tiengiang regions (Fig. 2).

Bacterial blight and ufra diseases were important in the rainy season and in deepwater areas. They sometimes caused severe losses in some limited areas.

Kernel smut broke out from February to April 1979 as an epidemic in the northwestern part of the delta. More

Diseases in rice fields in the Vietnamese Mekong delta, 1978 to 1980.[a]

Disease	Causal agent	Important notes	
Blast	*Pyricularia oryzae*	+++	
Sheath blight	*Thanatephorus cucumeris*	+++	
Bacterial blight	*Xanthomonas oryzae*	+++	in rainy season
Ufra	*Ditylenchus angustus*	+++	–do–
Rice ragged stunt	*Virus,* vector *Nilaparvata lugens*	+++ → ±	+++ in 1978
Brown spot	*Cochliobolus miyabeanus*	++	
Kernel smut	*Tilletia barclayana*	+++ → ±	+++ in 1979
Bakanae	*Gibberella fujikuroi*	++ → ±	
Bacterial leaf streak	*X. translucens* var. *oryzicola*	++ → ±	
Narrow brown leaf spot	*Sphaerulina oryzae*	+	
Akagare type II	H_2S toxicity	+	
Root knot nematode	*Meloidogyne* sp.	+	
Leaf spot	*Curvularia lunata*	±	
Acid sulfate soil toxicity	Fe, Al toxicity, and P deficiency	+	
False smut	*Ustilaginoidea virens*	±	
Sheath rot	*Acrocylindrium oryzae*	±	
Stem rot	*Helminthosporium sigmoideum*	±	
Stem rot	*H. sigmoideum* var. *irregulare*	±	
Minute leaf spot	*Nigrospora oryzae*	±	
Stackburn disease	*Trichoconis padwickii*	±	
Small leaf blight	*Phyllosticta glumarum*	±	
Leaf smut	*Entyloma oryzae*	±	
Sheath blotch	*Pyrenochaeta oryzae*	±	
Seedling blight	*Botryobasidium rolfsii*	±	
Bacterial sheath rot	*Pseudomonas oryzicola*	±	
Grassy stunt	Mycoplasma (?)	±	
Rice stripe (?)	(?)	±	
Orange leaf (?)	(?)	±	

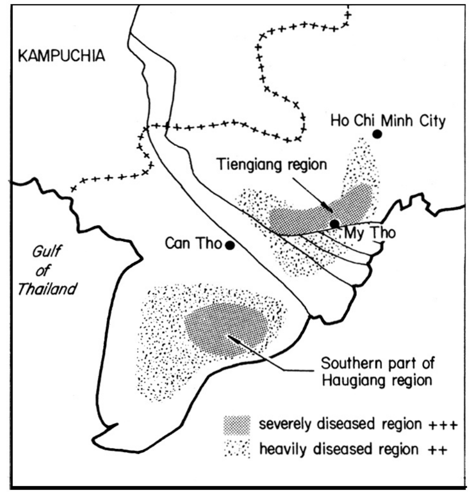
[a]± light, + medium, ++ heavy, +++ severe, (?) not yet determined.

than 10% diseased grain was observed in some fields in the center of the area.

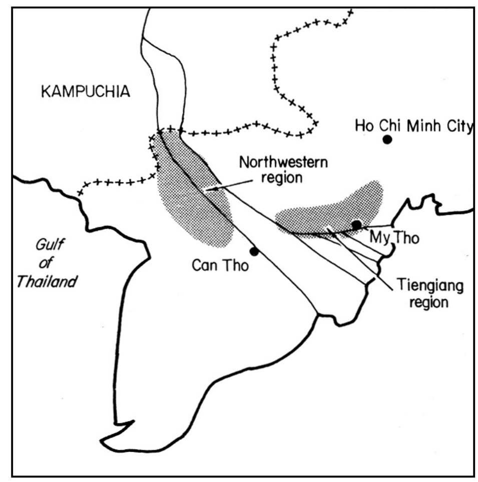
Rice ragged stunt also broke out severely in 1978 together with the brown planthopper *Nilaparvata lugens* epidemic and concentrated in the north-eastern part of the delta.

Bacterial sheath rot (*Pseudomonas oryzicola*) and seedling blight (*Botryobasidium rolfsii*) were first discovered in the delta in 1978 and 1979.

Fungi on stored grain were *Penicillium* sp., *Aspergillus* sp., *Trichoconis padwickii, Gibberella. fujikuroi, Helminthosporium oryzae,* and *Curvularia lunata.* ■



1. Distribution of regions with severe rice blast the Vietnamese Mekong delta, 1978-80.

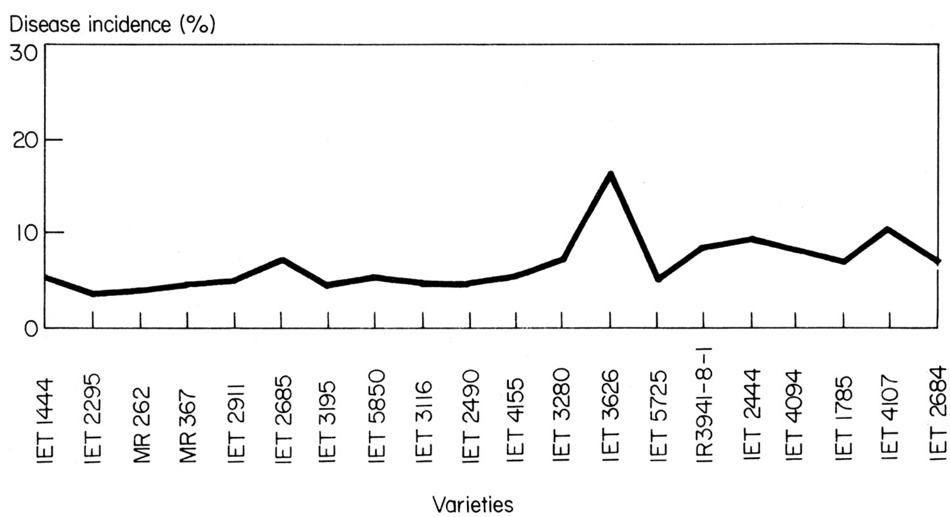


2. Distribution of regions with severe sheath blight in the Vietnamese Mekong delta, 1978-80.

Variability in the incidence of udbatta disease on paddy rice varieties in Karnataka State, India, 1978-80

S. Sanne Gowda, pathologist, All-India Coordinated Rice Improvement Project (AICRIP); and K. T. Pandurange Gowda, research assistant, University of Agricultural Sciences, Regional Research Station, V. C. Farm, Mandya 571405, Karnataka, India

Udbatta disease (caused by *Ephelis oryzae)* has occurred in Karnataka State for a long time. A fairly high incidence was noticed recently on some high-yielding varieties of paddy rice. In a diseased plant, the entire panicle is infected and incidence in even a single panicle results in 100% loss. This 3-year study was conducted to determine disease incidence in 20 selected paddy rice cultures.



Incidence of udbatta disease in 20 selected rice cultures in Karnataka State, India, 1978-80.

The average disease incidence (see figure) among cultures varied from 4% in IET2295 to 22% in IET3626. The data indicate a narrow range of variability in disease incidence in the varieties, except in IET3626. ■

Seasonal incidence of sheath rot in Thanjavur Delta, India

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Seasonal incidence of sheath rot was studied in 1977 and 1978 in 20 planting series covering the entire cropping period of the Thanjavur Delta area of Tamil Nadu.

The first planting was done on 15 June and the last on 25 December with a 10-day interval between plantings. Eight varieties or cultivars were evaluated in 1977 and 10 in 1978 for relative resistance. Sheath rot incidence was recorded at the ninth crop stage. The disease incidence (transformed value for percentage) for 1977 is given in Table 1 and that for 1978 is in Table 2.

