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Contents

Guidelines and Style for IRRN Contributors

To improve communication and to speed the editorial process, the editors of the *Inernational 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 abbreviation 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

Prevention of lodging in rice plants during rapid generation advance

M. Eunus, Bangladesh Agricultural University, Mymensingh, Bangladesh; H. Ikehashi, National Institute of Agricultural Science, Tsukuba, Japan, and B. S. Vergara and J. Peralta, Plant Physiologr, International Rice Research Institute

The maintenance of high nitrogen levels at the seedling stage is imperative for hastening flowering time during rapid generation advance (RGA). Dense spacing is needed to accommodate large numbers of segregating plants during RGA. The high nitrogen level and dense spacing conditions cause the breeding materials to become tall and to lodge as early as 3 weeks after planting. This creates inconvenience in raising the materials. Some plants may die unless some leaf pruning is done, additional support is provided, or a chemical is sprayed to prevent plant elongation.

The tests we conducted showed that pruning the plants at 15 cm above the ground 22 days after sowing prevented the plants from becoming too tall but did not significantly delay flowering.

During pruning, one could also inoculate the plants for bacterial blight by the clipping technique.

Premature lodging can also be minimized by spraying B995 at 4,000 ppm on 35day-old seedlings. Plant height can be reduced by as much as 40%, depending on the variety or line.

Another way of preventing lodging in plants growing in the RGA carts is to provide metal posts at each corner. The posts should have holes for strings that can help support the plants. ■

Submergence-tolerance screening of rice during rapid generation advance

S. K. Bardhan Roy, J. Peralta, and B. S. Vergara, Plant Physiology Department, International Rice Research Institute

In rainfed wetland rice culture, total submergence of the rice plant is common, especially just after transplanting. Varieties for this situation need submergence tolerance. It has been shown that varietal differences in submergence tolerance exist and that screening for the trait at the seedling stage is easy.

In rainfed wetland rice where photoperiod-sensitive varieties may be required, the breeding process is accelerated through rapid generation advance (RGA). A study investigated the possibility of screening for submergence tolerance during the RGA process crosses for rainfed wetland rice. The efficiency of two types of containers was also tested. Presoaked seeds of 9 susceptible and resistant varieties were sown in vials (3.0 cm diam, 4.5 cm high) and in square pots (5.2 cm diam, 5.0 cm high). Each vial or pot contained a single plant, and was replicated three times. Plants were submerged 10 days after sowing for 7 days and percentage of survival of each variety was recorded 7 days after treatment.

The known submergence-tolerant varieties FR 13A, Thavalu 153 14, Kurkaruppan, and Thavalu 15325 did not differ in survival ability in the two containers. Susceptible varieties like IR42, IR38, IR8 showed different results but equally poor survival. The mean survival percentage of all varieties is greater in vials than in square pots, but the difference is not statistically significant.

Thus, vials can be used instead of square pots in tests for submergence tolerance. The vials will save space, but the green pots have a larger volume of soil and provide larger panicles. If screening is at F_4, more seeds may be required and a larger container like the

Survival of 9 rice varieties in 2 types of containers submerged for 7 days at seedling stage. IRRI, 1980.

Variety	Mean percentage of survival	
	Vial	Square pot
Thavalu 15314	100	100
Thavalu 15325	100	100
Kurkaruppan	100	96
FR13A	100	90
KDML105	50	40
SML Temerin	38	23
IR8	38	80
IR42	50	16
IR38	17	30
Mean	66	64

"t" calculated value = 0.2927 ns at df. 8.

square pots may be necessary.

The study shows that screening for submergence tolerance at seedling stage during RGA is possible. Elimination of most of the susceptible lines will decrease the RGA population and increase the chances of the remaining lines to survive submergence under field conditions. ■

Selection for earliness or short growth duration during rapid generation advance in rice breeding

G. Pateña, S. K. Bardhan Roy, and B.S. Vergara, Plant Physiology Department, International Rice Research Institute

Delayed heading or long growth duration is a major effect of low temperature on rice plants. When temperature is low, delayed panicle initiation, which may result from long growth duration, causes degeneration of spikelets and sterility. Flowering of rice plants in low temperatures causes sterility.

