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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 he 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 (BP'H) 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

Three rice varieties for release in Bombuwela

P. E. Peiris, S. Abeysiriwardena, and E. Rajupaksa, Regional Agricultural Research Station, Bombuwela, India

Local variety Herath banda has three important characters improved varieties lack: exceptionally fast seedling growth, red pericarp and high palatability, and thrip resistance.

The 3-month strain BW 272-6B, bred to replace Herath banda, further consolidates high yield potential, resistance to lodging, high resistance to leaf blast, optimum yield at low levels of nitrogen, moderate resistance to salinity, high protein content (10-12.7%>), and suitability for mineral, half bog, and bog soils.

In farmers' fields BW 272-6B yielded twice as much as Herath banda. The average yield of Herath banda is 1.0-1.3 t/ha. The expected average yield of BW 272-6B is 2.6 t/ha, with a yield potential of more than 4.6 t/ha.

Because more emphasis has been placed on the selection of early-maturing strains, BW 267-3 and BW 266-7 have recently emerged from the Bombuwela varietal improvement program.

BW 267-3 takes 108 days from sowing to maturity. It has a culm length of 74 cm and because of a fast early growth rate, its weed competitive ability is high. It is nonlodging. The grain is long and the pericarp color is white. It is highly resistant to blast, iron toxicity, grain spotting, and moderately resistant to bacterial blight and sheath blight.

BW 266-7 takes 102 days from sowing to maturity. It is 4-5 cm shorter than BW 267-3. It is nonlodging and has white, long, slender, translucent grain of high quality. Even ripening and clean crop are characteristic features. The strain is highly resistant to blast and grain spotting and moderately susceptible to bacterial blight and sheath blight. It is highly resistant to gall midge. ■

Performance of IRRI cultivars in Afghanistan

S. S. Saini, rice breeder, Indian Agricultural Assistance Programme in Afghanistan Embassy of India, Kabul, Afghanistan

Testing exotic varieties has been the main activity of the rice improvement program in Afghanistan. By 1979, 510 IRRI cultures had been obtained, either directly from IRRI or from IRTP nurseries. Separate trials for fine-grained and coarse-grained cultures were conducted at Jalalabad (eastern zone) and Baghlan (northern zone) 1971-80. No trials could be arranged in Herat (western zone). One local fine-grained variety — Barah at Baghlan and Pashadi, Lawangin or Behsudi at Jalalabad— was included as a check. Coarse-grained cultures were compared with the local variety LUK at both sites.

Table 1. Performance of fine-grained IRRI cultures in varietal trials at Jalalabad and Baghlan, Afghanistan.

Culture	Yield	Increase	
			%
	Jalalabad		
IR1529-680-3-2	7.3	4.6	165.3
Local variety	2.8		
IRl561-228-3-6	6.2	3.6	143.0
Local variety	2.6		
IR1561-238-2	6.8	3.3	94.6
Local variety	3.5		
IR1628-632-1	7.6	4.6	156.7
Local variety	3.0		
IR1721-11-6-8-3-2	7.3	4.8	193.9
Local variety	2.5		
	Baghlan		
IR1529-680-3-2	6.0	0.8	15.6
Local variety	5.2		
1Rl561-228-3-3	7.3	1.8	32.6
Local variety	5.5		
IR1561-238-2	6.4	1.2	22.4
Local variety	5.2		

Only 43 cultures (26 fine and 17 coarse) at Jalalabad and 21 cultures (11 fine and 10 coarse) at Baghlan matured normally. Others did not ear at all or were very late and recorded very high sterility.

IRRI fine-grain cultures yielded 4% to 395% more at Jalalabad and from 2.4% to 112.3% more at Baghlan. The three highest-yielding cultures at Jalalabad were IR1628-632-1, IRl529-680-3-2, and IR1721-11-6-8-3-2 (Table 1). At Baghlan they were IR1561-228-3-3, IR1561-238-2, and IR1561-152-1. IR1561-228-3-3 and IR1561-238-2 yielded an average of more than 6 t/ha at both sites. Promising fine-grained cultures are being evaluated for qualities similar to those of local varieties.

IRRI coarse-grained cultures yielded from 47.28% to 163.5% more at Jalalabad and from 15.14% to 63.6% more at Baghlan (Table 2). Three cultures, IR747B$_2$-4-2-1-1, IR934-10-1-2-2, and IR934-239-1-3-2, yielded an average of more than 6 t/ha at both sites. Promising coarse-grained varieties are being tested in demonstration plots in farmers' fields. ■

Table 2. Performance of the best coarse-grained IRRI cultures in varietal trials at Jalalabad and Baghlan, Afghanistan.

Culture	Yield (t/ha)	Increase t/ha	Increase %
	Jalalabad		
IR747 B2-4-2-1-1	6.2	2.3	59.4
Local variety	3.9		
IR934-10-1-2-2	8.4	4.4	107.4
Local variety	4.0		
IR934-239-1-3-2	8.4	5.2	163.5
Local variety	3.2		
	Baghlan		
IR747 B$_2$-4-2-1-1	7.2	2.8	63.6
Local variety	4.4		
IR934-10-1-2-2	6.8	2.2	48.1
Local variety	4.6		
1R934-239-1-3-2	6.1	1.5	34.0
Local variety	4.6		

Low input variety BIET1107 for rainfed lowland areas of Bihar, India

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The average fertilizer consumption of a rice crop in Bihar is high — about 4 kg N/ha. A number of factors, including the economic condition of the farmers, are responsible.

BIET1107 is the result of efforts to breed varieties for low inputs. BIET1107 (from the cross Jaya/Mahsuri), had the designation RAU 51-57-1 before its release in 1981. In more than 5 years of varietal trials, recommended practices for low input varieties (40-50 kg N/ha) were used. Yield superiority was consistent (Table 1) over years and across sites. Under rainfed lowland conditions during 1979 and 1980, BIETl107 yielded an average 3.4 t/ha, compared with 2.5 t/ha of BR34, 2.2 t/ha of Mahsuri, and 1.8 t/ha of BR8. BIET1107 is also recommended as a substitute for varieties such as BR8, BR34, and Mahsuri in rainfed areas of medium lowlands. Beginning in 1978, BIET1107 showed its superiority over existing varieties in more than 815 minikit demonstrations in farmers' fields.

BIET1107 has intermediate height (135 cm) and good tillering ability. Its resistance to bacterial blight is moderate but better than that of Mahsuri. Grains are medium slender with quality comparable to Mahsuri's (Table 2), making BIET1107 acceptable to farmers and consumers. ■

Table 1. Average yield of BIETIl07 under low input irrigated conditions at 5 sites in Bihar, India, 1976-80.

Entry	Av yield (t/ha) Patna	Bikram ganj	Sabour	Pusa	K anke
BIET1107	4.7	4.2	4.0	2.4	2.5
BR34	3.2	2.8	3.4	2.2	2.3
Mahsuri	4.5	3.5	4.2	2.1	2.7
BR8	3.2	2.6	3.3	2.6	2.5

Table 2. Grain quality characters of BIET1107 and check varieties in Bihar, India.

Entry	Grain length (mm)	Length-breadth ratio	Hulling (%)	Head rice recovery (%)	Protein (%)	Cooking quality
BIET1107	5.1	2.6	73.4	63.3	7.0	Good
BR34	6.0	2.9	72.4	59.2	9.1	Good
Mahsuri	5.3	2.7	74.5	65.2	8.7	Good
BR8	6.8	3.0	71.2	58.2	7.2	Good

GENETIC EVALUATION AND UTILIZATION

Agronomic characteristics

Angle of leaf attachment in rice varieties

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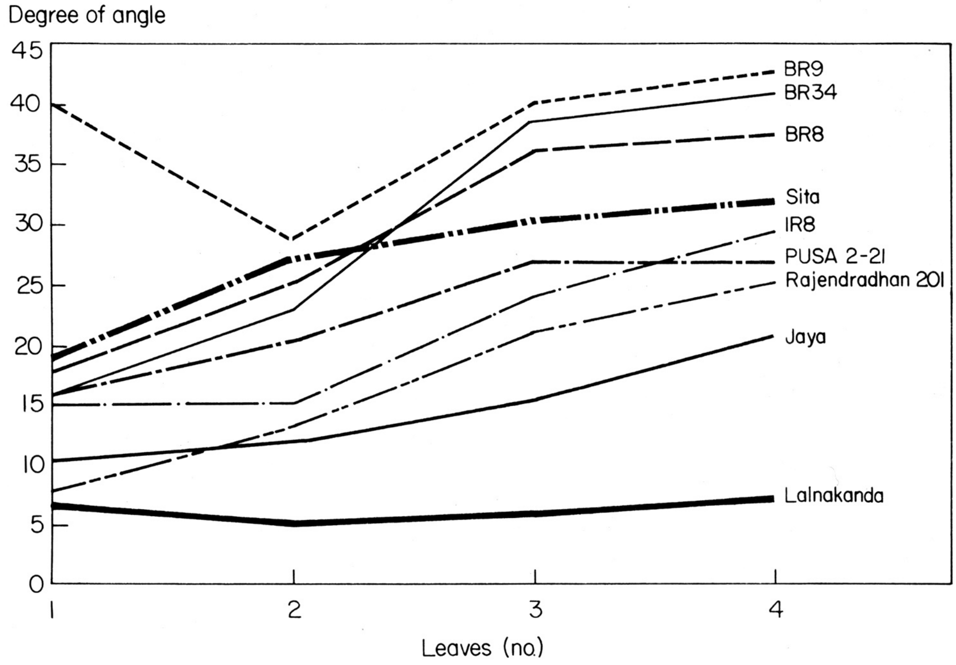
The angle a rice leaf blade makes at its base (collar) is influenced largely by leaf length. The wider the angle, the more the spread of leaves for light interception, especially in the lower leaves. This defect has largely been corrected in semidwarf lines where leaves are shorter than in tall varieties and form closer angles at the base. But overlapping still occurs in the lower leaves. In the ideal plant type, interception of light would be low. One way to achieve this is to develop rice plant types with minimum leaf attachment angles.

Lalnakanda is a tall variety with long leaves and acute leaf attachment angles. A study compared some selected tall (BR34, BR8, BR9) and semidwarf (Jaya, Sita, Pusa 2-21, RD1, and IR8) varieties and Lalnakanda. Varieties were grown at 20- × 20-cm spacing with 80-40-20 kg NPK/ha. Four leaves were taken from the top of 100 random tillers at the postflowering stage.

Leaves of tall varieties had wider leaf attachment angles than dwarf varieties (see figure). The difference is clear in the second and third leaves. But all leaves of Lalnakanda had closer angles than did dwarf varieties. Incorporation of acute leaf attachment angle in short-leaved dwarfs could result in better plant types where light interception would be less. Plant populations per unit area could be increased without adversely affecting photosynthetic rates. The trait is linked with a simply inherited rudimentary juncture condition and could be incorporated easily into the desired plant type. ■



Angles of leaf attachment of different rice varieties observed at Bhagalpur, India.

GENETIC EVALUATION AND UTILIZATION

Grain quality

A preliminary study on the specific gravity of rice grain

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Most Sri Lankans prefer red rices. But with the introduction of high yielding varieties, the number of red rice varieties in cultivation has decreased considerably. A preliminary study used specific gravity to compare rice color and grain weight.

Twenty rice varieties (10 red and 10 white), including both recommended varieties and elite lines, were grown under identical conditions during the 1980 dry season. Rice yield was dried in the shade to 14% moisture. Fifteen-gram samples from both brown rice and polished rice were drawn. Grain weight was determined by the specific gravity bottle method using kerosene oil.

Results suggest that the specific gravity of white rice is significantly higher than that of red rice (see table). Polishing increased the specific gravity, which could be attributed to removal of the high fat content of the bran.

Yield is the primary objective in varietal improvement work in Sri Lanka. It is possible that the reduction in the number of red rice varieties grown is due to an unconscious selection against red grains, which have a lower weight than white. ■

Specific gravity measurements of rice in Sri Lanka.

Specific gravity [a]			
Red rice		White rice	
Brown	Polished	Brown	Polished
1.4000	1.4260	1.4120	1.4390

t-value [b] for color (red & white):
Brown rice = 2.942**
Polished rice = 3.106**

Milling (brown & polished):
Red rice = 5.733**
White rice = 5.978**

[a] Mean of 10 samples. [b] **significant at .01 level.

Individuals, organizations, and media who wish additional details of information presented in IRRN should write directly to the authors.

Breeding high-quality and high-yielding varieties of rice in Afghanistan

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Rice consumers in Afghanistan are quality conscious. Local varieties are high quality, with long, slender, translucent grains that cook into excellent plaw or biriani. Two very popular varieties, Barah and Lawangin, are grown extensively in the northern and the eastern areas. They are tall growing with weak straw and poor response to fertilization; hence productivity is low.