Sheath rot incidence was extremely high on crops planted from 15 June to 15 August 1977 and from 15 June to 5 August 1978, the planting period of the first crop (kuruvai). It seems sheath rot needs to be controlled only in the first crop season to overcome heavy yield loss.

None of the variants tested was resistant. ■

Table 1. Seasonal incidence of sheath rot in Thanjavur Delta, India, 1977.

Date of planting	Incidence (%)								
	ADT31	IET1722	Tainan 3 (M)	AD11585	Pusa33-18	IR26	IR20	Bhavani	Mean [a]
15 Jun	40.1	35.4	22.9	42.7	36.5	55.5	54.6	43.2	42.2
25 Jun	42.2	35.5	30.3	52.8	35.2	45.5	31.0	33.1	38.2
5 Jul	51.3	52.9	34.7	49.5	41.1	38.7	40.1	30.1	42.3
15 Jul	55.1	59.0	57.4	50.4	51.6	33.3	34.9	30.5	46.5
25 Jul	45.4	50.6	51.4	44.6	39.8	52.2	49.3	50.6	48.1
5 Aug	31.8	47.2	46.4	36.7	32.6	48.8	45.4	49.2	43.0
5 Sep	22.8	14.0	20.5	20.7	18.3	15.8	18.9	13.2	18.0
5 Oct	41.3	37.9	36.6	17.0	36.2	35.3	29.8	19.8	31.7
5 Nov	14.0	10.2	12.4	9.8	10.3	12.7	12.3	11.2	11.6
5 Dec	17.9	9.8	9.8	8.5	10.2	7.3	11.1	11.7	10.8
Mean	27.2	24.6	24.2	25.4	23.1	25.8	25.3	23.9	

	Variety	Period	Variety x period
C.D	1.68	2.65	7.50

[a] Data on the maximum incidence of sheath rot observed in the first 6 plantings (15 Jun-5 Aug) are given in full. Where incidence continued to decrease, only data in the first planting of the given month are included. The actual mean of 20 plantings is given as the mean for varieties.

Table 2. Seasonal incidence of sheath rot in Thanjavur Delta, India, 1978.

Date of planting	Incidence (%)										
	ADT31	IET2881	4-1-11-1	AD6380	AD5620	AD54-1	AS3827	CRM 105747	Bhavani	IR20	Mean [a]
15 Jun	37.3	33.8	33.4	38.1	33.9	56.4	33.7	25.5	38.1	35.8	34.8
25 Jun	35.1	27.9	34.6	47.2	30.3	42.1	39.5	33.9	30.9	40.0	36.2
5 Jul	38.9	37.3	36.7	52.9	38.5	55.8	53.5	40.1	37.6	43.0	43.4
15 Jul	43.2	39.1	33.6	45.1	43.0	45.7	49.2	43.2	52.2	50.7	44.1
25 Jul	49.2	41.4	45.3	36.1	50.0	38.9	41.8	46.3	45.8	55.6	43.0
5 Aug	39.5	43.0	35.5	34.1	40.5	33.3	45.0	40.7	47.0	45.0	40.3
5 Sep	24.5	23.2	25.5	17.4	25.0	24.6	16.5	17.2	17.2	27.5	22.7
5 Oct	25.5	17.0	18.8	7.6	13.3	8.6	12.8	8.6	20.0	14.0	14.6
5 Nov	8.5	18.0	8.4	7.3	11.5	6.9	6.5	9.0	11.8	10.4	9.9
5 Dec	4.1	7.2	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.4
Mean	21.2	21.9	21.2	19.6	20.8	21.7	20.5	18.0	21.8	23.9	

	Variety	Planting	Variety x Period
C.D.	0.62	0.83	2.62

[a] Data on the maximum incidence of sheath rot observed in the first 6 plantings (15 Jun-5 Aug) are given in full. Where incidence continued to decrease, only data in the first planting of the given month are included. The actual mean of 20 plantings is given as the mean for varieties.

Pest management and control INSECTS

Comparison of virulence of isolates of *Xanthomonas campestris* pv. *oryzae* in Southeast Asia and in South China

S. Z. Wu, S. M. Shui, and J. M. Liu, Institute of Plant Protection Research of Guangdong, China

Twenty-three isolates of *Xanthomonas campestris* pv. *oryzae* collected from naturally infected rice leaves in Southeast Asia (India, Nepal, Bangladesh, Thailand, and Philippines) and South China (Guangdong Province) were evaluated for virulence on five Chinese differential hosts. Results indicated that these isolates may be distinguished into five race groups based on the interaction of the isolates and varieties measured by means of disease lesion patterns and compared with five Chinese pathogenic groups (see table).

Of the isolates collected from Southeast Asia, 6 (26.1%) correspond to Chinese bacterial group III, 6 (26.1%) to group IV, and 9 (39.5%) to group V. Isolates belonging to group V were strongly virulent on IR26, which corresponds to Chinese race group V. Group V breaks down the resistance of varieties with a dominant gene, *Xa 4.* Analysis of variance also indicated that the interaction between isolates and rice differentials was highly significant.

The resistance of IR26 was overcome by race V. A subsequent outbreak of bacterial blight on IR26 in the southern region of Guangdong Province perhaps was due to the occurrence of race V of pv. *oryzae* comparable to the race in India, Nepal, Bangladesh, and Indonesia that is known to be virulent to IR20, IR26, and IR36. ■

Virulence of 23 bacterial isolates on 5 Chinese rice differential hosts.

Number	Locality	Pathogenic group	Reaction[a]				
			Jing-Gong 30	Bao-Tai-Ai	Tsai-Ye-Ching 8	Nong-Kun 57	IR26
BB 003	Pan-Yu (China)	I	S	R	R	R	R
BB 016-7	Ai-Xian (China)	II	S	S	R	R	R
BB 135	Bihar (India)	III	S	S	S	R	R
BB 113	Ching-Yuan (Thailand)	III	S	S	S	R	R
BB 129	Chinsurah (India)	III	S	S	S	R	R
BB 054-5	Ling-Shui (China)	III	S	S	S	R	R
BB 106	Thai-7821 (Thailand)	III	S	S	S	R	R
BB 068	Chinghua (Vietnam)	III	S	S	S	R	R
BB 127	Faizabad (India)	IV	S	S	S	S	R
BB 111	Ching-Lai (Thailand)	IV	S	S	S	S	R
BB 068-5	Chinghua (Vietnam)	IV	S	S	S	S	R
BB 068-1	Chinghua (Vietnam)	IV	S	S	S	S	R
BB 139	Los Baños (Philippines)	IV	S	S	S	S	R
BB 064-2	Ling-Shui (China)	IV	S	S	S	S	R
BB 131	Parwanipur (Nepal)	V	S	S	S	S	S
BB 141	Orissa (India)	V	S	S	S	S	S
BB 125	Bihar (India)	V	S	S	S	S	S
BB 133	Bara (Nepal)	V	S	S	S	S	S
BB 242	Fu-Gong (China)	V	S	S	S	S	S
BB 172	Gao-Zhou (China)	V	S	S	S	S	S
BB 105	Young-Jiang (China)	V	S	S	S	S	S
BB 137	Dacca (Bangladesh)	V	S	S	S	S	S
BB 234	Tai-Poo (China)	V	S	S	S	S	S

[a]R = resistant, S = susceptible, V x I = 2.3471** P = 0.01.

Use of colored lights to attract rice insects

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In 1979, the use of colored lights to attract rice insect pests was studied. Petromax lamps in 5 colors — yellow, blue, green, red, and white — were set 100 m apart in rice fields from 1800 to 2000 hours on alternate days in October, November, and December. The early (planted Aug-Sep) crop was in the reproductive phase, and the late samba (planted in Sep-Oct) crop in the vegetative phase. The lamps were in the centers of iron trays (76 × 46 × 10 cm) containing water mixed with kerosene. The insects attracted by the lights got trapped in the water.