A 130-day cultivar in the tropics may have a growth duration of 200 days in low-temperature areas. To have a duration of 130-150 days in those areas, it should mature only within 90-100 days in the lowland tropics. Earliness is therefore one of the main criteria used for selection in improving cultivars for the low-temperature areas.

In an experiment to determine if selection for earliness is possible during the rapid generation advance (RGA) and in what generation it is feasible, the seeds of two crosses — 1R20654 (K78-13/IR5908-125-1) and IR22553 (Fujisaka 5/Knl B-361-8-6-9) — were sown in plastic pots (5.2 cm diam × 5.0 cm high) filled with soil and added fertilizer. Flowering dates for both F_2 and F_3 plants were noted.

Selection of F_2 plants that flowered in 70 days or less resulted in a 31% reduction of the population for IR22553 and 12% for IR20654. The reduction in population greatly facilitated the handling of the materials and provided space for more plants. However, in the IR22553 cross, 28% of the short-growth-duration lines (< 70 days) in the F_3 were eliminated when selection for earliness was made in F_2 plants. Similarly, 15% in IR20654 were lost. In a large F_2 population, an average loss of 21% may be permissible.

Of the F_3 population that resulted from selection for earliness in F_2 of the cross IR22553 (< 70 days), 72% had a growth duration of less than 70 days. The value for IR20654 was 84%. These high values justify early selection (at F_2) for earliness (see table).

Selection for earliness, however, does not involve cold tolerance at seedling stage. If selection for earliness is made at F_2, a population of around 2,000 plants should be the minimum so that F_3 selection for cold tolerance at seedling stage could be conducted. ■

Heading days of 2 crosses in 2 generations under rapid generation advance.

F_3	IR22553 F_2 plants (no.)		F_3	IR20654 F_2 plants (no.)	
	51–70 d	71–90 d		51–70 d	71–108 d
41– 70d	316	120	51–70 d	623	111
71–100 d	21	28	71–80 d	114	51

Problems and prospects of rice in Manipur

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Rice is the principal crop of the State of Manipur in the northeast corner of India. The State comprises an area of 22,356 km^2 and lies between 23.50° and 25.41° N latitude and 93° and 94.45° E longitude. The State is hilly and undulating except for the valley portion of about 2,235 km^2. The elevation of the valley is about 765-890 m; in the hills, the altitude ranges from 900 to 3,010 m. The climate is subtropical with assured rainfall, but temperature and other meteorologic conditions vary. Maximum temperatures of about 32° C in the valley and 27° C in the hills are registered in June-July. Minimum temperatures of about 1.5° C in the plains to 0° C in the hills are registered in December-January. Average annual rainfall varies from 1,350 mm in the valley to 1,800 mm in the hills. The dry season from December to March has little rainfall.

An area of 172,000 ha under rice cultivation yields an average of 1.5 t/ha. In the valley rice, mostly transplanted, is grown in low-lying areas. Rice is also the main crop in the hills. Farmers in the north and northeast practice terraced cultivation. Transplanting normally is from mid-June to late July. Harvest is from late October to late November. All these operations are 15 to 20 days early in the hills. More than 80% of the area is planted to local glutinuous varieties such as Moirangphou, Phoudum, Kakchingphou, and Langmanbi – preferred by the local population.

Over the last decade the Department of Agriculture has had limited success in introducing some high-yielding, short-duration, photoperiod-insensitive varieties such as IR8, Jaya, Ratna, and Palaman. IR24 is becoming popular because of its high yield and low amylose character, but it is very susceptible to blast, a disease that is favored by weather conditions in Manipur. With the development of

Promising cultures and their suitability for cropping. Orissa, India.