To increase yield potential, the two local varieties were crossed with a high yielding culture; IR790-28, at IRRI. Bulk seed for growing the F_3 was received in 1973. Selection of desirable recombinants was carried out in F_3 to F_6 plants grown under high-level fertility (120-60-60 kg NPK/ ha) at the Pos-i-Shan Agricultural Research Station at Baghlan.

Thirty high-yielding cultures from IR790-28/ Barah and 37 cultures from IR790-28/Lawangin met the quality standards of the local varieties. These cultures were tested in replicated varietal trials in 1975-1980 at the research stations at Baghlan in the northern zone and at Jalalabad in the eastern zone. Five cultures were selected for further testing in demonstration plots in farmers' fields. Their average yields in varietal trials is given in the table.

The new cultures gave 26.8% to 95.8% more yield than the local variety at Baghlan. At Jalalabad, the yield increase ranged from 11.8% to 221.1%. The cultures derived from IR790-28/Barah gave average higher yields than those from IR790-28/Lawangin.

The agroclimatic conditions at Baghlan seem conducive to high yield. Cultures 76-1-1 and 89-4-2 from IR790-281/Barah responded very well with yields of 10.2 and 12.5 t/ha. Besides high soil fertility at Baghlan, the main factor contributing to high yield was long sunny days. The average sunshine during the rice growing season was 9 to 11.6 hours daily. ■

Performance of new high-quality and high-yielding cultures in varietal trials at Baghlan and Jalalabad Research Stations, Afghanistan, 1975-80.[a]

Culture, variety	Yield (t/ha)	Increase t/ha	Increase %
IR 790-28/Barah (Baghlan)			
89-1	7.2	1.5	27.4
Local variety	5.6		
76-1-1	10.2	3.9	60.7
Local variety	6.4		
89-4-2	12.5	6.1	95.8
Local variety	6.4		
IR 790-28/Barah (Jalalabad)			
89-1	6.1	4.2	221.1
Local variety	1.9		
76-1-1	5.7	3.5	157.8
Local variety	2.3		
89-4-2	4.3	2.1	90.4
Local variety	2.3		
IR 790-28/Lawangin (Baghlan)			
10-5	6.8	1.4	26.8
Local variety	5.3		
10-1-3-4	7.0	2.4	51.9
Local variety	4.6		
IR 790-28/Lawangin (Jalalabad)			
10-5	5.0	2.2	76.9
Local variety	2.8		
10-1-3-4	4.1	0.4	11.8
Local variety	3.7		

[a] Yield data were averaged.

GENETIC EVALUATION AND UTILIZATION

Disease resistance

Screening rice varieties for bacterial blight resistance

I. Hossain, A. J. Miah, and M. A. Mansur, Institute of Nuclear Agriculture, P. O. Box 4, Mymensingh, Bangladesh

Bacterial blight (*Xanthomonas oryzae*) disease became widespread in Bangladesh after the introduction of high yielding rice varieties. Six F_2 crosses and their parents — BR3, BR4, IRATOM24, IRATOM38, and Dular — and two high-yielding, early-maturing gamma-ray induced M_7 mutants and their parents — Mut 1-1, Mut 1-2, and IR8 — were screened for resistance in the field February-July 1980.

One-month-old seedlings were transplanted at 25 × 20 cm spacing. The plants were artificially inoculated by the clipping method at flowering stage. None of the tested materials were completely free from infection. Only BR4-IRATOM38 and Mut 1-1 and Mut 1-2 were moderately resistant. The parent IR8 of the mutants appeared susceptible (see table). ■

Reaction of crosses, mutant strains, and varieties of rice inoculated with an isolate of *Xanthomanas oryzae* at flowering stage in Mymensingh, Bangladesh.

Cross, mutant strain, or variety	Disease reaction[a]
BR3/IRATOM24	MS
BR3/IRATOM38	MS
BR3/Dular	MS
BR4/IRATOM24	MS
BR4/IRATOM38	MR
BR4/Dular	MS
BR3	MS
BR4	MR
IRATOM24	MS
IRATOM38	MS
Dular	MS
Mut 1-1	MR
Mut 1-2	MR
IR8	S

[a] MR = moderately resistant, MS = moderately susceptible, S = susceptible.

Reaction of some deepwater rice varieties *to Ditylenchus angustus*

Dong-ngoc Kinh and Chau-Dieu Phuong, Plant Protection Department, University of Cantho, Hau-Giang, Vietnam

Tiem Dot San, caused by *Ditylenchus angustus,* is a serious disease of deepwater rice in the Mekong Delta. In thousands of infested hectares, yield losses ranged from 20 to 100%. Almost all local deepwater rice varieties are susceptible.

The coleoptile inoculation method, with 10 adult nematodes per germinated seed, was used to test 34 deepwater var-

Reaction of 34 deepwater rice varieties to *D. angustus,* University of Cantho, Vietnam.

Variety	Disease incidence (%)	Seedlings diseased (%)	Variety	Disease incidence (%)	Seedlings diseased (%)
BKN6986-8	26	70	BKN6986-11-3	55	88
CNL53	30	55	CNL231 B-B	56	87
Jalaj	39	65	CNLl8O	56	98
Yodaya	42	75	IR5857-3-2E-2	57	84
BKN6986-113	42	79	Trang Tep	58	88
BKN6986-51	43	74	BKN6986-45	58	100
Sulpan	44	75	B1050 C-Mr-18-1	59	91
PG56	45	81	BKN6986-29	59	84
BKN6986-57	47	65	BKN6986-70	59	96
Cula	47	87	BKN6986-44	60	88
HTA7204	50	85	Chenabsel	61	92
Trung Hung	50	85	CNL319	62	92
81050 C-MI-26-3	51	85	IR5825-41-2-P4	63	89
BKN6986-66-2	52	86	CNL241	64	95
TR5825-41-2-P1	53	86	BKN6986-81-5	65	92
BKN6986-67	54	91	Nang Tay Dum	67	93
TR5857-64 IE1	55	87	IR5825-114-3P2	78	96

ieties. After 48-hours inoculation in a saturated-moisture atmosphere at 28-30°C, 40 seedlings of each variety were transplanted at 10 seedlings/pot. Pots were placed under partly-shaded condition, 80-90% relative humidity, and temperature 28-30°C. At 30 days after inoculation, all varieties were infested (see table). Seven varieties had severe infestations (disease incidence 61-78%); 24 varieties, moderate (45-60%); and three varieties, slight (26-39%). ■

Tungro-tolerant rice varieties for second crop

K. M. Balasubramaniam and N. Jaleel Ahmed, Tamil Nadu Agricultural University Regional Research Station, Aduthurai-612101, Tamil Nadu, India

Normally second-crop rice in Thanjavur District, Tamil Nadu, is sown from 15 August to 30 September. The yields of 140- to 160-day varieties are adversely affected by epidemic rice tungro disease.

Four rice varieties — two Pankaji Jagannath (IET5852 and IET5897), one CR70-80-2/ Pankaj (IET5890), and one Pankaji Vijaya (IET6262) were compared to TN1 susceptible check and IR20 during 1979, a year when tungro occurred naturally, and 1980, a year when green jassids were kept under check (see table).

The parents of the hybrid derivatives — Pankaj, CR70-80-2, Jagannath, and Vijaya — have tungro and green jassid resistance. IET5897 (CR210-1009 of Pankaj/Jagannath) consistently registered high yields during both years. The variety IET6262 (Pankaj/Vijaya) had a higher degree of field tolerance for rice tungro. ■

Grain yield and tungro disease score of 4 second-crop varieties, Tamil Nadu, India.[a]

Variety	1979 Grain yield (t/ha)	1979 Tungro disease score	1980 Grain yield (t/ha)	1980 Tungro disease score
CR 70-80-2/Pankaj				
IET589 (CR213-1002)	3.4	5	4.8	3
Pankaj/Jagannath				
IET5852 (CR210-1005)	4.1	5	4.2	3
IET5897 (CR210-1009)	4.3	3	6.6	3
Pankaj/Vijaya				
IET6262 (CR262-16)	4.0	1	4.6	nil
TN1 (susceptible check)	0.5	9	0.7	9
IR20	2.2	5	3.8	3

[a]*Score chart scale* (% hills infected):
1 less than 1%
3 about 10%
5 about 30%
9 about 100%

Evaluation of rice mutants resistance to thrip

M. A. Chowdhury and A. J. Miah, Institute of Nuclear Agriculture, P. O. Box 4, Mymensingh, Bangladesh

Rice thrip *Thrips oryzae* Williams is generally considered a minor pest of rice in Bangladesh. The only species so far recorded in Bangladesh, its populations recently have assumed economic significance in some areas. Infestations occur in early growth stages of rice plants. Both nymphs and adult thrips damage rice plants by lacerating the leaf-tip tissues and sucking the sap. The infested plants appear to suffer from water stress. Infested leaves roll and yellow. In heavy infestations, the leaf-tips wither and the plant wilts.

Two early-maturing mutants, Mut 1-1 and Mut 1-2 originally isolated from IR8 after gamma-irradiation, with the mother variety and checks BR3, IRATOM24, and IRATOM38 were assessed for rice thrip resistance. Experiments in summer and autumn, 1981, used a randomized block design with four replications. The infested leaves in 10 randomly selected hills in each plot were counted.

Mut 1–1 and Mut 1-2 were found to be moderately resistant to thrip, but varieties BR3, IR8, and IRATOM38 were susceptible (see table). ■

Rice mutant resistance to thrip at Mymensingh, Bangladesh.

Mutant, variety	Leaf infestation[a] (%) Summer 1981	Leaf infestation[a] (%) Autumn, 1981
Mut 1-1	9.50 a	2.43 a
Mut 1-2	8.18 a	0.43 a
BR3	21.48 c	
IR8	19.02 bc	5.84 b
IRATOM24	18.59 bc	3.57 ab
IRATOM38	18.06 b	–

[a]In a column means followed by the same letter are not significantly different at the 5% level.

GENETIC EVALUATION AND UTILIZATION

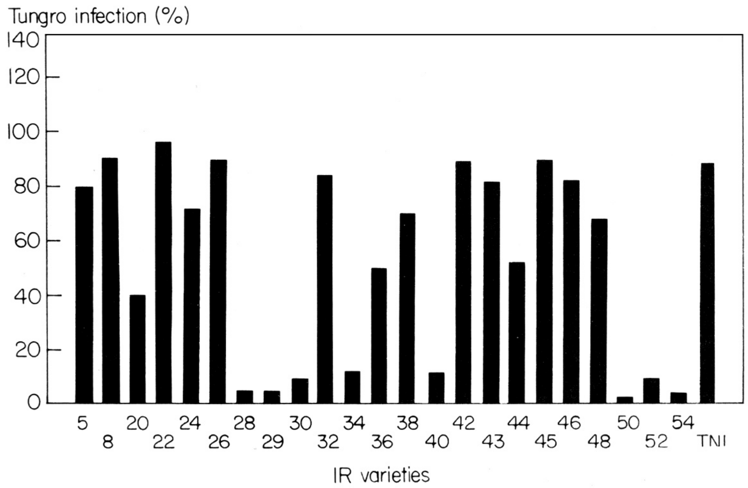
Insect resistance

Green leafhopper resistance and tungro infection in IR varieties

H. Rapusas and E. A. Heinrichs, The International Rice Research Institute

Varieties developed at the International Rice Research Institute (IRRI) and evaluated by the seedling bulk test (SBT) exhibited different levels of *Nephotettix virescens* resistance. *N. virescens* damages the rice plant directly and is a very efficient vector of rice tungro virus. To determine the degree of tungro resistance in varieties IR5 to IR54, 20-day-old seedlings of the test

Tungro infection in IR varieties, IRRI farm, April 1981.



varieties and TNl as the susceptible check were transplanted in 2.2- × 1.2-m field plots at 20- × 20-cm spacing. A row of tungro-infected TN1 seedlings planted around each plot served as a source of infection.

One week after transplanting, 100 *N. virescens* adults were caged on tungro-infected TN1 plants at the center of each plot. The insects were released 24 hours after caging. Treatments were replicated three times. Sixty days after release of the hoppers, tungro-infected hills were counted, and tungro infection was computed for each plot.

IR28, IR29, IR30, IR34, IR40, IR50, IR52, and IR54 had low levels of tungro infection (see figure). In general, varieties most resistant in the SBT also had the lowest tungro infection. In the IR varieties the degree of tungro infection in the field apparently is related to the degree of *N. virescens* resistance indicated by the SBT. ■

Response to insecticides of green leafhoppers from four sites in the Philippines

L. Fabellar, E. A. Heinrichs, and H. Rapusas, The International Rice Research Institute

To measure the development of insecticide resistance in green leafhoppers *Nephotettix virescens,* cultures collected from four sites in the Philippines were compared with a greenhouse culture. The insects originated from Pangasinan, Nueva Ecija, and Tarlac Provinces in Central Luzon.