The ordinary white-light trap was the most effective; it attracted and caught the largest number of green leafhoppers (5000), brown planthoppers (1000), and moths of stem borers (1 70) and leaffolder (210) during the study period. The four other colors — yellow, blue, green, and red — were almost equal in attraction, catching from one-third to two-thirds the number of insects in the white-light trap. ■

Classification of pathogenic groups of *Xanthomonas campestris* pv. *oryzae* and their regional distribution in South China, Guangdong

S. M. Shui, J. M. Liu, and S. Z. Wu, institute of Plant Protection Research of Guangdong, China

During 1978-80, 211 isolates of *Xanthomonas campestris* pv. ***oryzae*** were collected from 9 districts in Guangdong Province. Virulence was evaluated on five Chinese differential varieties: Jing-gong 30, Bao-Tai-Ai, Tsai-Ye-Ching 8, Nong-kun 57, and IR26. Flag leaves were inoculated by leaf clipping.

Five bacterial groups could be distinguished. Group I with 16 isolates was virulent only to Jing-gong 30, the susceptible check. Group V with eight isolates was virulent to all five differential varieties. This included IR26, which is known to have the *Xa 4* gene for bacterial blight resistance. Group V bacteria were distributed in the eastern and southern parts of the province.

Group II was composed of 38 (18%) isolates, group III of 49 (23%), and group IV of 100 (47%). Groups III and IV, the predominant groups in the province, were avirulent only to IR26. These two groups appear to be similar to race 1 in the Philippines, based on preliminary evaluation of the IRRI differentials. ■

Widespread outbreaks of immigrating leaffolders and whitebacked planthoppers in southwestern Japan

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Widespread and severe outbreaks of the leaffolder *Cnaphalocrocis medinalis* (Guenée) and the whitebacked planthopper *Sogatella furcifera* (Horvath) occurred in southwestern Japan in 1980. The leaffolder outbreak covered 58,900 ha (34% of the productive paddy area) in Kinki, 112,900 ha (59%) in Chugoku, 61,400 ha (69%) in Shikoku, and 218,000 ha (73%) in Kyushu. Areas affected by the whitebacked planthopper were nearly as large. In Kyushu, the total area of moderate to severe leaffolder infestations was estimated at 125,000 ha (39%).

The two insect pests cannot overwinter in Japan, except the leaffolder on the subtropical Nansei Islands. The outbreaks were attributed to a large number of immigrants in several migrating waves from overseas during the unusually long *bai-u* season (June to early August). During July to mid-September, weather in Japan was abnormal. Temperatures were much lower than normal and precipitation was very high, with few sunshine hours. Severity of the outbreaks increased because rainfall on consecutive days prevented the good timing of insecticide applications.

In contrast, the incidence of the brown planthopper *Nilaparvata lugens* (Stal), another immigrating insect pest, was light. ■

Atomizer for use in insecticide evaluations

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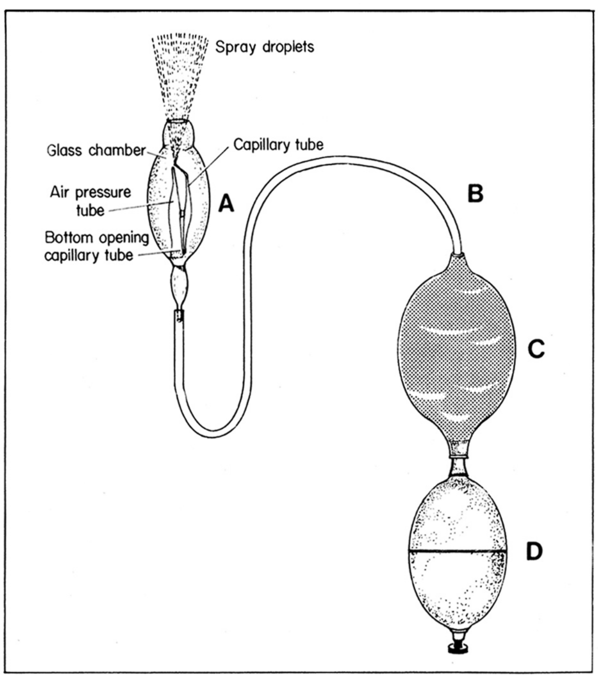
Conventional sprayers cannot handle small quantities of spray fluids for controlled insecticide evaluation in potted rice plants. Therefore, a hand atomizer used by asthma patients was modified to serve the purpose (see figure). It consists of a glass unit (A), a rubber tube (B), a rubber air reservoir (C), and a rubber bulb (D).

The glass unit has an air pressure tube through which air flows at high pressure. A bent capillary tube by the side of the air pressure tube draws the spray fluid from the glass chamber and atomizes it by air pressure. The glass chamber can be filled up to the air vent with 3 ml spray fluid, which is adequate to spray a potted plant.

The atomizer discharges fine spray droplets that are deposited uniformly on the plant surface without runoff. It is useful for spraying small quantities of insecticides and other chemicals in laboratory or glasshouse toxicity evaluation studies. ■



Hand atomizer modified for use in controlled insecticide evaluation in potted rice plants. Coimbatore, India.

Green rice leafhopper resistance to malathion, methyl parathion, carbaryl, permethrin, and fenvalerate in Taiwan

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Green rice leafhoppers were collected from 10 sites throughout Taiwan in 1980. To measure susceptibility to the insecticides malathion, methyl parathion, carbaryl, permethrin, and fenvalerate, females were topically treated with the insecticide according to the FAO recommended method for the detection and measurement of insecticide resistance.

All populations showed various levels of resistance to malathion and methyl parathion (see table). Resistance ratios, as compared with data reported for the susceptible strain, ranged from 27 to more than 800. Resistance levels to carbaryl in these populations were somewhat lower, ranging between 12 and 79.

Susceptibility to malathion, methyl parathion, carbaryl, permethrin, and fenvalerate of green rice leafhoppers in Taiwan.

Site	Resistance ratio[a]				
	Malathion	Methyl parathion	Carbaryl	Permethrin	Fenvalerate
I-lan	30	90	14	1.7	1.0
Hsin-chu	27	32	12	1.0	1.4
Dah4	250	226	79	5.5	1.0
Tsao-tung	408	235	74	2.1	1.4
Pai-ping	106	298	77	1.9	1.6
Pei-tung	288	326	37	4.9	1.9
Lu-ku	38	151	–	1.1	–
Chang-hua	225	172	47	2.9	2.3
Mei-nung	451	875	78	2.9	2.0
Ping-tung	368	554	24	2.2	1.5
Susceptible[b] strain	1	1	1	–	2.4

[a]Resistance ratio = LD_{50} of each strain divided by LD_{50} of susceptible or pertinent strain. [b]LD_{50}'s of malathion, methyl parathion, carbaryl, and fenvalerate against the susceptible strain were 0.57, 5.7, 0.71, and 0.34 µg/g, respectively. LD_{50} of permethrin against Hsin-chu strain was 0.17 µg/g.

Permethrin and fenvalerate, two major synthetic pyrethroids recommended in 1980 for the control of this leafhopper, possessed higher inherent toxicity to green rice leafhopper than the three conventional insecticides. Little, if any, resistance to the two synthetic pyrethroids was detected in the 10 multiresistant field populations, indicating no cross resistance between organophosphorus or carbamate compounds and synthetic pyrethroids. ■

Brown planthopper resistance to several insecticides in Taiwan

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The susceptibility to malathion, methyl parathion, MIPC, propoxur, permethrin, and fenvalerate of one susceptible (S), one malathion-resistant (R-mal), one MIPC-resistant (R-mipc), and four field strains of brown planthopper (BPH) from Taiwan was determined.

The 4th and 5th instars were sprayed with an acetone solution of insecticide. Toxicity of malathion, methyl parathion, and MIPC to the S strain was much lower than that of propoxur, permethrin, and fenvalerate (see table). The R-mal strain possessed some resistance to methyl parathion and MIPC. The R-mipc strain also showed some resistance to malathion and methyl parathion. Both R strains were significantly resistant to propoxur and permethrin, while remaining susceptible to fenvalerate. Field strains of BPH from heavily treated areas showed similar patterns of resistance to the six chemicals.