Culture or variety	Yield av (t/ha) for 2 years	Total duration (days)	Cropping suitability
CR126-42-1/Ratna	6.1	110–115	1st crop (Feb-Mar)
Kalinga 2	6.0	115–120	–do–
CH1039-6-106	5.3	110–115	–do–
K28-1	5.1	105–110	–do–
Cauvery/CH988-3	6.1	130–135	Main crop May to June sowing
IR24	5.8	140–145	–do–
HXG60-49	6.1	130–135	–do–
K336-1	5.5	128–130	Late planting, i.e. Aug planting
HP30	5.8	128–130	–do–
P33-C-78	5.4	125–130	–do–

medium-lift irrigation facilities an effort is made to introduce rice double-cropping. But low temperature becomes a problem at germination and during the seedling stage for the first crop sown in February—March and the duration is prolonged. There is presently no high-yielding variety that can be harvested in late June or early July. Seed dormancy is important for varieties grown in the first crop because the harvest coincides with the heavy rains. Realizing the vast potential of the region, the Indian Council for Agricultural Research has established a research center at Manipur with headquarters at Shillong for all aspects of crop, animal, and fishery sciences. Preliminary trials with a large number of breeding material from AICRIP, CRRI, and IRRI were conducted in 1977 and 1978. Promising varieties for early, normal, and late-planted conditions were identified (see table).

In the State, large areas under 1 to 1.5 m of water grow local deepwater rices such as Taothabi, which yields only 0.5 t/ha.

Heavy rainfall and high humidity most of the year favor weed growth; about 60% are monocots. Hand weeding is the best control method but it increases production costs. Good herbicides and varieties with ability to compete well are needed.

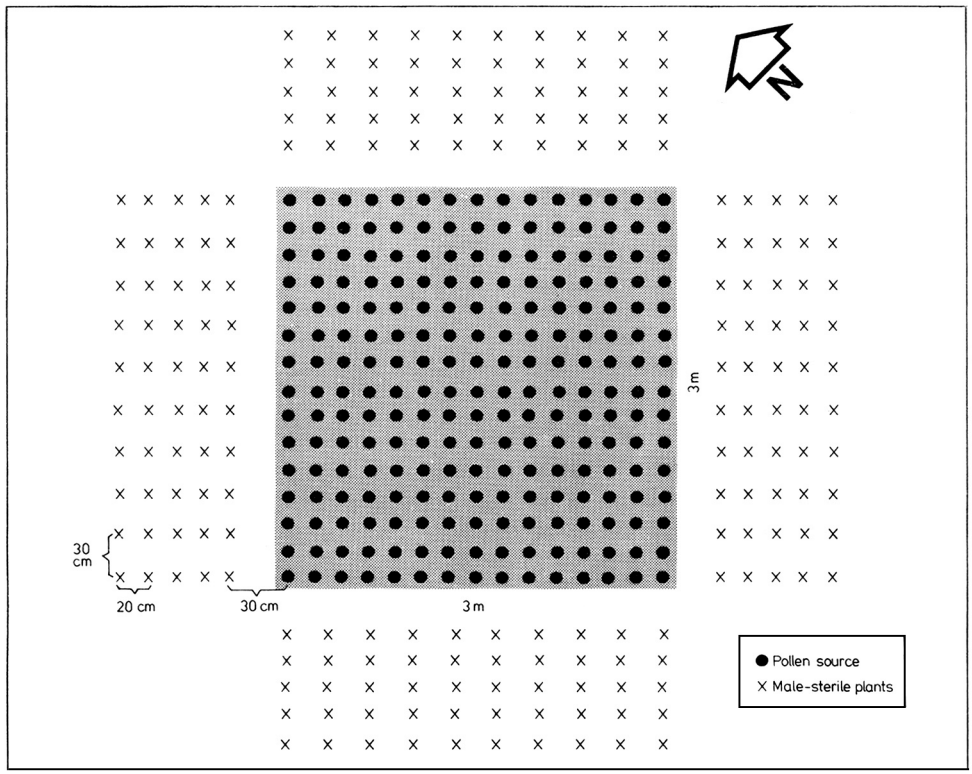
A hybridization program involving local and hill rices such as Moirang-phou, Khonorulu, and Ryllo-red and other high yielding varieties was initiated to develop early-maturing, high-yielding, cold-tolerant rice varieties suitable for Manipur. ■