Insecticide solutions of acephate, methyl parathion, MIPC, and monocrotophos were prepared. Three- to seven-day-old adult insects were anaesthetized and sprayed with 2 ml of the insecticide solution at rates of 0.125, 0.25, 0.4, 0.5, and 0.75 kg a.i./ha with a Potter's spray tower. Each treatment of 25 insects was replicated twice.

Treated insects were transferred to potted 2-week-old rice seedlings, covered with mylar cages (15.38 cm tall, 3.50 cm in diameter), and placed in 25° C to 27° C temperature, 60 to 80% relative humidity and 12 hours light. Mortality was recorded 48 hours after treatment and the computed lethal concentrations to kill 50% of the population (LC_{50}) were compared between colonies (see table).

Cultures from Palayan had 1.32-fold resistance to acephate and 2.02-fold resistance to methyl parathion. Cultures from Santa Maria had 1.36-fold resistance to acephate.

Methyl parathion and monocrotophos are probably the insecticides most commonly used in the Philippines. The low level of resistance to the four insecticides indicates that resistance would not be a problem for farmers at the four sites. ■

Resistance of field-collected green leafhoppers to insecticides (LC_{50}[a] values). IRRI insectary, 1980.

Source of culture (Philippines)	Level of resistance [b]			
	Acephate	Methyl parathion [c]	MIPC	Monocrotophos
Palayan, Nueva Ecija	1.32 [d]	2.02 [d]	0.86	0.84
Santa Maria, Pangasinan	1.36 [d]	1.11	0.28	0.62
Rosales, Pangasinan	0.95	1.12	0.28	0.53
Pura, Tarlac	1.00	1.24	0.52	0.53

[a] LC_{50} = lethal concentration in kg a.i./ha applied in Potter's spray tower to kill 50% of the insect population. [b] Level of resistance = $\frac{LC_{50} \text{ of field-collected culture}}{LC_{50} \text{ of greenhouse culture}}$. Resistance ratio of >1.0 indicates field culture resistance greater than greenhouse culture. [c] PENNCAP M formulation. [d] Cultures with significantly higher (5% level) LC_{50} values than the greenhouse culture.

Resistance of rice varieties to the green leafhopper in Southern India

S. Chelliah and A. M. Hanifa, Tamil Nadu Agricultural University, Coimbatore, India; and E. A. Heinrichs and G. S. Khush, International Rice Research Institute

Resistance of rice varieties to the green leafhopper (GLH) *Nephotettix virescens* (Distant) was studied in an international collaborative research project. Eleven varieties with known resistance genes, four varieties with unknown resistance genes, and resistant and susceptible checks were screened.

Test varieties were planted in seedboxes (60 × 40 × 10 cm) in 15 cm rows, replicated three times. Seedlings were thinned to 30/ row 7 days after sowing. Seedboxes were infested with GLH adults (about 2/seedling), covered with nylon mesh cages, and maintained on galvanized on trays containing 6 cm water.

Damage rating began 6 days after infestation (DI) and continued to 11 DI. The 1-9 damage rating scale of the Standard Evaluation System for Rice was used. The rating at 9 DI, when 2 test varieties scored 8, was used to judge GLH resistance.

Moddai Karuppan with gene *Glh 7,* Ptb 8 with *glh* 4, and TAPL 796 with *Glh* 6 had the highest levels of resistance (see table). ASD7 (*Glh 2*), IR8 (*Glh 3*), and ASD8 (*Glh 5*) were moderately resistant. Pankhari 203 (*Glh 1*) was

Green leafhopper (*Nephotettix virescens* Dist.) resistance ratings of rice varieties with different resistance genes, Coimbatore, India.

Variety	Resistance gene[a]	Damage rating[b]					
		6 DI	7 DI	8 DI	9 DI	10 DI	11 DI
Pankhari 203	*Glh 1*	9.0 c	9.0 d	9.0 e	9.0 e	9.0 d	9.0 d
ASD 7	*Glh 2*	2.3 a	3.0 ab	5.0 bcd	5.7 cde	7.0 cd	7.7 d
IR8	*Glh 3*	1.7 a	3.7 b	5.0 bcd	6.3 de	7.0 cd	1.0 cd
Ptb 8	*glh 4*	1.0 a	2.3 ab	2.3 abc	3.0 abc	3.7 ab	3.1 ab
ASD 8	*Glh 5*	1.0 a	3.0 ab	3.7 abcd	5.0 bcd	5.7 bc	7.0 d
TAPL 196	*Glh 6*	1.7 a	1.7 ab	3.0 abcd	3.7 abcd	3.7 ab	5.0 bc
Moddai Karuppan	*Glh 7*	1.0 a	1.0 a	1.0 a	1.0 a	1.7 a	2.3 a
IR20	*Glh 3*	1.7 a	3.7 b	5.7 cde	6.3 de	7.7 cd	7.7 d
IR24	NA	2.3 a	3.7 b	5.7 cde	7.0 de	7.7 cd	7.7 d
IR26	NA	1.0 a	1.0 a	1.7 ab	2.3 ab	3.0 a	3.0 ab
IR36	*Glh 6*	1.7 a	1.7 ab	1.7 ab	1.7 ab	1.7 a	1.7 a
IR42	NA	1.7 a	1.7 ab	2.3 abc	3.0 abc	3.0 a	3.0 ab
IR50	NA	1.0 a	1.7 ab	1.7 ab	1.7 ab	1.7 a	1.7 a
IR54	NA	1.7 a	1.7 ab	3.0 abcd	2.3 ab	2.3 a	2.3 a
IR29 (resistant check)	NA	1.0 a	1.7 ab	1.7 ab	1.7 ab	2.3 a	3.0 ab
TN1 (susceptible check)	–	5.0 b	6.3 c	7.0 de	8.3 e	8.3 d	9.0 d

[a]NA = not ascertained. [b]Scored by the Standard Evaluation System for Rice. Within a column, means followed by a common letter are not significantly different at the 5% level. DI = days after infestation.

susceptible.

Genes *Glh I, Glh 2, Glh 3, glh 4,* and *Glh 5* were identified at IRRI using a Philippine population of *N. virescens* Genes *Glh 6* and *Glh 7* were identified in Bangladesh.

Pankhari 203, which is susceptible at Coimbatore, is highly resistant in the Philippines. On the other hand, Moddai Karuppan is moderately susceptible in the Philippines but is highly resistant at Coimbatore and Bangladesh. ■

Resistance of rice cultivars and wild rices to thrips

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Among yield nursery seedlings of rice cultivars and wild rices screened for thrips *Baliothrips biformis* (Bagnall) resistance, Ptb 33, BG379-1, and Kalubalawee Sudurvi 305 were highly resistant. Gangala, Utri Rajappan, BG367-1, BG367-9, BG379-5, OB678, and IR17494-32-1-1-3-2 were resistant.

Wild rices found resistant to thrips at Coimbatore, India.

IRRI accession number	Name	Origin	Rating
103437	*O. glaberrima*	Senegal	1
103443	*O. glaberrima*	Senegal	1
103831	*O. sariva* f. *spontanea*	Bangladesh	1
103836	*O. nivara*	Bangladesh	1
101171	*O. eichingeri*	Tanzania	3
101510	*O. nivara*	India	3
101993	*O. rufipogon/O. nivara*	Sri Lanka	3
103438	*O. glaberrima*	Senegal	3
103791	*O. nivara/O. sativa*	Venezuela	3
103826	*O. sativa* f. *spontanea*	Bangladesh	3
103849	*O. perennis*	India	3

Eleven wild rices were resistant (see table).

Varieties BG367-1, BG367-9, BG379-1, BG379-5, IR17494-32-1-1-3-2, and OB678 also were resistant to brown planthopper. ■

Reaction of gall midge-resistant cultures at Warangal, India

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The Agricultural Research Station, Warangal, India, collaborated with the All India Cooperative Rice Improvement Project and IRRI in a study to identify gall midge biotypes and their distribution in India.

Field screening was conducted from 1977 to 1980. Observations on midge incidence were made on hill and tiller

Call midge biotype collaborative study, Warangal, India, and IRRI, 1978-80.

Culture	Hills infested (%)			Reaction[a]
	1978	1979	1980	
Leuang 152				
Leuang 152	0	0	0	R
CR95-JR-46-1	0	0	0	R
CR95-JR-214	0	14	0	MR
Ptb				
Ptb 10	0	–[b]	–	R
Ptb 18	0	0	4	R
Ptb 21	0	0	4	R
CR157-392-4	4	0	–	R
CR94-13	5	4	–	R
IR36	0	2	22	S
Eswarakora				
W1263	0	0	2	R
Kakatiya	0	0	0	R

(Continued on next page)

Table continued

Culture	Hills infested (%)			Reaction[a]
	1978	1979	1980	
WGL22585	–	–	2	R
IET2895/RP9-4	–	0	–	R
RD9	1	0	–	R
BKN6806-46-60	2	0	–	R
B1047d-Kn-1-2-2-3	18	33	–	S
Muey Nahng 62 M				
Muey Nahng 62 M	0	6	26	S
Muey Nahng 62 M/Eswarakora				
BKNBR1030-11-2	0	6	6	MR
Siam 29				
Siam 29	14	0	–	MR
Siam 29 (ACC5915)	–	–	37	S
Siam 29 (ACC5473)	–	–	45	S
Siam 29 (ACC5916)	–	–	32	S
Siam 29 (ACC42)	–	–	18	S
Siam 29 (ACC36665)	–	–	32	S
RP6-17	0	0	0	R
W6L13400	0	0	0	R
CR189-4	2	0	–	R
OB677				
OB677	0	0	0	R
75-159	0	0	–	R
BG401-2	–	–	0	R
Ptb/Siam 29				
IR4744-123-1-3	3	11	–	MR
IR8 (susceptible check)	26	12	–	S
Jaya (susceptible check)	–	25	21	S
Tella hamsa (susceptible check)	–	–	44	S

[a]Based on highest infestation over 3-year period. Resistant (R) = 0-5%; moderately resistant (MR) = 6-15%; susceptible (S) = 16% or more. [b]No data available.

basis at 30 and 50 days after transplanting. The data represent the highest replications (see table).

Accessions of Siam 29, a prominent donor for many resistant cultures, were susceptible to gall midge. Its derivatives WGLl3400 (Surekha) and RP6-17 (Phalguna) were resistant and are popular varieties in the region. Eswarakora derivatives W1263 and Kakatiya, originated at Warangal, were resistant while the exotic B1047d-kn-1-2-2-3 (Pelita 1/Eswarakora) was susceptible. Leuang 152 and OB677 were resistant. Leuang 152 derivatives reacted differently. CR95-JR-46-1 was resistant, while CR95-JR-214 was moderately resistant. Muey Nahng 62 M was susceptible. All Ptb derivatives except IR36 were resistant. ■

The lnternational Rice Research Newsletter (IRRN) invites all scientists to contribute concise summaries of significant rice research for publication. Contributions should be limted 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.