Susceptibility to 6 insecticides of 1 susceptible (S), 1 malathion-resistant (R-mal), 1 MIPC-resistant (R-mipc), and 4 field strains of brown planthopper in Taiwan.

Insecticide	LC_{50} (mg/ml) S	RR[a]					
		R-mal	R-mipc	Ping-tung	Mei-nung	Chia-yi	Tai-chung
Malathion	0.023	1183	574	526	359	437	288
Methyl parathion	0.029	82	44	41	48	84	32
MIPC	0.021	22	41	14	15	18	10
Propoxur	0.0067	72	76	36	46	36	19
Permethrin	0.0058	171	122	74	121	83	71
Fenvalerate	0.0083	5	5	1.6	2.9	3.0	1.7

[a]Resistance ratio = LC_{50} of each strain divided by LC_{50} of S strain.

Field populations of BPH could not have been previously exposed to synthetic pyrethroids; therefore, the permethrin resistance detected must represent cross-resistance from insecticides used previously. These include organochlorine, organophosphorus, and carbamate compounds. Susceptibility of all strains to another synthetic pyrethroid fenvalerate could be taken as an indication that in the BPH permethrin might have a mode of action or metabolic fate different from that of fenvalerate. ■

Acetylcholinesterase sensitivity and carbamate resistance in brown planthopper

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The sensitivity of acetylcholinesterases (AChE) of susceptible (S) and MIPC-resistant (R) strains of brown planthopper to MIPC and several other carbamate insecticides was determined. The homogenate of 4th and 5th instars was incubated with a series of concentrations of insecticide solution. Residual activity of AChE was measured using acetylthiocholine iodide as substrate.

AChE of the R strain was 15.7-times less sensitive to MIPC than the S strain (see table). The R strain AChE also was

Sensitivity of acetylcholinesterases of susceptible (S) and MIPC-resistant (R) *N. lugens* strains to carbamate insecticides, Taiwan.

Insecticide	RR[a]	*N. lugens* strains S	R	Ratio
MIPC	41	0.23	3.62	15.7
MTMC	80	5.86	18.0	3.1
Propoxur	76	0.15	1.10	7.3
Carbofuran	73	0.08	0.33	4.1
Carbaryl	41	0.38	0.92	2.4
Methomyl	33	6.99	29.4	4.2

[a]Resistance ratio = LC_{50} of R strain divided by LC_{50} of S strain.

less inhibited by several other carbamate insecticides.

A decrease of AChE sensitivity might be the primary cause of MIPC resistance in brown planthopper. A secondary cause is degradation of MIPC mediated by esterases, since a DEF inhibitor of these enzymes enhances the toxicity of MIPC to R strain. Insensitivity of AChE also contributed to brown planthopper resistance to several other carbamates. ■

Pest management and control WEEDS

Integrated weed management in dryland rice

G. C. Tosh, B. S. Reddy, and K. C. Nanda, Orissa University of Agriculture and Technology, Bhubaneswar, Orissa, India

Weeds are a serious problem for direct-sown, short-duration, high-yielding rice-cultivars in Eastern India. This study involved 2 methods of sowing (broadcast and row), 3 seed rates (70, 90, and 110 kg/ ha), 4 weed control treatments (nitrofen thiobencarb, propanil, and manual), and unweeded and untreated controls. The experiment was laid out in a split-plot design with method of sowing and seed rate as the main plots and weed control and unweeded treatment as subplots.

Irrespective of seed rates, sowing in rows recorded higher plant populations, lower dry matter accumulation in weeds, and higher grain yield than broadcast method of sowing (see table). High seed rates recorded higher plant populations, lower dry matter accumulation of weeds, and higher grain yields than low seed rates.

Thiobencarb as a preemergence herbicide was slightly phytotoxic to rice, causing mortality of some seedlings. Maximum grain yield was obtained with propanil applied as split doses of 1.5 kg a.i./ ha each at 15 and 30 days after sowing (DS) or high seed rate sown in rows. Manual weed control by hoeing once 15 DS and hand weeding 30 DS was next in yield. Propanil treatment reduced the dry matter accumulation in weeds from 324.7 g/m^2 to 68.8 g/m^2. Nutrient loss of 19.3 kg N/ha, 11.6 kg P_2O_5/ha, and 68.1 kg K_2O/ha in the unweeded control was reduced to 3.1 kg N/ha, 2.5 kg P_2O_5/ha, and 14.5 kg K_2O/ha with propanil. ■

Effects of sowing method, seed rate, and weed control treatment in Orissa, India.[a]

Treatment	Plant population (no./m^2) 10 DS	Dry matter accumulation of weeds (g/m^2) 60 DS	Nutrient uptake by weeds (kg/ha) 60 DS N	P_2O_5	K_2O	Grain yield (t/ha)
Sowing method						
Broadcasting	107.5	171.0	10.5	6.3	33.7	1.5
Row	143.5	156.8	9.0	5.4	25.9	1.8
Seed rate (kg/ha)						
70	115.6	151.8	9.6	5.6	33.1	1.6
90	128.4	142.6	8.1	4.9	30.8	1.4
110	146.4	104.1	6.1	4.9	23.9	2.0
Weed control method						
Nitrofen@ 1.5 kg a.i./ha 2 DS	150.7	151.5	9.0	5.4	31.9	1.6
Thiobencarb @ 1.5 kg a.i./ha 2 DS	112.0	166.6	10.7	7.0	41.4	1.2
Propanil @ 1.5 kg a.i./ha each 15 and 30 DS	158.0	68.8	3.1	2.5	14.5	2.8
Manual	146.3	76.9	4.6	2.8	16.4	2.1
Unweeded control	155.5	324.7	19.3	11.6	68.1	0.6
CD (0.05) for sowing method	20.6	7.3				0.04
CD (0.05) for seed rate	25.2	9.6				0.05
CD (0.05) for weed control method	11.2	16.4				0.09

[a]DS = days after sowing.

Effects of herbicides and water management regimes on weeds and grain yields of transplanted rice in India

A. Misra, G. C. Tosh, and K. C. Nanda, Weed Research Scheme, Orissa University of Agriculture & Technology, Bhubaneswar, India

The use of several herbicides under different water management treatments was tried in a replicated field trial at the Agriculture Research Station, Bhubaneswar, during the 1977 and 1978 wet seasons.

Continuous submergence had significantly the lowest weed population and weed weight (see table). Fluchloralin treatment showed promising effects on weed control at all the levels of water

Effect of water management practices and herbicides on weeds growing in association with wetland rice and grain yield of IET723, Bhubaneswar, India.

Treatment	1977 crop season			1978 crop Season		
	Weed population (no./m^2) 40 DT	Dry wt of weeds (g/m^2) at harvest	Grain yield (t/ha)	Weed population (no./m^2) 40 DT	Dry wt of weeds (g/m^2) at harvest	Grain yield (t/ha)
Main plot						
Continuous 10 cm submergence to grain filling	67.6	18.5	3.5	59.3	15.8	3.3
Saturation to maturity and 5 cm submergence to dough stage	88.5	21.8	3.1	62.8	16.6	3.3
Saturation to grain filling	114.6	29.1	2.6	87.9	22.8	3.0
Subplot [a]						
Fluchloralin EC @ 0.8 kg a.i./ha	23.3	12.6	3.4	38.1	9.4	3.3
2,4-D EE (G) @ 1.0 kg a.i./ha	30.8	14.2	3.3	40.5	11.2	3.3
Butachlor (G) @ 1.0 kg a.i./ha	46.1	14.8	3.2	56.7	10.4	3.1
Thiobencarb (G) @ 1.0 kg a.i./ha	52.8	15.9	3.1	39.5	9.2	3.3
Manual weeding at 25 and 50 days after planting	37.1	13.0	3.3	39.3	9.8	3.3
Unweeded control	233.7	70.4	2.5	156.8	58.4	2.7
CD (0.05) for water management practice	4.9	3.0	0.3	1.4	1.4	0.2
CD (0.05) for herbicides	8.4	2.7	0.5	4.3	1.3	0.3

[a] Fluchloralin was applied as preplanting soil spray a day before transplanting; granular formulations of 2,4-D EE. butachlor, and thiobencarb were applied directly 7 days after transplanting (DT).

management.