Natural outcrossing on cytoplasmic male sterile lines of rice under tropical conditions

S. S. Virmani, G. S. Khush, E. H. Bacalangco, and Ran Cui Yang, Plant Breeding Department, lnternational Rice Research Institute

Rice scientists in China have shown that heterosis can be exploited commercially in rice through a cytoplasmic-genic male sterility system. On the average, 33-45% (in one case, 74%) seed set is obtained through natural outcrossing on cytosterile lines grown in isolation with restorer lines, in hybrid seed production plots. Information on the extent of natural outcrossings on male sterile lines of rice grown in the tropics is limited.

During the 1980 dry season, we planted two cytosterile lines (Zhen Shan 97A and V20A, from China) along with their respective maintainer lines (Zhen Shan 97B and V20B) in two isolation plots with an isolation distance of 60 m. The maintainer line, used as pollen source, was planted in a 3- × 3-m plot with 20- × 20-cm spacing. Fifty plants of a cytosterile line were planted at 30- × 20-cm spacing in 5 rows on each side of the pollen-source plot. The first row of 10 plants was 30 cm from the pollen source; the second, 50 cm; the third, 70 cm; the fourth, 90 cm; and the fifth, 110 cm (see figure).



Layout plan of outcrossing experiment at IRRI.

One of the primary panicles of each of the male sterile plants was bagged at flowering. The other panicles were kept

Seed setting on 2 cytosterile lines in relation to direction and distance from the pollen source. IRRI, 1980 dry season.

Direction	Seed set (%)					Mean
	30 cm	50 cm	70 cm	90 cm	110 cm	(%)
			Cytosterile Zhen Shan 97A			
Southwest	28.2	24.9	19.5	17.1	22.0	22.3
Southeast	21.3	11.5	4.5	6.0	3.6	9.4
Northwest	16.8	1.3	4.1	6.9	4.1	8.0
Northeast	3.9	1.6	1.4	0.6	1.1	1.7
Mean	17.6	11.3	7.5	1.6	7.7	10.4
			Cytosterile V20A			
Southwest	19.0	10.1	11.9	11.7	9.1	12.4
Southeast	19.9	7.3	8.0	11.2	10.0	11.3
Northwest	8.9	8.9	4.6	2.5	2.9	5.6
Northeast	8.6	3.2	1.2	0.9	1.0	3.0
Mean	14.1	7.4	6.4	6.6	5.8	8.1

open for natural outcrossing. The extent of outcrossing on the male sterile plants, located at various distances from the pollen source, was determined by comparing the seed set on two randomly selected, unbagged panicles with that on bagged panicles. The data were adjusted in relation to percentage seed set of the pollen sources (94.4% for Zhen Shan 97B and 86.3% for V20B).

The two cytosterile lines did not set any seed on the bagged panicles. This indicated the stability of their male sterility system. Seed set on the open pollinated panicles varied with the cytosterile line, direction of planting, and distance in relation to the pollinator (see table). Some individual plants gave as high as 35-45% seed set. Cytosterile Zhen Shan 97A showed higher seed set than V20A, probably because of its slightly better panicle exsertion and synchronized flowering in relation to the pollen source. The higher seed set on the male sterile plants located in southwest and southeast directions than on the plants located in the other two directions may have been caused by the prevailing wind direction (mostly north-northeast) during the flowering period (18 Feb - 16 Mar). Seed set was higher on plants 30 cm away from the pollen source than on plants located further away. The effect of distance up to 110 cm on natural outcrossing was, however, less pronounced on the plot in the southwest, which lay across the direction of wind. Therefore, it should be possible to obtain satisfactory seed set in hybrid seed production plots by growing five rows of a cystosterile line (1-m wide strip) alternately with one row of pollen source.