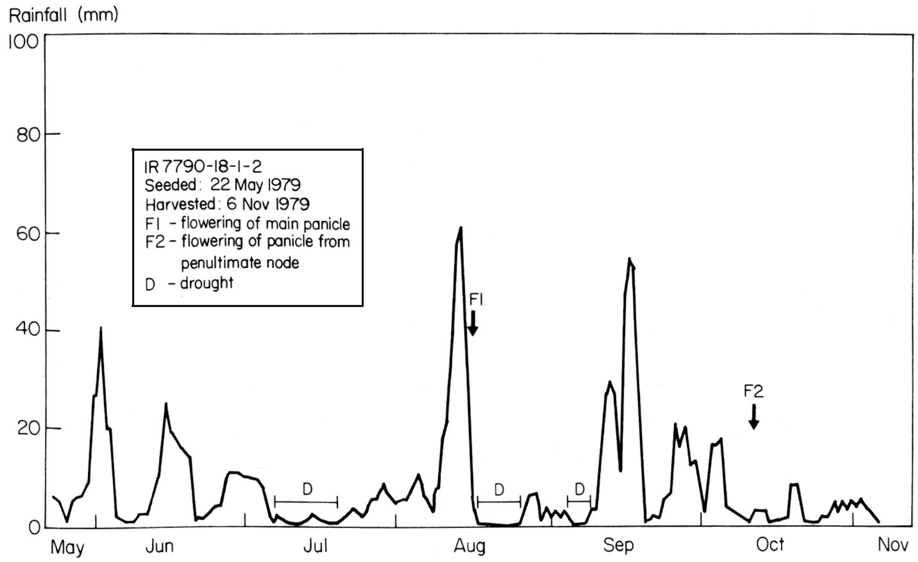
GENETIC EVALUATION AND UTILIZATION

Drought resistance

Productive nodal panicles after severe water stress

O. S. Namuco, research assistant, and J. C. O'Toole, agronomist, The International Rice Research Institute, Los Baños, Philippines

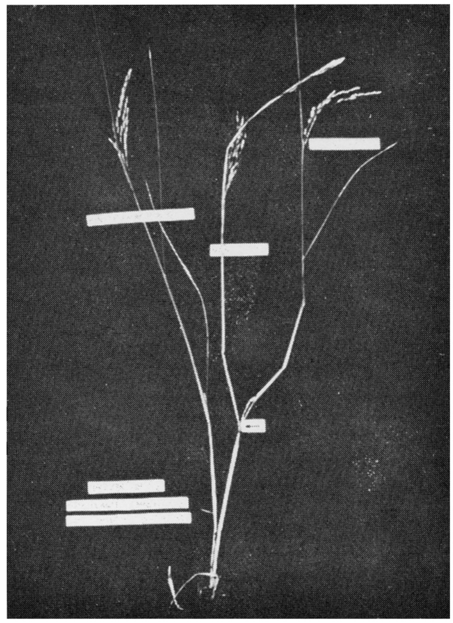
The production of a second or nodal panicle from the primary tiller after water stress at the flowering period has been observed in rice. IR7790-18-1-2 produced a second panicle from the penultimate node of the main culm after a 10-day drought at the onset of flowering of the primary panicle (Fig. 1). The nodal panicles flowered about 60 days after partial or total desiccation of the primary panicles. Side tillers also flow-



1. Second nodal flowering pattern in rice after drought, IRRI.

ered at almost the same time as the nodal panicles. These side tillers developed from the most basal node of the main culm (Fig. 2). Total computed yield (0.3 t/ ha) was derived mainly from nodal panicles (0.2 t/ ha) and side tiller panicles (0.1 t/ ha). Primary panicles yielded a comparatively low 0.02 t/ ha.

The importance of nodal tiller panicles is questionable, but they may have economic implications in dryland rainfed areas, especially where the rainy season is long but variable at anthesis. Subsistence farmers could benefit from seed production for next season's crop. Any yield in the event of a severe drought at flowering would benefit food and seed production. ■



2. Second nodal panicle and side tiller panicle on drought-stressed rice plant. IRRI.

GENETIC EVALUATION AND UTILIZATION

Adverse soils tolerance

Response of IR8 to zinc fertilizer

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Zinc is considered an important limiting nutritional factor in Bangladesh rice production, especially where lands remain wet for long periods of the year and in calcareous soil zones. A simple fertilizer trial was carried out in a noncalcareous dark grey floodplain soil (order Inceptisol, suborder Aquept, and Subgroup Aeric Haplaquept) at BAU farm during the 1980 spring season.

IR8 was the test crop. Soil characteristics were pH 6.3, organic carbon 1.67%, and available zinc 0.11 ppm. Treatments were control (no zinc application), application of 10 kg $ZnSO_4$/ ha, and root-dipping in 2% ZnO suspension before transplanting.

At early growth stage, plants became stunted and tillering was reduced in the control plots. Growth in the zinc-treated plots was relatively better. Affected plants recovered partially at a later growth stage but plant maturity was delayed by about 2 weeks. Although yields were relatively low in all plots, zinc application produced a marked yield increase over control (see table). The highest grain yield was recorded in $ZnSO_4$ treatment (130% increase over control). ■

Effect of zinc fertilizer on rice yield[a] at Mymensingh. Bangladesh.

Treatment	Grain yield[b] (t/ha)	Increase (%) over control	Straw yield[b] (t/ha)	Increase (%) over control
$ZnSO_4$	2.04	130	3.04	112
ZnO	1.94	118	2.74	91
Control	0.89	–	1.44	–

[a]Av of 3 replications. [b]Oven-dry basis.

Pest management and control DISEASES

Observations on diseases of dryland rice in Brazil, March 1981

S. C. Mathur, Central Rice Research Institute, Cuttack-753006. India

Goinia (Goias), Campinas (São Paulo), and Cuiaba (Mato Grosso), extensive rice areas in central southeastern Brazil were visited by a traveling workshop on blast and dryland rice and monitoring tour of large dryland rice areas in Brazil. The workshop-tour was jointly organized by the Brazilian Government (CNPAF, Goiania, and EMPA, Cuiaba-MT), Centro Internacional de Agricultura Tropical (CIAT, Colombia), and the International Rice Research Institute (IRRI) 12-19 March 1981.

The highly mechanized direct-seeded rice crop grown in acidic (pH about 4.0 to 5.0) soils with low water retention was found to be infected with varying severity by a number of fungal diseases. In the large rice areas in Mato Grosso, disease incidence was high (see table). In general, rice was in grain ripening or maturity stages and in some cases was being harvested. Diseases recorded were foliar blast, neck blast (*Pyricularia oryzae*), narrow brown leaf spot (*Sphaerulina oryzae*), leaf scald (*Rhynchosporium oryzae*), stack burn (Alternaria *padwickii*), sheath rot (*Acrocylindrium oryzae*), sheath blight (*Thanatephorus cucumeris*), and brown spot (*Helminthosporium oryzae*).

Because of a long drought (about 25 days), the crop in Campinas was generally poor and foliar blast was either absent or in a mild form. No other disease was observed. In uniform blast nursery trials, however, foliar blast was severe in irrigated crops.

Observations at the sites visited led to these conclusions:

- Three varieties under extensive cul-

Diseases of dryland rice in Mato Grosso, Brazil, 1981.

Site	Variety	Blast		Narrow brown leaf spot	Scald	Stack burn	Sheath blight	Sheath rot	Glume blotch	Brown spot
		Foliar	Neck							
Cuiaba										
Umurama Farm	IAC 47	Severe	Severe (20-30%)	Severe	–	–	–	Mild	Moderate	Trace
Prata Farm	IAC 47[a] IAC 25 IAC 164	Trace	Severe (20%)	–	Severe	–	–	Mild	–	–
Rondonopolis	Uniform Variety Trial, 18 entries	Trace	–	Mild	Modcrate to severe	Moderate to severe	–	Moderate to severe	Moderate to severe	Mild
Jaciara										
Guarita Farm	IAC 47	–	Mild	Very severe (neck region affected)	Trace	–	–	Moderate	–	–
Expt. fields	UVT, 18 entries	Trace	Mild	–	Moderate	–	–	Moderate	–	–
Santa Fe Exp. Station EMPA	IAC 25[b]	–	–	–	–	Moderate	–	–	Moderate	–
Chapada dos Guimaraes										
Estrella do Norte	IAC 47[c]		Trace to mild	Moderate to severe (neck region affected)	Mild	–	Mild	Mild	Trace	Mild

[a]Disease severe at early growth stage. [b]Sprayed twice with B1M '75PM fungicide. [c]Sprayed with Kitazin.

tivation — IAC 47, IAC 25, and IAC 164 — are highly susceptible to the fungal diseases observed.

- The incidence of one or more diseases was high at every site.
- Narrow brown leaf spot disease was found on the neck node, giving an appearance of neck blast, a symptom which so far has not been noticed in Asian countries.
- Typical white chaffy panicles due to neck blast were not observed, although some farms had a high incidence — more than 20% — of neck infection, probably because of late infection.
- Spraying with tricyclalole [5-methyl-1, 2, 3-triazol (3,4-b)- benzothiazol] helped control blast but not stack burn.
- Most of the fungal diseases observed are known to be seedborne. In many areas rice cultivation started in the last two to three years. Apparently, the diseases were introduced through seed and established because of favorable weather conditions.
- No bacterial or viral diseases of rice were observed.

In the absence of disease-resistant varieties suitable for Brazilian conditions, the interim measures to minimize diseases are regular seed treatment with systemic fungicides, spraying the crop three times with fungicides having different active ingredients in rotation, and producing disease-free seed through plant protection. ■

Dose and application schedule of IBP granules to control rice blast

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Rice neck blast (*Pyricularia oryzae* Cav.) causes yield losses in transplanted paddy of valleys and foothills of Nagaland. Abundant rainfall from April to October reduces the efficacy of spray fungicides. Earlier experiments showed that IBP (0,0 - Diispropyl - S-benzyl thiophosphate (IBP) 10% G) granule was the most effective fungicide to control blast.

This experiment in 1980 kharif investigated the effect and cost of an application schedule of IBP granules.

Six doses of IBP granules were dispersed by hand between rows in two equal applications (at tillering and at panicle initiation). Standing water (5-6 cm) in the paddy was maintained for 6-7 days. All treatments gave significant neck blast control (see table). IBP granules at 3.74 kg a.i./ha was the most economical dosage (yield 19.24% more than control). Higher doses of IBP granules gave better neck blast control but without significant increases in yield. ■

IBP granule effect on neck blast incidence and grain yield of IR8 at Nagaland, India.

IBP granules (kg a.i./ha)	Neck blast infection (%)	Grain yield (t/ha)
2.50	35.4	3.96
3.74	37.1	4.40
5.00	32.7	3.81
6.24	28.8	4.28
7.50	25.6	4.04
8.74	31.9	4.08
0 (control)	52.3	3.69
CD at 5%		0.36

Survival of *Ditylenchus angustus* in diseased stubble

Dung-ngoc Kinh, Plant Protection Department, University of Cantho, Hau-Giang, Vietnam

Rice disease Tiem Dot San caused by *Ditylenchus angustus* has occurred not only in deepwater rice in the Mekong Delta but also in double-transplanted rice of the main crop and in transplanted rice following the main crop.

Diseased rice hills with the panicle still enclosed in the leaf sheath were collected (20-30 tillers/ hill) from an infested field and left on the surface of a grassy, nonflooded soil in late October 1976. Each week, three diseased plants were taken out randomly and the average percentage of surviving nematodes per plant was estimated by extracting the nematodes from each plant into 50 ml water in a petri dish and counting with a 1-ml counting slide.

The percentage of active nematodes decreased rapidly after harvest. After 3 weeks, the population was 40%. From 4 to 10 weeks the percentage was lower and stabilized as the nematodes adapted to dormant conditions. In early February 1977, no live nematodes were found.

The result shows the ability of *Ditylenchus angustus* to survive from the main rice crop to the crop transplanted in November and December and the need to find control measures against nematodes in crop residue. ■

Survival of sclerotia of rice stem rot fungus

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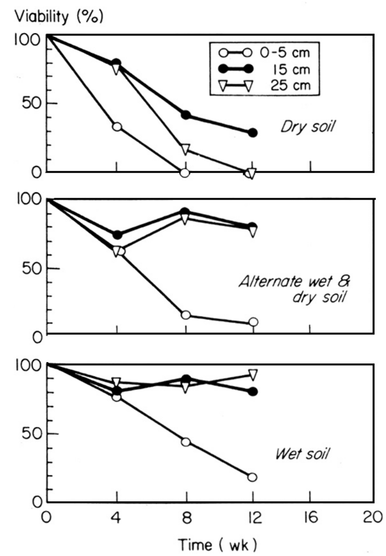
Sclerotia of *Sclerotium oryzae,* rice stem rot fungus, grown on sterilized rice culm pieces for 10 months were placed in soil layers 5, 15, and 25 cm deep in 5-cm-diameter polyethylene columns. The columns were buried in sandy clay loam (pH 7.3) with the top of the column at field level. Three water treatments were used: continuously dry; continuously wet to field capacity; and 3 days continuously wet, 10 days dry. Columns were removed at 4, 8, and 12 weeks and sclerotia retrieved by washing over an 80-mesh screen. Sclerotia viability was tested by growing them on water agar containing penicillin and streptomycin sulfate at 3,000 ppm each (see figure).

Viability of sclerotia declined more in the surface soil. After 12 weeks, losses were 100% in dry soil, 91% in wet, and 84% in alternately wet and dry. At 15 and 25 cm depths, sclerotia viability was not much affected in wet and alternately wet and dry soil. In dry soil, viability was reduced to 30% at 15 cm depth and 0% at 25 cm. Pronounced loss in germinability of sclerotia in dry soil would suggest effects of desiccation, solar radiation, starvation, or other factors. ■



Viability of sclerotia of *Sclerotium oryzae* on paddy stubbles under dry or wet soil conditions.