Continuous submergence from 7 days after planting to harvest recorded the highest grain yields. Preplanting treatment with fluchloralin recorded the maximum grain yield. ■

Pest management and control OTHER PESTS

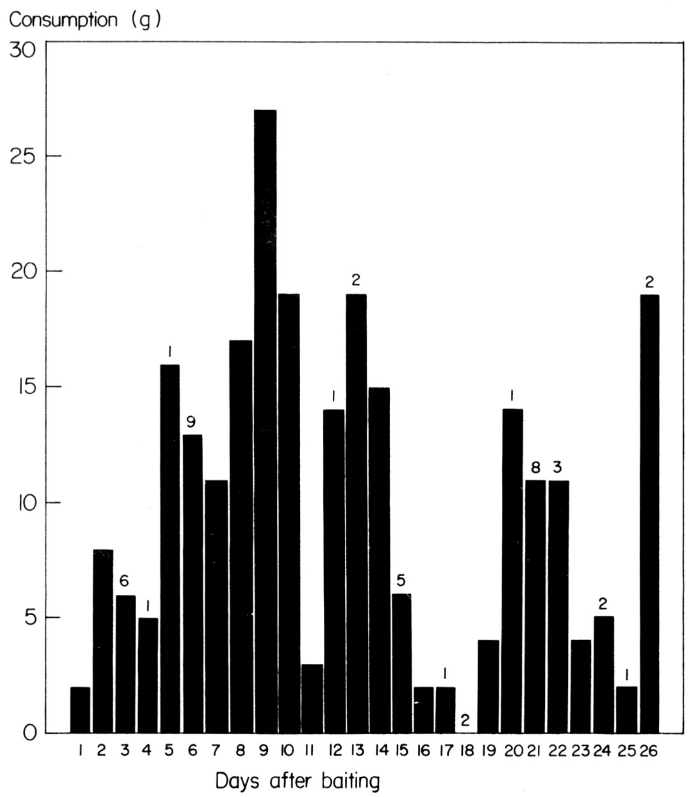
Efficacy of brodifacoum baits against rodents in storage areas

F. O. Lanting, senior farm supervisor, IRRI Los Baños, Laguna; F. L. Andres, product development officer, and R. B. Rondon, manager, ICI-PPD, Warner Barnes & Co., Inc.

Brodifacoum is a new anticoagulant rodenticide of exceptional activity against rodent species both resistant and susceptible to other conventional rodenticides. The formulated product, which contains 50 ppm active ingredient (a.i.), is highly toxic and can provide a single-feeding action for many species. It compares with Warfarin baits containing 250 ppm a.i. in its adverse effect to man and domestic animals. Accidental poisoning can be countered with treatments of Vitamin K_1.

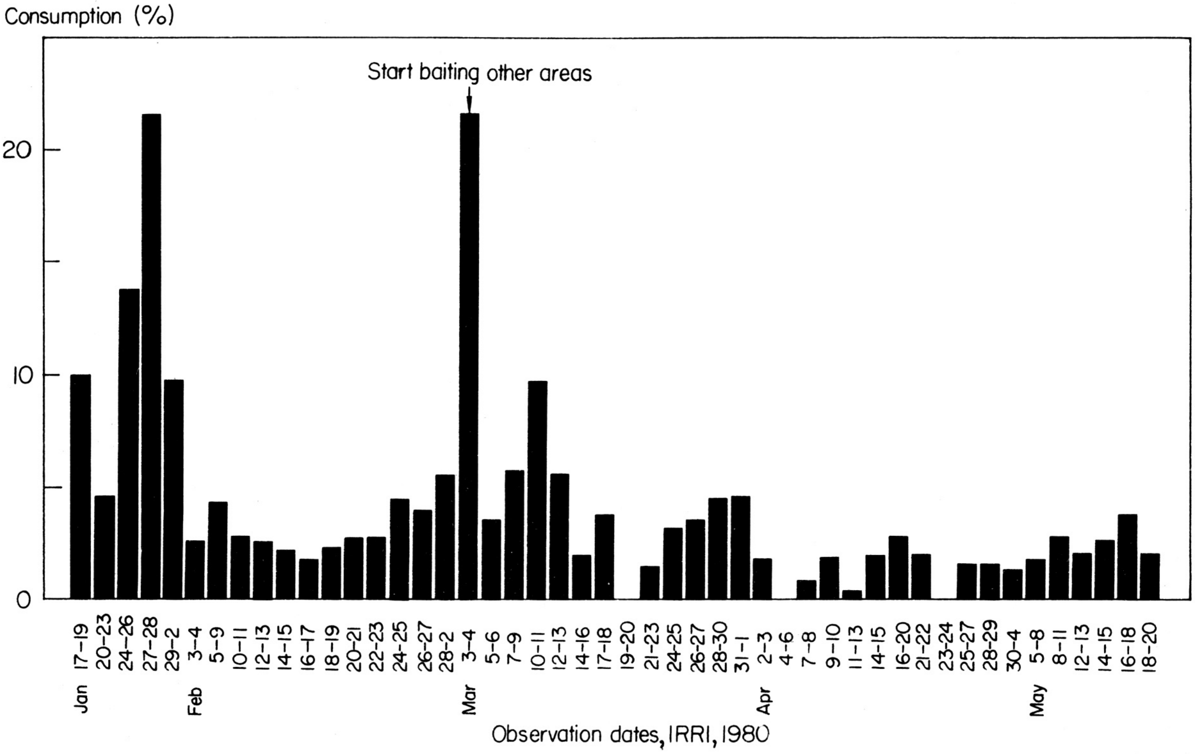
Baiting tests at the short-term storage room and seed processing lab of the International Rice Research Institute showed that brodifacoum pellet baits were effective in controlling mice infestations.

During the 26-day baiting period, high bait intake was followed by decline and death of mice (Fig. 1). That indicated migrants or even new-generation mice from births in the original population just before control.



1. Daily consumption of brodifacoum bait at the Rice Genetic Resources Laboratory storage room. IRRI, 1980.

A long-term baiting trial indicated that mice population was kept at satisfactorily low levels by maintaining adequate baiting points. Better control was



2. Bait consumption during a long-term baiting test at the IRRI Rice Genetic Resources Laboratory, 1981.

attained by baiting all possible breeding areas (Fig. 2).

Mice in the storage rooms fed on pelletized baits despite the abundance of rice, showing the attractiveness of the bait. ■

Irrigation and water management

Water management in dry season rice

R. L. Nayak, S. S. Mandal, A. Zaman, and M. Das, faculty of agriculture, Agronomy Department, Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani 741235, Nadia, West Bengal

Dry season rice in West Bengal requires large quantities (170-180 cm) of water, 50-60% of which is lost in deep percolation because of continuous deep submergence of fields. Water requirements can be reduced. The medium-duration (120 days) rice cultivar IET 2815 was grown on clay loam with 8 water management practices (see table). Yields were higher with 10-0 cm water from transplanting to yellow ripe stage than with 5-0 cm. Irrigating the crop 2 days after complete recession of 10-cm standing water did not reduce grain yield from that obtained by irrigating sooner, but the irrigation requirement was reduced by 20-22%. The flowering stage was found most sensitive and the grain-filling stage least sensitive to water stress. ■

Influence of 8 water management practices on grain yield and irrigation requirement of dry season rice in West Bengal.