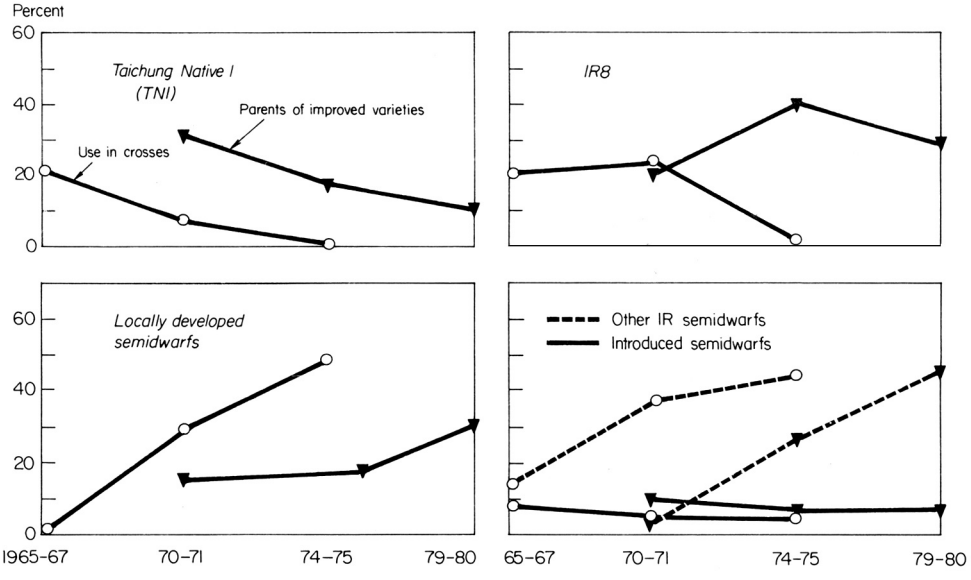
Although we did not practice manual flag leaf clipping and supplemental pollination, as in China, the results are encouraging. Further increase in natural outcrossing on rice cytosterile lines should be possible through selection or breeding, or both, of male sterile lines possessing shorter flag leaves, well-exserted panicles, and spikelets with exserted stigma. ■

Genetic composition of parents used in crosses and of subsequent rice varieties

Thomas R. Hargrove, editor; and Victoria L. Cabanilla, research assistant, International Rice Research Institute

Plant breeders develop most improved crop varieties by hybridization or crossbreeding. In 1975, IRRI began a study of Asian plant breeders' use of semidwarf rice varieties as parents in their crosses. The data were collected at 14 research centers: 7 centers in India, 2 in Korea, and 1 each in Bangladesh, Indonesia, the Philippines, Sri Lanka, and Thailand.

We speculated that *cross analysis* might be used as a tool in predicting the genetic composition of future crop varieties. We compared data on rice cultivars that Asian plant breeders crossed over a 10-year period (1965-75) with data on the genetic composition of the improved rice varieties released and recommended to farmers 5 years later (1975-1980) in the same countries. Five or six years is about the minimum time required to advance the progeny of a cross to the varietal stage.



Comparison of use of varieties as parents in crosses and genetic composition of improved rice varieties released from 1965—80. 355 randomly selected crosses involving 819 parents at 7 research centers and 202 varieties involving 433 parents. IRRI, 1980.

In 1980, a list of 202 improved rice varieties, developed locally and released in the 7 Asian countries, was compiled from records of the IRRI-sponsored

International Rice Genetic Survey. Copies of the lists were sent to the senior rice breeder of each research center, with the request that he provide each variety's cross, and add new varieties not recorded and the year of release.

We then plotted the percentages of new varieties that were progeny of major gene sources released from 1965 to 1970, from 1971 to 1975, and from 1976 to 1980.