Weed hosts of *Acrocylindrium oryzae* Saw., a sheath rot pathogen of rice

B. Balakrishnan and M. Chandrasekharan Nair, Plant Pathology Department, College ofAgriculture, Vellayani, Kerala. India

The host range of *Acrocylindrium oryzae* Saw., the rice sheath rot pathogen, has not been widely studied. Because the disease often occurs in severe forms in almost all rice-growing areas of Kerala, irrespective of the cropping season, investigations on the source of inoculum are important. An initial survey at the Model Agronomic Research Station Farm, Karamana, Trivandrum district of Kerala, in fallow fields during the third crop season showed that two field weeds — *Ciperus difformis* L. and *Echinochloa crus-galli* (L.) Beauv. were infected naturally with the rice sheath rot pathogen. The symptoms were identical to those on rice and pathogenicity tests of isolates from the weeds showed that they were highly pathogenic to rice.

Artificial inoculation tests at the College of Agriculture, Vellayani, screened out more weed hosts of the pathogen. Uninfected wetland field weeds were collected from different localities in the Trivandrum district and raised in earthen pots under controlled conditions. They were artificially inoculated with actively growing mycelial bits taken from a 10-day-old pure culture of the pathogen grown in potato dextrose agar. Mycelial bits of uniform size (5 mm) cut from the dish culture with a cork borer were introduced in the leaf axils of test weeds. Inoculated plants were kept in above 92% humidity. Symptom development was recorded 5 to 8 days after inoculation.

Of the 10 weed plants tested, 5 — *Eleusine indica* (L,.) Gaertn., *Monochoria vaginalis* (BURM. f.) Presl., *E. crus-galli. Cyperus iria L.,* and *Cyperus teneriffae* Poir — were recorded for the first time as pathogen hosts. ■

Control of helminthosporium leaf spot by foliar sprays

A. Sindha Marhar, M. Balasubrarnanian, and L. Anavaradham, Paddy Experiment Station, Ambasamudram, India

The effect of chemicals on the control of helminthosporium leaf spot was studied in a field trial October-February 1980. The randomized block design with 11 treatments and 3 replications used 3- × 1.5-m plots and 20- × 10-cm spacing. Test variety was IR20. Fertilizer was applied at 120-8.75-147.5 kg NPK/ha. P_2O_5 and K_2O were applied as basal dressings; N as urea was applied 1/2 as basal and 1/2 as topdressing. Chemicals were sprayed three times: 30, 45, and 60 days after transplanting,

The data indicate that spraying 0.1% carbendazim significantly controlled helminthosporium leaf spot disease (see table). ■

Effect of chemicals on the control of helminthosporium leaf spot disease. Ambasamudram, India.

Treatment		Helminthosporium infection	
		%	Transformed value
Carbendazim	0.1%	6.5	14.7
Copper oxychloride	0.25%	8.8	17.3
Edifenphos	0.15%	8.8	17.3
Zineb	0.25%	9.5	18.0
Agrimycin	0.025%	9.0	17.4
Urea	1.0%	7.7	16.1
DAP	1.0%	11.1	19.4
Kc1	1.0%	9.4	17.8
Carbofuran at 0.5 kg a.i./ha[a]		8.8	17.1
Carbendazim SST[b]	0.04%	8.3	16.7
Control		12.0	20.3
CD (P = 0.05 level)			2.19

[a]Carbofuran was applied 10, 25, and 40 days after transplanting. [b]Sprouted seed treatment = sprouted seeds were soaked in carbendazim solution for 15 minutes before sowing.

Rice blast disease outbreak in Sinjai and Bulukumba, South Sulawesi, Indonesia

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The Indonesian Government released Semeru (IR2307-247-2-2-3, CRI 3/ IRl561-228-3-3) in 1980 for planting in both low and high elevations. As part of a rainfed wetland pilot production program (Lappo Ase) in South Sulawesi, Semeru was planted at elevations of 300-1,000 m in Sinjai District and at 700-1,000 m in Bulukumba district.

In Bulukumba, rainfall varied from 151 to 521 mm June-July (8-18 rainy days), with July overcast most days and nights. In the more than 900 ha planted to Semeru and fertilized with 100 kg N/ ha (urea) and 37.5 kg P_2O_5 triple superphosphate, neck blast infection ranged from 6 to 85%. About 80 ha had more than 85% neck blast infection.

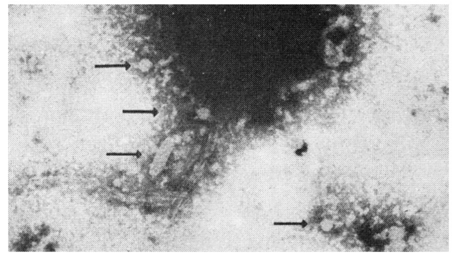
At Sinjai, rainfall ranged from 60 to 658 mm June-September (7-20 rainy days). Of about 390 ha planted to Semeru and fertilized with 87.5 kg N/ha (urea and ammonium) and 37.5 kg P_2O_5/ha, 3.5 ha suffered early from serious leaf blast. Eventually the entire area was seriously affected. Observations during heading to hard dough stage showed that neck blast infection varied from 1 to 100% on about 390 ha. More than 100 ha were hopperburned during the filling stages. ■

Association of rice tungro spherical virus and rice tungro bacilliform virus with the disease in Janakpur, Nepal

T. Omura, Institute for Plant Virus Research (IPVR), Tsukuba Science City, Yatabe, Ibaraki 305, Japan: H. Inoue, Kyushu National Agricultural Experiment Station, Chikugo, Fukuoka 833, Japan; U. B. Thapa, Division of Plant Pathology, Department of Agriculture, Ministry of Food, Agriculture and Irrigation, Khumaltar, Lalitpur, Nepal; and Y. Saito, IPVR, Japan

Rice plants showing symptoms of yellow leaf discoloration, plant stunting, and delayed flowering were found at Hardinath Agricultural Farm, Janakpur, Nepal. The disease occurred in circular field patches several meters in diameter.

Electron microscopic observations of dip preparations revealed polyhedral particles about 30 nm in diameter and bacilliform particles about 30-35 nm in diameter, both 100-300 nm in length (see figure). This shows that rice tungro disease in the Janakpur area is caused from double infection by both rice tungro spherical virus and rice tungro bacilliform virus, as has been reported in the Philippines, Thailand, Malaysia, and Indonesia.■



Electron micrograph showing rice tungro spherical virus and rice tungro bacilliform virus (arrows) in dip preparation from leaf sap infected with rice tungro disease from Janakpur, Nepal.

Rice stem nematode disease in Vietnam

Nguyen-thi-thu Cuc and Dang-ngoc Kinh, Plant Protection Department, University of Cantho, Hau-Giang, Vietnam

Rice stem nematode disease has become a serious concern in Vietnam. Department of Plant Protection surveys 1975-1980 showed that the disease was focused in the Mekong Delta, the largest (more than 2 million ha) rice production area.

Each year *D. angustus* causes important losses in thousands of hectares of deepwater rice and double-transplanted rice (yield losses of 50-100%). Some damage is done in improved rice areas.

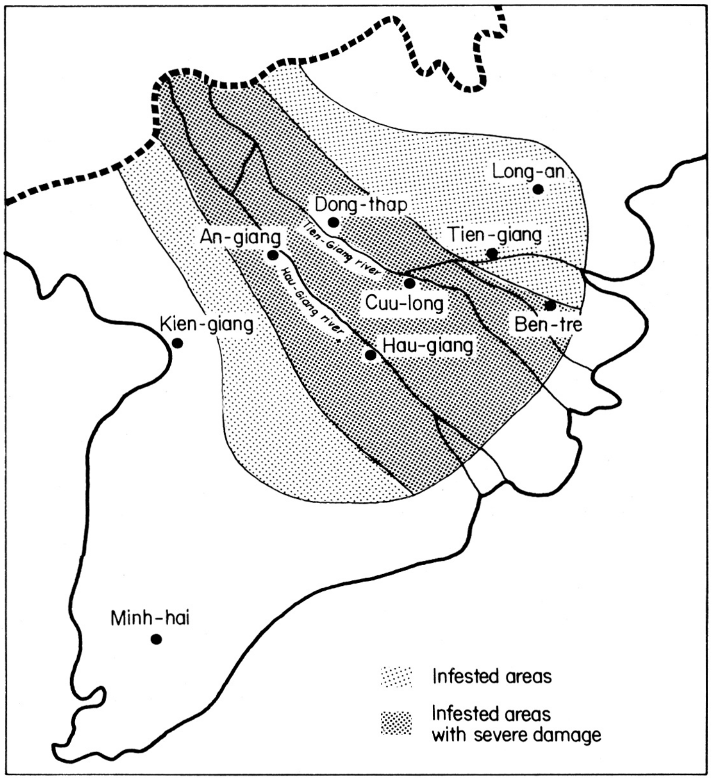
The disease appears to be serious in the deepwater area between two branches of the Mekong (Hau-Giang and Tien-Giang Rivers) and in provinces along the rivers (An-Giang, Hau-Giang, Long-An, Bon-Tre). It has not been reported in coastal and upland areas.

The nematode has caused great damage to rice crops in Cuu-Long, Dong-thap, An-Giang Provinces. At the end of 1974, hundreds of hectares of deepwater rice in the Due-Thanh district were totally lost. Infested areas increased to

10,000 ha in 1976. In Cuu-Long, 5,000 ha of the main rice crop were infested in 1975 and more than 6,000 ha in 1980.

Infested rice areas in the Mekong Delta seemed to increase gradually. The most common local rice varieties such as Trang-Lun, Trang-Tep, Tau-huong, Nang-Tay-Dum, Nang-Tay C, Tau-Nuc, Trung-Hung, Chau-Hang-Vo, Chet-xanh, and Ba-Thiet were affected seriously. Field surveys of 200 local varieties showed that none escaped. The disease also occurred in transplanted areas on short growth duration varieties such as IR5, IR30, IR36, and IR9129-192-2-3-5.

The disease was most severe in months of heavy rainfall, or high field water level. Of the three rice crops in the Mekong Delta, the main crop (June-December) suffered great damage, the He-thu crop (April-August) moderate damage, and the Dong-xuan crop (December-April) little damage. ■



Distribution of rice stem nematode disease in the Mekong Delta 1975-80. University of Cantho, Hau-Giang, Vietnam.

Effect of length of treatment and fungicide concentration on seed germination and incidence of foot rot disease of rice

L. P. Kauraw, Central Rice Research Institute, Cuttack 753 006, India

Most rice seeds are infested with the fungus *Fusarium monilifiorme* (foot rot) which causes preemergence and post-emergence damping-off of seedlings. To promote germination, seeds in wetbed nurseries usually are soaked in water for 24 hours and kept in wet bags for 2-3 days before sowing. Most seeds are attacked by foot rot during this period. This study was conducted to find the effect of seed treatment period on germination and infection.

The fungicide Ceresan wet (methoxy-ethyl mercury chloride) was used at 0.1 and 0.2% concentrations in water. Rice cultivar Ratna seeds were dipped in the fungicidal solutions for 3-96 hours. Matching bags of seed were dipped in plain water for a control. Seed bags were shaken at intervals during treatment. Germination and foot rot infection of 400 seeds were tested by the blotter method.

Effect of seed immersion and fungicide treatment on germination and foot root incidence in rice cultivar Ratna, Cuttack. India.

Immersion time (h)	Plain water		Ceresan wet		
	Seed germination (%)	Foot rot infection (70)	Concn (%)	Seed germination (%)	Foot rot infection (%)
3	46	6.6	0.1	49	3.8
			0.2	50	2.5
6	58	5.0	0.1	62	3.2
			0.2	54	1.5
12	62	6.0	0.1	71	3.0
			0.2	62	1.2
24	65	5.3	0.1	70	3.0
			0.2	73	0.5
36	66	4.5	0.1	72	2.5
			0.2	74	0.0
48	67	3.3	0.1	70	0.0
			0.2	76	0.0
72	68	4.0	0.1	73	0.0
			0.2	74	0.0
96	64	3.8	0.1	69	0.0
			0.2	74	0.0

Germination percentages were higher for seed soaked in Ceresan (see table). Foot rot infection was controlled when seeds were immersed in 0.1% Ceresan for 48 hours or longer and in 0.2% solution for 36 hours or longer. ■

Seasonal incidence of brown spot and narrow brown leaf spot in the Thanjavur delta, India

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Seasonal incidence of brown spot (BS) and narrow brown leaf spot (NBLS) was studied for five consecutive cropping seasons 1975-80. Each year, 20 plantings spanning the cropping period in Thanjavur delta were done at 10-day intervals. Ten varieties were planted each year except 1977-78, when only 8 were planted. No crop protection was provided.

Varieties evaluated were:

1975-76: AD11585, ADT31, IET1722, IR20, IR26, TKM8, Pusa 33-18, Tainan 3(M), Bhavani, Ponni.

1976-77: AD54-1, AD5620, AD6380, AS3821, ADT31, CRM10-5747, IET2881, IR20, Pusa 4-1-11-1, Bhavani.