Water management practice	Grain yield (t/ha)			Av irrigation requirement[a] (cm)
	1977-78	1978-79	Av	
10-0 cm water regime from transplanting to yellow ripe stage	3.8	5.0	4.4	180 (18)
5-0 cm water regime from transplanting to yellow ripe stage	3.6	4.1	3.8	100 (20)
Stress[b] during early tillering, no stress[c] during rest	3.4	4.3	3.8	90 (18)
Stress during late tillering, no stress during rest	3.7	4.3	4.0	90 (18)
Stress during flowering, no stress during rest	3.6	4.0	3.8	90 (18)
Stress during grain filling, no stress during rest	3.8	4.7	4.2	90 (18)
10 cm irrigation 2 days after recession of standing water, from transplanting to yellow ripe stage	3.9	5.1	4.5	140 (14)
5 cm irrigation 2 days after recession of standing water, from transplanting to yellow ripe stage	3.8	4.8	4.3	80 (16)
C.D. (5%)	0.24	0.15		

[a]The figures in parentheses denote number of irrigations. [b]Stress: application of 5 cm water 2 days after recession to 0 cm. [c]No stress: application of 5 cm water immediately after recession to 0 cm.

Soil and crop management

Effect of herbicides on azolla

J. D. Janiya, research aide, and K. Moody, agronomist, International Rice Research Institute

A randomized complete block design with three replications was used to determine the effect of some herbicides on azolla (*Azolla pinnata* R. Br.) in transplanted rice. Azolla at a rate of 300 g fresh weight/m^2 was inoculated into plots immediately after transplanting. The rates and times of herbicide application are shown in the table.

All herbicides used were deleterious to azolla and caused a significant reduction in fresh weight 30 days after transplanting (DT) (see table). Of those applied 4 DT, 2,4-D caused the least reduction in growth. Propanil was more detrimental than 2,4-D applied 21 DT.

When 2,4-D was applied 4 DT, there was a general thickening of the azolla layer, followed by yellowing of the plants and localized death. Eventually, some recovery was observed. With other herbicides applied 4 DT, the azolla layer turned red or purple, then black. Virtually no recovery occurred.

Of the herbicides applied 21 DT, propanil was more rapid in action than 2,4-D. No recovery was observed in either plot 9 days later.

From these results, it appears unlikely that herbicides can be used for weed control when rice is to be inoculated with azolla. The weeds will have to be controlled by other means, such as by the suppressive effect of azolla itself, by hand weeding or by using a rotary weeder at the time azolla is incorporated into the soil. ■

Fresh weight (g/m^2) of azolla 30 days after transplanting as affected by herbicide application. IRRI, 1980 wet season.

Treatment	Rate of application (kg/ha)	Time of application (DT)[a]	Azolla fresh wt[b] (g/m^2)
Thiobencarb	1.0	4	418.0 d
Propanil	3.0	21	536.3 d
Piperophos - 2,4-D	1.5	4	667.7 cd
Butachlor	1.0	4	814.3 cd
2,4-D (liquid)	0.5	21	1420.6 bc
2,4-D (granule)	0.8	4	1660.3 b
Untreated	–	–	2840.0 a

[a]DT = days after transplanting. [b]Means followed by a common letter are not significantly different at the 5% level.

Azolla influence on rice yield

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The effect of azolla on paddy rice yields was studied in June-September and October-February 1980-81. A randomized block design with 10 treatments and 3 replications examined the effect of different levels of nitrogen (N) and nitrogen plus azolla. Phosphorus (P_2O_5) and potassium (K_2O) were applied uniformly at 50-50 kg/ha as basal dressing. Spacing was 20 × 10 cm.

Azolla was applied at 300 g/m^2 on the week after transplanting and incorporated 15 days later. Variety TKM9 was raised in the first season and IR20 in the second.

Azolla contributed to yield increase in both seasons (Table 1). In the first season, the yield with 50 kg N/ha + azolla equaled that with 75 kg N/ha. A similar trend with 25 kg N + azolla and 50 kg N/ha was seen in the second season.

Table 1. Effect of azolla on yield at Ambasamudram, India, 1980-81.

Treatment (kg N/ha)	Jun-Sep		Oct-Feb	
	Grain yield (t/ha)	Increase over control (%)	Grain yield (t/ha)	Increase over control (%)
0 N (control)	8.6	–	4.5	–
0 N + azolla	8.8	2.3	4.7	4.4
25 N	9.0	4.7	4.9	8.9
25 N + azolla	9.0	4.7	5.0	11.1
50 N	9.2	7.0	4.9	8.9
50 N + azolla	9.4	9.3	5.0	11.1
75 N	9.4	9.3	5.2	15.6
75 N + azolla	9.7	12.8	5.4	20.0
100 N	9.0	4.7	5.3	17.8
100 N + azolla	9.7	12.8	5.5	22.2
CD (P = 0.05)	ns		0.49	

Table 2. Azolla weight and multiplication ratio at Ambasamudram, India, 1980-81.

Treatment	Azolla mean weight (kg)	Multiplication ratio for 16 days
200 g azolla + 50 g superphosphate	1.8	9.0
200 g azolla + 100 g superphosphate	1.8	9.3
400 g azolla + 50 g superphosphate	2.0	4.9
400 g azolla + 100 g superphosphate	2.1	5.2
800 g azolla + 50 g superphosphate	2.2	2.7
800 g azolla + 100 g superphosphate	2.2	2.8
1,600 g azolla + 50 g superphosphate	2.4	1.5
1,600 g azolla + 100 g superphosphate	2.3	1.5

An observational trial to find the rate of azolla multiplication in February-April 1981 examined 4 levels of azolla (200, 400, 800, 1600 g/ m^2) and 2 levels of superphosphate (50, 100 g/m^2) in 5 replications.

Multiplication of azolla was highest (9 times original level) at the low inoculation level of 200 g/m^2 (Table 2). There was not much difference between the two superphosphate levels. Azolla at 200 g with 50 g superphosphate/m^2 seems to multiply well.

The maximum temperature range was 29-39° C. It also appears that azolla multiplies well at higher temperatures. ■

Effect of neem cake-blended urea on the yield of wetland rice

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Trials at University Research Centre, Aduthurai, during 1978-79 kharif assessed the merits of neem cake-coated urea and coal-tar-treated urea basally or split applied. The soil is clay loam with low nitrogen, medium phosphorus, and high potassium. Soil pH is 7.5. The rice variety tested was IR20.

The trials were laid in a randomized block design replicated four times. Urea was mixed with neem cake by 1) blending the cake with 30% by weight of urea in a plastic bag shaken vigorously, and 2) mixing the cake with 30% by weight of urea pretreated with a solution of coal tar and kerosene.

Split application of coal tar- and kerosene-coated urea recorded significantly higher grain yields than all treatments except split application of urea alone (see table).

Treating urea with coal tar and kerosene and applying in split doses (25% basal, 50% at tillering, and 25% at panicle initiation) showed promise in increasing N use efficiency and grain yield. ■

Effect of neem cake-blended urea on rice yields. Aduthurai, India.

Treatment	Yield (t/ha)	
	1978	1979
Control	2.2	4.9
Urea-blended neem cake @ 30% by weight, basal application	2.8	5.0
Urea-coated neem cake (30%) using coal tar and kerosene, basal application	2.6	5.1
Urea coated with coal tar and kerosene, basal application	2.7	5.2
Incorporation of neem cake in flooded soil, followed in a week by urea, basal application	3.1	5.6
Urea only, basal application	2.9	5.3
Urea split application (25% basal, 50% at active tillering, and 25% at panicle initiation)	3.4	5.9
Urea coated with coal tar and kerosene, split application (25% basal, 50% at active tillering, and 25% at panicle initiation)	3.6	6.0
SE	0.22	0.10
CD	0.50	0.29

Environment and its influence

Effects of laser seed treatment on rice panicle characteristics

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Four lasers (Table 1) were used in treating seeds of indica rice varieties.