1977-78: AD9186, ADT31, IET1722, IR20, IR26, TM1251, Tiruveni, Vaigai.

1978-79: AD5231, AD6120, AD6970, AD7211, AD7481, AD13893, ADT32, AS3704, IR26, IR34.

1979-80: AD6120, AD4481, AD8991, ADT31, ADT32, ADT33, AS3704, IR34, PL29, TKM9.

The average disease incidence was recorded at the ninth stage of crop growth using the standard evaluation system. Higher incidence of BS and NBLS was observed in late plantings (see table). The diseases appear to cause significant yield reductions only in the second season crop. ■

Individuals organizations, and media who wish additional details of information presented in IRRN should write directly to the authors.

Seasonal incidence of brown spot and narrow brown leaf spot in Thanjavur, India.

Date of planting	Disease incidence (%)					
	1975-76	1976-77	1977-78	1978-79	1979-80	Mean
			Brown spot			
15/6	–	17.2	4.8	–	7.4	5.9
25/6	–	13.4	11.6	–	5.8	6.2
5/7	–	13.2	7.9	6.9	9.4	7.4
15/7	15.0	18.1	14.0	10.4	6.3	12.8
25/7	18.9	17.3	12.4	9.7	14.8	14.6
5/8	14.0	14.2	13.7	12.2	19.2	14.7
15/8	9.7	11.0	16.4	15.2	18.5	14.2
25/8	7.2	14.6	8.4	7.9	14.0	10.4
5/9	5.1	14.4	11.2	6.4	20.3	11.5
15/9	8.4	17.5	9.5	14.2	12.2	12.4
25/9	7.9	16.8	14.4	17.1	11.0	13.4
5/10	12.2	21.2	19.3	19.9	9.9	16.5
15/10	17.5	26.5	15.5	16.4	18.2	18.8
25/10	26.4	26.9	31.4	19.7	37.4	28.4
5/11	31.9	25.7	46.4	29.4	35.2	33.7
15/11	35.5	37.1	53.1	37.0	42.6	41.1
25/11	47.7	42.0	67.4	51.4	43.1	50.3
5/12	46.8	50.3	59.5	48.1	53.3	51.6
15/12	53.1	68.7	66.1	47.4	55.2	58.1
25/12	51.6	62.4	64.2	48.0	50.0	55.2
			Narrow brown leaf spot			
15/6	6.3	–	15.1	–	12.6	6.8
25/6	8.7	–	15.5	5.6	7.4	7.4
5/7	–	–	–	10.5	9.5	3.9
15/7	–	–	12.7	–	–	2.5
25/7	–	–	13.2	3.6	–	3.4
5/8	5.0	–	13.7	9.4	–	5.6
15/8	7.3	7.3	7.2	14.5	–	7.3
25/8	5.4	9.6	–	7.8	–	4.6
5/9	–	17.2	–	10.2	–	5.5
15/9	–	10.1	9.5	–	–	3.9
25/9	10.4	–	11.6	4.6	–	5.3
5/10	9.9	–	14.6	7.9	3.5	7.2
15/10	8.9	–	15.6	–	9.6	6.8
25/10	10.0	7.5	14.6	–	–	6.4
5/11	10.9	13.6	13.4	15.2	–	10.6
15/11	15.4	19.1	12.9	17.6	14.7	15.9
25/11	29.9	20.6	18.5	19.7	20.3	21.8
5/12	31.7	47.2	29.7	37.3	32.5	39.7
15/12	32.2	43.0	26.8	26.2	29.3	31.5
25/12	28.5	36.5	27.5	24.4	22.0	27.8

Pest management and control INSECTS

Major insect pests of paddy in Guyana

I. Rambajan, entomologist, Guyana Rice Board, Research and Extension Division, Guyana, South America

A double-cropping system of rice cultivation is recommended in Guyana, although continuous cropping is practiced extensively. The autumn crop (May-Jun) accounts for 90,000-110,000 ha and the spring crop (Dec-Jan) for 40,000-50,000 ha. The rice belt spans most of the Atlantic coastal lands from Crabwood Creek in the east to the Pomeroon in the west, including Berbice, Demerara, and Essequibo counties. Farmholdings range from less than 1 ha to more than 500 ha.

Rice, the staple cereal, also is an invaluable foreign exchange earner and provides more than 50,000 jobs. Land preparation and harvesting are completely mechanized. Pregerminated seeds are broadcast under wet cultivation method and fertilizers and pesticides are applied manually except in large holdings where applications are by air.

Pest problems have increased with a change from dry to wet cultivation, introduction of double or continuous cropping, increase in hectarage, and development of pesticide resistance. The cultivars used have no genes for insect and disease resistance. The table shows the major insect pests of wetland rice in Guyana and their occurrence in relation to growth stages. Two storage pests have been included because recent studies show significant field infestation and damage. ■

Major insect pests of wetland rice in Guyana, South America.

Growth stage	Pest: Scientific name	Pest: Common name	Damage
Emergence to maximum tillering	1. *Helodytes foveolatus* Duval (Curculionidae: Coleoptera)	Rice water weevil	Larva feeds on roots. Adult feeds on eye of pregerminated seeds.
	2. *Hydrellia deonieri* Rambajan (Ephydridae: Diptera)	Rice leafminer Rice blackfly	Larva feeds in growing shoot, causes deadheart.
	3. *Spodoptera frugiperda* (Smith) (Noctuidae: Lepidoptera)	Fall armyworm	Larva feeds on seedling leaves, causes burnt tip, later defoliation.
	4. *Mocis punctularis* Hubner (Noctuidae: Lepidoptera)	Rice looper	
	5. *Neoconocephalus* Spp. *Caulopsis* Spp. (Tettigoniidae: Orthoptera)	Long-horned grasshopper	Feeds on leaves that appear shredded, cobweb.
Panicle initiation to heading	1. *Caulopsis cupsidata* Scudder (Tettigoniidae: Orthoptera)	Long-horned grasshopper	Feeds on leaves and ball, causes whitehead.
Heading to hard dough	1. *Oebalus poecilus* Dallas (Pentatomidae: Hemiptera)	Stink bug or paddy bug	Nymph and adult feed on grains at milk stage, cause wind paddy or atrophied glumes; at dough stage cause broken barrels, discolored rice after milling.
Hard dough to harvest, storage	1. *Sitotroga cerealella* (Olivier) (Gelechiidae: Lepidoptera)	Angoumois grain moth	Larva feeds on kernel.
	2. *Rhyzopertha dominica* (Fabricius) (Bostrichidae: Coleoptera)	Lesser grain borer	

Rice gall midge incidence in the dry season

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Rice gall midge (*Orseolia oryzae*), a major insect pest in late-planted fields in the wet season (May-November) in the Andhra Pradesh Krishna and Godavari deltas, has become a major problem in the dry season (November-April) in the Godavari delta since 1978. The percentage silver shoots or galls recorded in coordinated variety trials show the high pressure of gall midge at Maruteru center (see table).

It is likely that extensive use of pesticides to control insects has resulted in the destruction of predators and parasites of rice gall midge. Popular *rabi season* varieties Jaya, Prabhat, Prakash, Rasi, and Tella Hamsa are susceptible to rice gall midge. BPT1235 and IR36 are promising early-maturing, gall midge-resistant varieties. ■

Percent silver shoots in dry season, Maruteru, India.

Trial	Silver shoots (%) 1979 Mean	1979 Maximum	1980 Mean	1980 Maximum
Uniform Variety Trial 2	11	20	5	8
Uniform Variety Trial 3	17	24	18	25
Uniform Variety Trial 4	16	28	13	8

Effects of rice plant age on diopsid oviposition and plant susceptibility

A. M. Alghali, research fellow, IITA, Rice Research Station, Rokupr, Sierra Leone; and E. O. Osisanya, Agricultural Biology Department, University of Ibadan, Nigeria

Diopsis thoracica (West), a serious pest limiting rice yields in West Africa, prefers plants of particular ages for oviposition. Confirmation of the specific age range would be useful in planning pest management programs involving host plant resistance and other control measures.

Pregerminated seeds of 2 rice varieties with similar tillering abilities, IR5 and GH106-76, were sown at 10-day intervals. Seedlings 21 days after sowing (DS) were transplanted separately at 2 seedlings/pot. Rice plants 60, 50, 40, 30, 20, and 10 days after transplanting (DT)

Diopsis thoracica **eggs laid on rice plants of different ages and subsequent development of deadhearts in Sierra Leone.**[a]

DT[b]	IR5 Eggs (no.)	IR5 Deadhearts (no.)	IR5 Deadhearts/egg (no.)	GH106-76 Eggs (no.)	GH106-76 Deadhearts (no.)	GH106-76 Deadhearts/egg (no.)
10	4 cd	6 b	1.5	2 ab	4 ab	2.0
20	11 ab	13 a	1.2	2 ab	3 b	1.5
30	14 a	14 a	1.0	5 a	6 a	1.2
40	8 bc	6 b	0.8	3 ab	3 b	1.0
50	2 d	2 c	1.0	1 b	0	0.0
60	1 d	0 c	0.0	0 b	0	0.0

[a]Total of 6 replications. In the same column, means followed by the same letter do not differ at the 1% level of probability. [b]DT = days after transplanting.

were exposed to *Diopsis thoracica* (25 males and 25 females) in a wooden cage for 3 days to allow egg laying. The eggs laid per pot were counted. Ten days after the eggs hatched, deadhearts were counted.

The most eggs and deadhearts were recorded on plants 20-40 DT (see table). In both varieties, 30-day-old plants recorded the highest number of eggs and deadhearts. The rate of deadheart development was fastest in 10- to 30-day-old plants. Virtually no eggs were laid or deadhearts developed on 60-day-old plants. ■

Effect of intensity of light on the predacious green mirid bug

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The green mirid bug *Cyrtorhinus lividipennis* Reuter is a predator on the eggs and early-stage nymphs of brown planthoppers (BPH) and green leafhoppers (GLH). Its number is large in the light traps and in the field during September-October when the activity of BPH and GLH is very high.

The effect of light intensity on attracting this predator was studied using incandescent lights of different intensities from October 1980 to February 1981 (see table).

Mirid bugs trapped with lights of 4 intensities, 1980-81, Tamil Nadu, India.

	Mirid bugs trapped (no.)				
	15 watts	40 watts	60 watts	100 watts	Total
October	543	1156	1570	3670	6939
November	11	120	156	474	761
December	9	75	48	194	326
January	1	16	42	66	125
February	–	1	5	7	13
Total	564	1368	1821	4411	–

The mirid bug was very active during October, when the numbers of BPH and GLH were also high (BPH 21,174; GLH 11,928). Predator incidence was positively correlated with populations of BPH and GLH. The mirid bug population then declined and reached very low levels during February, when activity of the two insect pests also was low (BPH 129, GLH 17).

With increased light intensity, there was a corresponding increase in the catch of pests and predators. But high wattage in the light trap removed biocontrol agents from rice fields. Rice pests can be monitored with low wattage bulbs. ■

Esterases and malathion resistance in brown planthopper

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The 4th and 5th instars of the brown planthopper (BPH) were used in the bioassay to determine the effect of *S,S,S*-tributyl phosphorotrithioate (DEF), an esterase inhibitor, on toxicity of malathion and of two other organophosphorus insecticides against a malathion-resistant (R) strain of BPH. DEF enhanced malathion toxicity 20 times, methyl parathion toxicity 6 times, and parathion 11 times (see table).

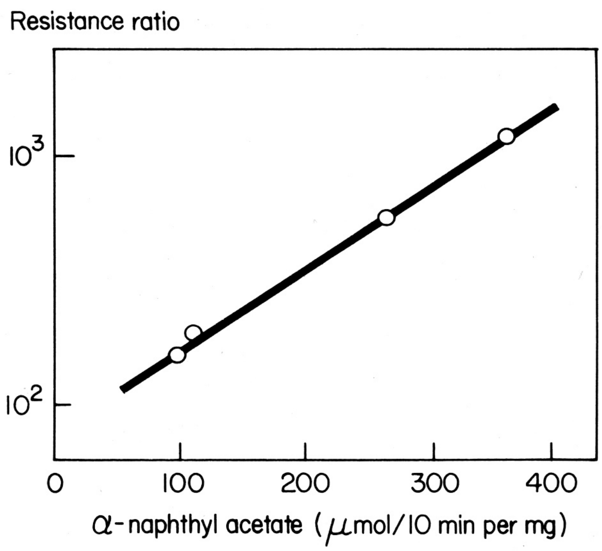
Effect of DEF on susceptibility to 3 insecticides of a malathion-resistant (R) brown planthopper strain, Taiwan.

Insecticide	RR[a]	LC_{50} (mg/ml) Alone	LC_{50} (mg/ml) With DEF	SR[b]
Malathion	484	11.13	0.56	19.9
Methyl parathion	35	1.00	0.17	5.9
Parathion	141	2.67	0.24	11.1

[a]Resistance ratio = LC_{50} of resistant strain divided by LC_{50} of susceptible strain. [b]Synergistic ratio = LC_{50} of insecticide divided by LC_{50} of insecticide with DEF (*S,S,S*-tributyl phosphorotrithioate).

This implies that detoxification mediated by these esterases is associated with insecticide resistance in the BPH.

Spectrophotometric determination of esterase activity in BPH males with different levels of malathion resistance showed a linear relationship between esterase activity and log-resistance ratio (see figure). Similar reactions have been reported for the green rice leafhopper and the smaller BPH. ■



α-naphthyl acetate (μmol/ 10 min per mg).

Occurrence of smaller rice leafminer *Hydrellia griseola* (Fallen) (*Diptera: Ephydridae*) in the Philippines

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

Until now, two species of ephydrid flies have been known to attack rice plants in the Philippines: whorl maggot *Hydrellia sasakii* Yuasa and Isitani (formerly called *H. philippina*) and root maggot *Notiphila spinosa* Cresson. In 1979-80, a third ephydrid rice pest *H. griseola* (Fallen), known as the smaller rice leafminer, was collected by D-VAC suction machine from rice at the IRRI experimental farm (identified by Dr. Philip J. Clausen, University of Minnesota, USA).

H. griseola was widely distributed mainly in temperate regions of Asia (Japan and Korea), Europe (France, Italy, and Germany), and North and South America. In the Asian tropics it has been found only in Malaysia and the Philippines.

The adult *H. griseola* can be distinguished from *H. sasakii* on a number of morphological characters (see table). ■

Characters that distinguish *H. griseolo* from *H. sasakii.*[a]

Character	*H. griseola*	*H. sasakii*
Body		
Length (mm) female	2.04-2.08	2.22-2.25
male	1.62-1.64	2.10-2.14
Width (mm) female	0.54-0.58	0.78-0.79
male	0.48-0.52	0.65-0.67
Head	Facial carina greyish-white	Facial carina silvery
Width (mm)	0.63-0.66	0.75-0.83
Height (mm)	0.46-0.58	0.64-0.66
Width vs height	Broader than long	Both longer and broader compared to *H. griseola*
Eye (cmpd.)		
Color	Brown	Reddish brown
Height (mm)	0.44-0.48	0.58-0.59
Width (mm)	0.24-0.36	0.40-0.43
Distance from ptilinal suture to anterior ocellus (mm)	0.044-0.50	0.056-0.060
Distance between 2 posterior ocelli (mm)	0.10-0.12	0.14-0.15
Distance from anterior to poterior ocellus (mm)	0.08-0.10	0.12-0.15
Antenna		
Size and shape of 3rd segment from base	As long as broad (0.080-0.085 mm)	Longer (0.12 mm) than broad (0.10 mm)
Number of hairs arising from arista	7-8	8-9
Distance between antennal bases (mm)	0.160-0.164	0.18-0.185
Thorax	Dorsally blue green with light brown tinge and grayish-white margins	Grayish brown
Wing		
Length (mm)	1.70-2.20	2.42-2.48
Width (mm)	0.60-0.76	0.80-0.84
Cross veins	Cross vein 2 exactly 3x longer than 1	Cross vein 1 shorter than 1/3 the length of cross vein 2
Haltere	Lemon yellow	Pale yellow
Legs	Femora and tibiae metallic blue-green to dark gray except the yellow brown first (inner) tarsal segment and reddish brown to black remaining segments	Golden to yellowish brown except grayish white femora and reddish brown last tarsal segment
Coxa I	Grayish white	Yellow with silvery base
Apical inner half of femur 1	With a row of 12-13 minute spines	With a row of 10-14 prominent spines
Abdomen	Tergites with numerous setae, greenish-brown in color with grayish white margins	Tergites with less setae, grayish brown in color with silvery margins
Length (mm)	1.09-1.40	2.08-2.10

[a] Measurements were based on 6 specimens of *Hydrellia griseola* and 48 of *H. sasakii.*

Rice gall midge in the summer crop at Ranchi

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The rice gall midge *Orseolia oryzae,* an endemic pest in the Ranchi district of Bihar, mainly attacks transplanted kharif (wet season) rice. To study the off-season behavior of the pest, a survey of the summer rice crop was undertaken around Ranchi (within a range of 30 km north and 145 km south). The crop is grown only in areas where there are natural streams. Out of 5 sites surveyed, an unusually high incidence of gall midge was recorded only at Bundu (50 km southeast). Seventy percent of the hills of variety Pusa 2-21 had silver shoots. An average of 26% of the tillers had silver shoots. Some new tillers without silver shoots were brought to the laboratory and dissected. Those having a swollen base were found to contain gall midge larvae. Therefore, counting silver shoots underestimates the true infestation.

Parasitization by Platygaster was as high as 40% in May 1981. Normally the parasite appears late in kharif, toward the end of October. Silver shoots which contained parasitized pupae were stout and short. The average length of normal silver shoots was 24.8 cm, while the parasitized ones were 14.4 cm. Heavy parasitization during summer is unusual, but it may keep the gall midge population under control in the main (kharif) rice crop. ■

Evaluation of granular insecticides to control rice root weevil

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In a trial in farmers' fields in Patiala district during the 1979 wet season, eight granular and one emulsifiable concentrate insecticides were evaluated for control of rice root weevil *Echinocnemus oryzae.* The randomized block design used a 33-m^2 plot size. Granular insecticides were broadcast in paddy water. The emulsifiable concentrate was diluted and sprinkled. Larval populations were counted by uprooting 10 hills/plot immediately before and 10 and 20 days after treatment (DAT).

At 10 DAT, none of the insecticides had caused more than 80% reduction in larval population (see table). However, carbofuran, mephosfolan, phorate, and quinalphos caused more than 70% reduction.

At 20 DAT, aldrin, carbofuran, mephosfolan, phorate, and quinalphos had caused more than 80% reduction in larval populations. Isofenphos caused more than 70% reduction. ■

Effect of granular insecticides on control of rice root weevil, Punjab, India, 1979 wet season.

Insecticide[a]	Larval population reduction[b] (%)	
	10 DAT	20 DAT
Aldrin (Aldrin 30EC)	66.9 ab	84.5 ab
Carbofuran (Furadan 3G)	71.8 a	89.6 a
Disulfoton (Solvirex 5G)	56.6 bc	65.0 c
Fensulfothion (Dasanit 5G)	64.0 abc	63.6 c
Gamma BHC (Lindane 6G)	52.6 a	62.2 c
Isofenphos (Oftanol 5G)	57.0 bc	76.6 ab
Mephosfolan (Cytrolane 5G)	77.3 a	88.4 ab
Phorate (Thimet 10G)	75.6 a	81.2 ab
Quinalphos (Ekalux 5G)	73.8 a	84.9 ab

[a] Applied @ 0.75 kg a.i./ha 21 days after transplanting. [b] In a column, means followed by a common letter are not significantly different at 5% level. DAT = days after treatment.

Effect of carbofuran root zone application rate on feeding activity and mortality of the green leafhopper

R. P. Basilio and E. A. Heinrichs, The International Rice Research Institute

Tungro, a serious rice disease, is controlled by planting resistant varieties and by applying insecticides. Incorporating carbofuran in the root zone at planting time generally controls tungro by preventing green leafhopper (*Nephotettix virescens*) feeding. An insectary study was conducted to determine the effect of carbofuran rates on residual activity and feeding of the insect.

Three rates of encapsulated carbofuran 3% granules were inserted into the root zone. Beginning 1 day after application, 10 adult female green leafhoppers were caged over filter paper on the plants at 5-day intervals. Forty-eight hours after infestation, insect mortality was recorded. Feeding activity was determined by measuring the size of purple-stained spots produced by the action of honeydew and ninhydrin on filter papers treated with 0.01% ninhydrin solution.

Although there was substantial feeding at all rates, less feeding activity occurred at the rates of 0.75 and 0.50 kg a.i./ha than in the control until 40 days after treatment (see table). It was observed that the insects kept moving away from the treated plants, suggesting that the feeding that occurred was limited to a short time. Under field conditions, feeding time on treated plants may be too short to inoculate plants with tungro virus. ■

Residual activity of carbofuran applied in the root zone to control green leafhopper and its effect on insect feeding.[a] IRRI insectary, 1980.

Days after treatment	0.75 kg a.i./ha	0.50 kg a.i./ha	0.25 kg a.i./ha	Control
	Insect mortality (%)			
1	90 a	33 b	38 b	0 c
5	100 a	98 a	63 b	0 c
10	100 a	100 a	100 a	0 b
15	100 a	100 a	78 b	0 c
20	95 a	98 a	70 b	0 c
25	90 a	50 b	20 b	0 c
30	80 a	48 b	13 c	0 c
35	68 a	40 b	10 c	3 c
40	65 a	25 b	3 c	3 c
45	30 a	5 ab	0 b	0 b
	Feeding activity (mm^2)			
1	106 b	172 b	262 b	625 a
5	60 b	91 b	205 b	540 a
10	44 b	46 b	52 b	623 a
15	34 b	37 b	136 b	626 a
20	46 b	60 b	117 b	637 a
25	115 c	349 c	736 b	978 a
30	173 b	256 b	593 a	669 a
35	177 b	338 b	652 a	641 a
40	210 b	394 b	733 a	641 a
45	438 b	874 a	1079 a	904 a

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

Fluctuation of yellow stem borer moths in Tirur, India

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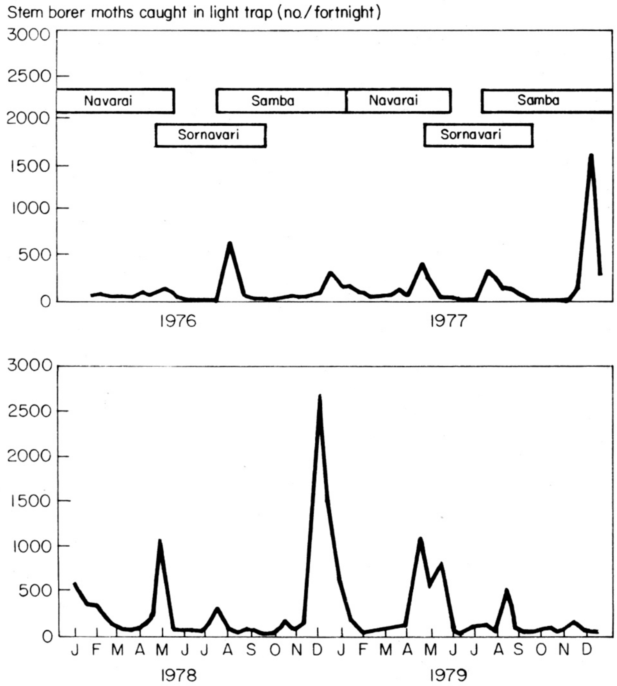
The yellow stem borer *Tryporyza incertulas,* a major pest of rice in Chingleput district of Tamil Nadu, occurs in all three seasons: sornavari (Apr-May to Aug-Sep), samba (Jul-Aug to Nov-Dec), and navarai (Dec-Jan to Apr-May).

Light trap studies were conducted from January 1976 to December 1979 to study the pattern of stem borer occurrence and to find the peak periods of incidence.

The light trap was fitted with an ordinary tungsten 200-watt bulb in 1976 and 1979 and with an 80-watt mercury vapor lamp in 1977 and 1978. The light was on daily from 1800 to 0600 hours. The daily collection of stem borer moths was recorded.

The data show that first-generation moths were abundant in April-May (see figure). In June and the first fortnight of July, the population declined. From the second fortnight of July, until the end of August, the moths again increased. From September to November, emergence was at its lowest. But moth occurrence increased in December-January. From February to March, moth incidence was low.

In general, three abundant periods — April-May, July-August, and December-January — were noted. These periods synchronized with the productive phase of navarai crops, vegetative phase of sornavari crops, and productive phase of samba crops. Evidently moth density was strongly influenced by the local rice cropping pattern. ■



Fluctuation of stem borer moth populations, 1976 to 1979. Tirur, India.

Evaluation of commercial and coded insecticides to control brown planthopper and green leafhopper

R. P. Basilio and E. A. Heinrichs, The International Rice Research Institute

One of the most serious problems in insect pest control is insecticide resistance. A countermeasure is the substitution of new insecticides. Continuous screening of newly developed insecticides is conducted in IRRI greenhouses and fields. In 1980, 23 compounds were screened as contact and foliar spray applications in the greenhouse against brown planthopper *Nilaparvata lugens* and green leafhopper *Nephotettix virescens.*

Of the compounds tested, only cypermethrin, dioxacarb, M9918, M10604, NNI-750, UC27867, and UC54229 were effective against the brown planthopper and green leafhopper in Potter's spray tower and foliar application tests (see table). NNI-750, a growth regulator which kills the insect at molting, was effective against nymphs, but had no effect on adults. ■

Effectiveness of insecticides applied in the Potter's spray tower and as foliar spray against brown planthoppers (BPH) and green leafhoppers (GLH). IRRI, 1980.