Treating the variety Zhen-Zhu-Ai with He-Ne laser did not advance the date of heading (Table 2), but it increased primary rachis-branches by 13.4%, secondary rachis-branches by 11.4%, filled grains by 19.8%, and percentage of filled grains by 1.0%. The same treatment on Zhai-Ye-Qing increased the secondary rachis-branches by 13.7-38.3%, 1,000-grain weight by 6.5-11.8%, and filled grains by 4-6 grains/ panicle (Table 3).

Seed treatment with Ai laser did not advance panicle emergence but it increased secondary rachis-branches by 12.0% for Zhen-Zhu-Ai and by 6.6% for Zhai-Ye-Qing. The treatment also increased the percentage of filled grains by 5.0-8.8% and by 11.8% for the 2 varieties. The Ar^+ laser was more effective for 20- to 30-minute treatments with Zhen-Zhu-Ai and for 3 minutes with Zhai-Ye-Qing.

Seed treatment with N_2 laser did not advance the heading stage of either Zhen-Zhu-Ai or Zhai-Ye-Qing, nor did it affect their dry seed status or germination rate. But it increased secondary rachis-branches of Zhen-Zhu-Ai seeds by about 32.0%, the number of grains per ear by about 12.2%, and the 1,000 grain weight about 5.5%. The N_2 laser treatment of seeds had the same effects on dry and germinating seeds of Zhai-Ye-Qing, except that it decreased the grain number per panicle. Hence, the

Table 1. Wavelength and power density of 4 lasers. Guangzhou, China.

Laser	Wavelength	Power density[a]
CO_2 laser	10.6 µ	20 w/cm^2
He-Ne laser	6328 A°	5 mw/cm^2
Ar^+ laser	4880, 5145 A°	5.7 w/cm^2
N_2 laser	3771 A°	66-88 mw/cm^2

[a]w = watts, mw = milliwatts.

Table 2. Effect of laser treatment on the heading date of rice. Guangzhou, China, 1980.

Treatment	Heading date	
	Zhen-Zhu-Ai	Zhai-Ye-Qing
Control	4 Jun	6 Jun
He-Ne laser	6 Jun	6 Jun
Ar^+ laser	4 Jun	8 Jun
N_2 laser	5 Jun	6 Jun
Control	9 Jun	6 Jun
CO_2 laser	6 Jun	9 Jun

Table 3. Effect of laser treatments on panicle characteristics of rice. GuangZhou, China, 1980.

Treatment	Panicle characteristics[a] Primary rachis-branches (no.)	Secondary rachis-branches (no.)	Filled grains (no./panicle)	Fertile (%)	1,000 grain wt (g)
	Zhen-Zhu-Ai				
Control	9.7	14.1	88.0	88.8	23.7
He-Ne laser	11.0	15.9	107.8	89.8	23.6
Ar^+ laser	11.0	15.8	101.4	96.6	24.6
N_2 laser	9.3	18.8	110.2	90.0	25.0
	Zhai- Ye-Qing				
Control	10.5	14.6	89.7	86.4	23.0
He-N laser	9.8	16.6	95.0	89.1	25.1
Ar^+ laser	10.0	15.5	102.0	91.5	25.1
N_2laser	9.0	15.0	18.8	88.1	25.4

[a]Mean of 20 panicles inspected. For the laser treatment, geminated seeds were planted in pots and placed in the field garden.

Table 4. Effect of CO_2 -laser treatment on panicle characteristics of rice, Guangzhou, China, 1980.

Treatment	Panicle characteristic[a] Primary rachis-branches (no.)	Secondary rachis-branches (no.)	Filled grains (no./panicle)	Fertile (%)	1,000 grain wt (g)
	Zhen-Zhu-Ai				
Control	10.1	18.7	87.4	76.5	21.6
CO_2 laser	12.1	18.4	124.4	91.8	23.7
	Zhai- Ye-Qing				
Control	8.8	15.6	70.2	12.1	21.6
CO_2 laser	9.0	15.4	85.8	90.1	23.2

[a]Mean of 20 panicles inspected.

efficiency of the N_2 laser treatment differs with variety and with seed status.

CO_2 laser treatment of Zhen-Zhu-Ai increased its 1,000-grain weight about 19.0% and number of filled grains by 18.2-37.0 grains/panicle (Table 4). For Zhai-Ye-Qing, CO_2 laser treatment increased the 1,000-grain weight by 5.5% and the number of filled grains by 15.5-15.8 grains/ panicle, and delayed panicle emergence by 2-3 days.

Seed treatment with all four lasers slightly decreased the protein content of rough rice. ■

Rice-based cropping systems

Evaluation of new technology developed at Walagambahuwa Minor Tank Settlement in Sri Lanka

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The Walagambahuwa settlement is typical of 10,000 similar settlements with 100-120,000 ha of wetland paddy in the dry zone of Sri Lanka. Lands below the minor tanks have been cultivated to rice only once every 5 or 6 years. Settlers harvest a successful rice crop only if wet season rainfall exceeds 1,200 mm.

New technology developed at the site has two major components — timely cultivation with the onset of wet season rainfall and a rice variety that will mature in 3-3 1/2 months. This combination allows a successful rice crop every year and the collection in tanks of runoff that is used for an additional rice crop or other highland crops in the dry season.

This technology has increased the paddy production in the area by a factor of 3-3 1/2 the last 5 years.

Two similar tanks in the same agro-ecological area, with and without the new technology, were compared.

The second village, Mudaperumagama, is 10-15 miles away from Walagambahuwa. Socioeconomic conditions are similar to those of Walagambahuwa. Per capita income is low and each family has 4–5 members.

Rainfall in 1980-81 was just above average:

191.8 mm in September,
212.8 in October,
460.8 in November,
108.3 in December, and
68.8 in January.

Farmers at Walagambahuwa cultivated the whole paddy under the tank with no supplementary irrigation. Average yield was 2.9 t/ha. Forty-five percent of the farmers harvested more than 3 t/ ha; 28% 2-3 t/ha; and 27% less than 2 t/ha.

The farmers also saved sufficient water in the tank to use during the dry season for another rice crop or highland crops.

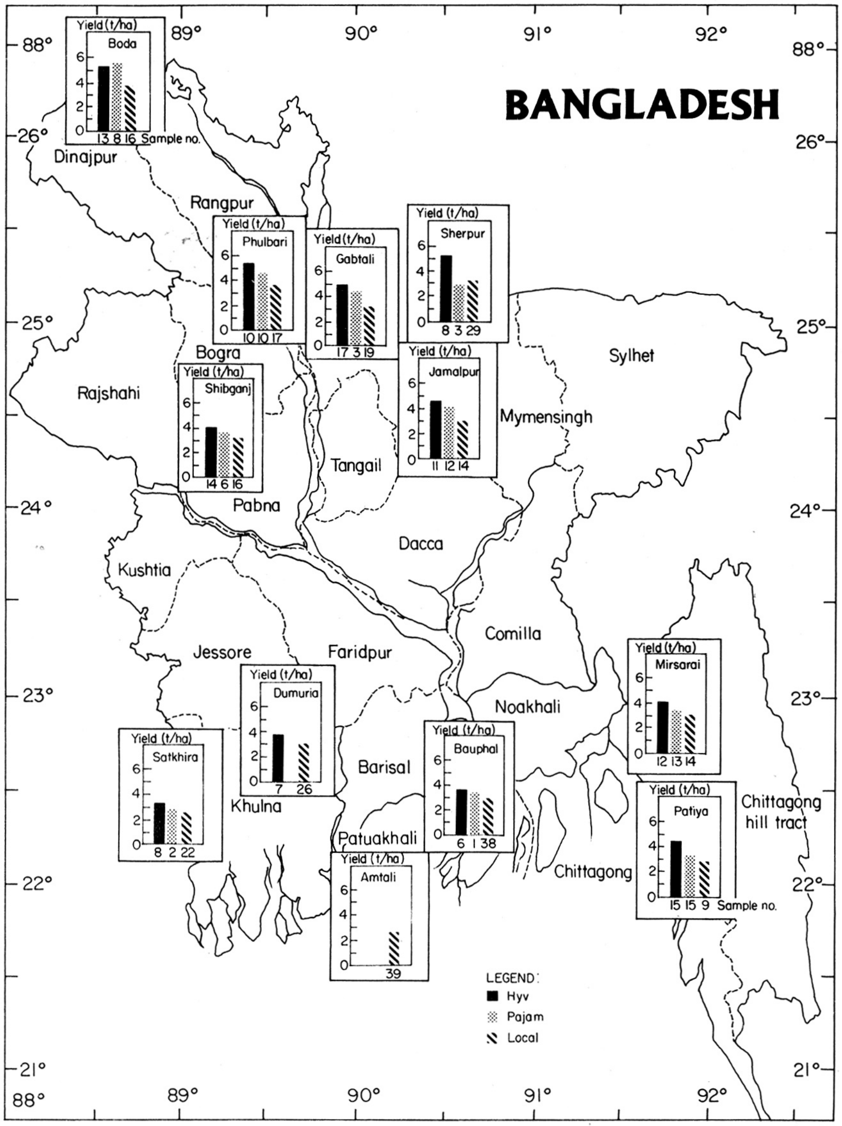
Farmers at Mudaperumagama started traditional paddy cultivation in late December. The crop was seeded in late January. Land preparation for paddy was by puddling, using a lot of water from the tank. The crop was raised solely with water drawn from the tank. At heading time the crop experienced moisture stress because the tank had no water for further irrigation. Forty-seven percent of the farmers harvested 0.2 t/ha and 53% 0.6-1.1 t/ha.

With the tank completely dry, there was no hope for another cultivation during the dry season. ■

Performance of 1980 transplanted aman rice in 12 selected *thana* of Bangladesh

M. Zahidul Hoque (present address: Multiple Cropping Department, IRRI), cropping systems specialist, Bangladesh Rice Research Institute (BRRI); Md. Mosharraf Hossain, chief; Agro-Economic Research Section, Ministry of Agriculture and Forests; and Nazrul Islam Miah and N. U. Ahmed, senior scientific officers, BRRI

A large-scale yield assessment study of the 1980 Bangladesh transplanted (t) aman rice crop was undertaken in 12 *thana* under 6 districts to determine the relative performance of new high yielding varieties (HYV), Pajam (an intermediate type between HYV and local varieties and known as Mashuri in other countries), and local varieties. A crop-cut of 5-m^2 area was harvested and the grain yield was adjusted to 14% moisture content. A total of 453 crop-cuts were analyzed for this report. Yields of the 1980 t. aman crop were high, HYV t. aman (BR4, BR3, IR5, IR20) gave quantitatively higher yields than Pajam except in Boda thana of Dinajpur district (see figure). The performance of the local t. aman varieties was inferior to that of HYV and Pajam in all thana, except at Sherpur where the local t. aman gave a slightly higher grain yield than Pajam. On the basis of 453 sample crop-cuts, the average grain yields for HYV, Pajam, and local t. aman were 4.5, 3.9, and 3.1 t/ha. Thus, our results indicated that under current farmer management, the HYV t. aman could produce additional grain yields of 593 and 1,470 kg/ha in Bangladesh if grown instead of Pajam and local varieties. The study also indicated that constraints in Khulna and Patuakhali districts limit the grain yield of t. aman rice and particularly of the modern varieties. ■



Yields of three groups of transplanted aman rice varieties in 12 thana of Bangladesh in 1980.

Agroeconomic evaluation of farmers' direct-seeded upland rice crop at a rainfed site in Bangladesh

M. Zahidul Hoque (present address: Multiple Cropping Department, IRRI), head, Raisuddin Akanda, scientific officer, Division of Rice Cropping Systems, Bangladesh Rice Research Institute (BRRI), and N. U. Ahmed, senior scientific officer, BRRI, Joydebpur, Dacca, Bangladesh

Agroeconomic monitoring of the farmers' rainfed aus rice crop was done at the BRRI cropping systems research site at Alimganj, Rajshahi district, during 1980. Traditionally, farmers at this site grow local varieties of aus rice in aus rice - transplanted aman rice, aus rice - rabi (winter) crops, and aus rice - t. aman rice - rabi crops patterns. Four modern rice varieties were introduced at the site in 1980 to compare their performance with the traditional local varieties under farmers' management.

All varieties were seeded between 10 and 17 May. Seeds were broadcast for all local and most of the modern variety fields. All farmers used fertilizers and hand weeding, Except for Purbachi, the average fertilizer rates for the modern varieties were higher (see table) than for the local varieties. Weeds were a problem in all fields and farmers hand weeded 2 to 5 times. Insecticide was used only on the modern varieties. The average field duration of local varieties ranged between 86 and 89 days; that of the modern varieties ranged from 100 to 138 days. The local varieties Hashikalmi

Management practices, productivity, and costs and returns analysis of farmers' direct-seeded rainfed aus rice at Alimganj cropping systems research site, Rajshahi district, Bangladesh, 1980.

Observation	Local variety		Modern variety[a]			
	Hashikalmi	Dharial	BR1	BR3	BR9	Purbachi
Sample number	6	4	3	2	4	1
Seeding date range	10-17 May	13-17 May	10-13 May	10-13 May	10-17 May	10 May
Av N-P_2O_5-K_2O rate (kg/ha)	34-44-40	41-38-30	92-43-19	64-49-39	72-54-33	42-56-0
Hand weeding frequency (range)	2-4	2-3	3-5	3-5	3-5	2
Farmers (%) who used insecticide	0	0	33	100	50	100
Av field days	89	86	113	138	115	100
Av grain yield (t/ha)	2.28	2.19	2.85	3.20	2.23	2.48
Grain yield (kg/day per ha)	25.62	25.49	25.19	23.15	19.36	24.77
Grain yield range (t/ha)	1.9-3.0	1.8-2.8	2.4-3.3	3.0-3.4	2.1-2.3	–
Av production costs (US$/ha)[b]	146	155	234	218	187	176
Production costs range (US$/ha)	119-217	143-172	187-296	180-257	188-220	–
Av net return (US$/ha)	313	256	348	435	268	290
Net return range (US$/ha)	164-403	189-369	291-453	428-442	247-303	–
Benefit-cost ratio	3.14	2.65	2.48	2.99	2.44	2.64

[a]First introduced at the site. [b]Exchange rate used in computation: US$1 = Taka 15.

and Dharial yielded 2.28 and 2.19 t/ha, respectively. The modern varieties produced about 9 to 40% higher average yield than the better local variety Hashikalmi. However, both the local varieties gave higher daily production per hectare. On the average, the production cost for modern varieties was 35% higher than for the local varieties. Hashikalmi gave the highest benefit-cost ratio (3.14) and BR9 gave the lowest, apparently because of heat injury at the reproductive stage. Results of the present monitoring study indicated that although BR1 and BR3 have prospects in the area, it might be advantageous to continue the use of local aus varieties until higher yielding and earlier modern varieties are identified or developed for the agroclimatic conditions at the site. ■

ERRATA

In vol. 6, no. 2 (Apr 1981) Genetic evaluation and utilization — overall progress, page 3 item: RAU21-168-1-2, a promising rice variety for waterlogged areas of Bihar, India, paragraph 3 should read:

The tall-statured RAU21-168-1-2 matures in 150-155 days in the field and is moderately resistant to bacterial blight. It has short bold grains and is weakly sensitive to photoperiod.

In vol. 6, no. 3 (Jun 1981) Soil and Crop Management, page 22, item: Population of the weed *Marsilea quadrifolia* in plots with azolla. The name of the weed was misspelled in title and in article. *Panicum colonum* and *Echinochloa colona* are the same weed. *Pistia stratiotes* is the correct spelling. *Cyperus rotundus* is not a wetland weed.

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