Insecticide			Application method[b]			
			Potter's spray tower		Foliar spray	
Common name	Formulation	Group[a]	BPH	GLH	BPH	GLH
A-41286	48 EC		–	–	–	+
Agrotin 300	30 EC		–	–	–	–
Cypermethrin	10 EC	Pyrethroid	+	+	+	+
Dioxacarb	50 WP	Carbamate	+	+	+	+
Dioxathion	96 EC	Organophosphate	–	–	–	+.
EXP5494	25 EC		+	–	–	–
M9918	20 OE		+	+	+	+
M10604	20 OE		+	+	+	+
Methidathion	40 EC	Organophosphate	–	+	+	+
Methiocarb	50 WP	Carbamate	–	–	+	+
NN1-750	50 WP		+	+	+	+
Pirimiphos methyl + carbophenothion	20 EC	Organophosphate	–	–	+	+
RP-32861	20 EC		+	+	–	–
SAN 285 AD	76 WP		–	–	–	–
SAN 2401	74 WP		–	–	–	–
Trichlorfon	95 SP	Organophosphate	–	–	–	–
U-56295	85 WP		–	–	–	–
U-57770	85 WP		–	–	–	–
UBI-W439-1265	50 WP		–	–	–	–
UC27867	50 WP	Carbamate	+	+	+	+
UC54229	100 Tech.	Carbamate	+	+	+	+
UC/MP 19779	48 EC	Carbamate	–	–	–	+
UC SF-1	40 F	Carbamate	–	+	+	+

[a]Composition of several insecticides not available. [b]+ = ⩾ 80% mortality 48 hours after spraying with Potter's spray tower and placing insects on foliar-treated plants.

Pest management and control WEEDS

Biological control of weeds in rice, Cuttack, India

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In an *experiment on the biological control of weeds during the 1978 dry* season, *Altica cyanea* Web., commonly known as the steel blue beetle, was released on *Ludwigia perennis* L., a common weed in rice, in both field and cage treatments.

In the field, beetles were released in plots planted with 100 plants each of rice, sedges, *Sphenoclea zeylanica* Gaertn., and *L. perennis.* All weeds were planted separately except *L. perennis,* which also was interplanted between rice rows. Three replications were made.

A large number (uncounted) of beetles were released at 5 p.m. Observation of beetle damage was at 9 a.m. the next day. *L. perennis* were completely denuded within 16 hours. Each plant was loaded with beetles. Rice plants were not harmed, although beetles were found resting on them.

Only 5 of 300 *L. perennis* plants regenerated 3 months after treatment, with 1.7% bud resurgence.

In nethouse conditions, 25 weed plants were planted on trays in 5 glass cages. Four levels of beetle infestation were used — 25, 50, 75, and 100. The load of beetles affected denuding time and resurgence ability.

Beetles consumed weeds faster in the field than in cages. Younger weed plants were preferred. Larvae also were observed feeding on weeds. Because the beetle prefers nonrice plants and multiplies rapidly, investigations on the biological control of *Altica cyanea* in rice fields should include techniques of large-scale multiplication and field release. ■

Early crop weeding and weed growth and grain yield of third crop

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An important rainfed or partially irrigated cropping pattern in Bangladesh is rice - rice - nonrice crop. The first rice crop is dry-seeded, the second is transplanted, and the third nonrice crop is established on residual soil moisture or is partially irrigated. Under this pattern, weed problems in the first rice crop are acute and in the second crop are moderate. In the nonrice crop, weeds cause some yield reduction. Farmers do varying degrees of weed control in the two rice crops, but usually do no weed control in the third crop.

This experiment studied the impact of weeding regime in the two rice crops on weed growth and grain yields of the nonrice crop. A randomized complete block design with 3 replications was used. Land preparation was done plot by plot. First crop treatments were assigned at random and treatments were maintained in the second crop. The third crop was not weeded. All recommended management practices except weeding were followed. Plot sizes were 15 m × 4 m in the first and second crops and 5 m × 4 m in the third crop. Grain samples were taken from 4 m × 3 m per plot and weed samples at harvest were taken from 3 places in each plot, using 0.5 × 0.5 m quadrats.

Weed weight at harvest and grain yields of the third nonrice crops were unaffected by the weeding regime applied to the two rice crops (see table). When better weed control measures were applied to the first and second crops, actual weed weight was slightly reduced and grain yields were slightly increased in all three crops tested.

Weeds common to all three crops are *Echinochloa colona* (L. Link), *Cyperus iria* L., and *Fimbristylis littoralis* Gaud. ■

Weed weight at harvest and grain yields of nonrice crops after weeding of two rice crops. BRRI, 1980-81. [a]

Weeding regime [b]		Third crop (winter 1980-81)					
		Millet		Gram		Soybean	
First crop (dry-seeded rice, 1980)	Second crop (transplanted rice, 1980)	Weed wt ($g/0.25\ m^2$)	Grain yield (kg/ha)	Weed wt ($g/0.25\ m^2$)	Grain yield (kg/ha)	Weed wt ($g/0.25\ m^2$)	Grain yield (kg/ha)
No weeding	No weeding	11.1 a	826 a	11,2 a	421 a	9.9 a	1455 a
Butachlor 2.0 kg a.i./ ha, one hand weeding 3 WE	Hand weeding 3 WT	10.0 a	854 a	7.5 a	440 a	9.2 a	1471
Hand weeding 2, 5, and 8 WE	Hand weeding 3 and 5 WT	8.1 a	883 a	6.4 a	431 a	8.6 a	1468 a

[a] Av of 3 replications. In a column, means followed by common letters do not differ significantly at the 5% level. [b] fb = followed by, WE = weeks after emergence, WT = weeks after transplanting.

Soil and crop management

Effect of applied and residual phosphorus on yield of wetland rice under acid soil conditions

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Wetland rice frequently does not show immediate response to applied phosphorus because of the reduction of ferric phosphate to ferrous phosphate and the hydrolysis of aluminum and iron phosphates on the one hand and the simultaneous fixation of applied phosphorus on the other. However, the phosphate is released in subsequent years.

Effect of applied and residual phosphorus on grain yield of Cauvery rice variety at Kanke, India.

P level (kg/ha)	Grain yield (t/ha) 1978	1979	1980	Mean
0	2.3	1.8	0.8	1.6
9	2.5	2.2	1.2	2.0
18	2.6	2.6	1.4	2.2
21	2.6	3.0	1.6	2.4
CD at 5%	ns	0.3	0.2	

The response of wetland rice to applied and residual phosphorus was studied under acid soil (pH 5.2) conditions during the 1978, 1979, and 1980 rainy seasons. The soil was sandy clay loam with low fertility (0.6% organic carbon and 10 kg available P/ha). Rice variety Cauvery (a selection from TKM6/TN1) was the test crop. Single superphosphate was applied in 1978.

Applied phosphorus showed no effect on grain yield in 1978 (see table). In subsequent years, the residual effect was marked. ■

Soil test-crop response correlation approach — a prediction equation for economic paddy yields

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A multilocational trial was conducted on transplanted paddy rice Ratna as part of an All-India coordinated scheme to investigate soil test-crop response correlations in farmers' fields.

Sixteen treatments out of 32 possible combinations of 4 nitrogen levels (0, 40, 80, 120 kg/ha), 4 levels of phosphorus (0, 30, 60, 90 kg/ha), and 2 levels of potash (0, 30 kg/ha) were randomized at 12 sites. Net plot size was 20 m^2. Soils were analyzed for physical and chemical characteristics before treatment (Table 1).

Table 1. Physical and chemical characteristics of soil at Jabalpur, India.

Parameter	Range	Mean
pH	6.4-7.6	6.8
Mechanical analysis		
Sand (%)	50-56	53
Silt (%)	32-38	34
Clay (%)	10-16	12
Organic carbon (%)	0.20-0.65	0.4
Available nitrogen (kg/ha)	224-324	277
Available phosphorus (kg/ha)	2.7-31.9	10.9
Available potassium (kg/ha)	225-851	421

Table 2. Effect of soil test values and added nutrient on yield at Jabalpur, India.

Regression equation[a]	Fertilizer adjustment equation[b]
$Y = 2642 - 192.54\ SN^{**} + 120.39\ SP^{**} - 2.02^{**}\ SP^2 + 0.83\ SK - 0.0004\ SK^2 + 28.18\ {}^{*}FN - 0.05\ FN^2 + 18.8\ {}^{**}FP - 0.09\ FP^2 - 41.25\ FK + 1.7\ FK^2 - 0.05\ FNSN - 0.039\ FNSP - 0.006\ FKSK$	$FN = 282 - 0.5\ SN - 10\ R$ (224-324 kg/ha)
$R^2 = 0.39^{**}$	$F\ P_2O_5 = 104 - 2.17\ SP - 5.56\ R$ (2.7-31.9 kg/ha)

[a] **Significant at 0.01% (**) and 0.05% (*).** [b] **Figures in parentheses indicate range of applicability.**

The polynomial trend equation was found significant with coefficient of variation 6-38% at only 6 sites. The average control yield was 1.7 t/ha. Yield in treated plots varied from 0.6 to 5.9 t/ha. The average response ratio was 8.6 for N at 120 kg/ha, 6.5 for P_2O_5 at 90 kg/ha, and 7.6 for K_2O at 30 kg/ha. These nutrient levels were statistically significant.

The multiple regression relationship relating yield to added nutrient and available fraction of inherent soil nutrient also were calculated (Table 2). The paddy responded significantly to fertilizer N and P. Available N and P also contributed significantly to grain yield.

In the regression equation, the response of a nutrient — linear (+), quadratic (–), and interaction (--) — represents a second degree parabola. This can be mathematically expressed as:

$$Y = a + bf - cf^2 + d.s.f.$$

where Y = grain yield (kg/ha); a = absolute constant independent of soil and fertilizer; b, c, and d = regression coefficients; f = fertilizer dose (kg/ha); and s = soil test value (kg/ha).

By isolating partial derivatives, the formula for optimum fertilizer nutrient for economic yield can be written as:

$$FN = \frac{b - \text{d.s.} - \text{R}}{2C}$$

where R = ratio of price/kg of nutrient to price/kg grain.

Fertilizer adjustment equations for economic yield, worked out for nitrogen and phosphorus, obeyed the law of diminishing returns. The recommended fertilizer doses are useful because they are not only based on soil test values but also take into account the relative cost of fertilizer nutrients and price of the crop.

Response of Basmati 370 to azolla application

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The water fern azolla, with its nitrogen-fixing Anabaena endosymbiont, has certain limitations when used as a biological source of nitrogen in rice cultivation. Its sensitivity to high light intensity and temperature becomes a major constraint to large-scale use in northern and some parts of eastern India. This study deals with the effect of dried azolla on nitrogen uptake and yield of Basmati 370.

Azolla fortified with 150 g superphosphate was grown during the September-October season in polythene-lined, shallow, 2-m^2 ponds. Periodic harvests (15-day intervals) were sundried and stored. In randomized pot culture experiments during the 1979 wet season, each pot contained 14 kg soil, 4 rice seedlings, and phosphorus and potassium at the rate of 50 kg/ha. Three levels of urea (60, 80, and 100 kg N/ha were applied as a basal dose with and without dried azolla at 1 t/ha).

Crop yield was a function of fertilizer nitrogen input, showing a progressive increase from 60 N to 100 N (see table). Grain and straw yields increased significantly when nitrogen was supplemented by dry azolla. At every nitrogen level, the effect of azolla supplementation was equal to that of the next higher nitrogen level without azolla. The azolla was the equivalent of 20 kg N/ha. Nitrogen uptake also showed significant increases with dried azolla application.

Yield and nitrogen uptake by Basmati 370, northern India, 1979 wet season.[a]

Treatment[b]	Yield (g/pot)		N uptake (mg/pot)
	Grain	Straw	
Control	3.58	4.01	53.4
Azolla	5.6	5.0	76.4
60 kg N	14.4	12.0	193.9
60 kg N + azolla	19.3	16.6	259.4
80 kg N	19.3	16.6	267.7
80 kg N + azolla	27.9	21.8	374.3
100 kg N	28.0	22.1	375.9
100 kg N + azolla	32.9	28.2	453.7
C.D. 5%	1.25	1.65	

[a]Values are mean of 3 replications. [b]Azolla rate was 1 t/ha.

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