The most heavily used semidwarf parents in crosses were Taichung Native 1 (TN1) and IR8. The other semidwarf parents were categorized as *locally developed* (bred by the national programs); *other IRRI* (any IRRI cultivar other than IR 8); and *introduced from another country* (for example if Sona, an Indian semidwarf, were used in Indonesian crosses).

TN1 was used in 22% of all the crosses analyzed for 1965-67, and appeared as a parent of 40% of the new varieties released in the same nations by 1970 (see figure). The steady decline in its use as a parent in the subsequent decade was matched by a corresponding decline in its appearance as a direct parent of new varieties released.

IR8 was involved in about 20% of the crosses made in the mid-1960s and was a parent of about 25% of the varieties released 5 or 6 years later. Its use in crosses increased and then declined; so did it subsequent appearance as a parent of varieties. Breeders had almost stopped using IR8 as a parent by 1975, but it was a parent of 24% of the varieties released from that time until 1980.

The strongest trend found in the 1975 survey was the increasing use of locally developed semidwarfs as parents-from 0 to about 50% from 1965 to 1975. But of the subsequent varieties, only about 20% are progeny of those crosses. Most of the local semidwarf parents were progeny of IR8 or TN1. ■

GENETIC EVALUATION AND UTILIZATION

Disease resistance

Sheath rot incidence and chaffy grain percentage on some popular rices

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The incidence of sheath rot of rice and percentage of resulting chaffiness on some popular varieties grown in the Chhattisgarh region of MP in 1979 kharif were recorded. Nine varieties were grown in a replicated trial with fertilizer applied at 60-40-20 kg NPK/ ha with 3 replications/variety.

The disease incidence was assessed by observing for sheath rot symptoms 10 plants from 3 patches selected for each replication. The percentage of infection was calculated by counting the infected and healthy panicles for each plant (see table).

The infected panicles that showed sheath rot symptoms were randomly collected from the plots and pooled. Because neck rot infection also increases chaffy grain production, care was taken to select neck rot-free panicles. The chaffy and filled grains of 10 panicles were counted. The healthy panicles with no sheath rot or neck rot served as control. The percentage of chaffy grains was higher in the diseased panicles than in the healthy ones.

Percentage of sheath rot incidence and chaffy grains developed. Madhya Pradesh, India.

Variety	Panicle infection (%)	Chaffy grains (%) on	
		Diseased panicles	Healthy panicles
Phakuna	28.8	31.0	8.2
Madhuri	31.2	49.5	9.4
Anupama	32.0	45.8	8.9
Jaya	37.2	32.6	7.5
Kranti	38.0	37.5	11.5
Patel 85	49.5	38.0	12.0
Pragati	53.2	42.0	10.5
Bangoli 5	62.7	30.1	11.0
Patel 17	72.5	48.0	15.0

Patel 17 had maximum incidence and Phalguna minimum. Bangoli 5 had more infection than Phalguna, but the latter had a higher percentage of chaffiness. Similar observations were made on Patel 17 and Anupama. This indicates that the time of panicle infection may play an important role in chaffy grain production. ■

Outbreak of sheath rot on rice

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During late kharif 1978-79, an outbreak of sheath rot (caused by *Acrocylindrium oryzae*) occurred at Nellore. In October, entries in the national screening nursery were planted singly in 2 rows, each 3 m long. A spacing of 20 x 15 cm was adopted. Urea at 150 kg N/ ha was applied in 3 equal splits. Sheath rot was observed at the panicle initiation stage. Unusual rains in December (153 mm), in addition to cool moist weather with relative humidity of 95% and above on many days, helped spread the disease.

The rot appeared on the uppermost leaf sheaths enclosing the young panicles. Oblong lesions on the leaf sheath coalesced quickly and covered most of the sheath. Among 673 entries tested, 124 recorded clear susceptible reactions (score 5-9). In these susceptible entries almost every panicle was damaged by the fungus. Panicles either remained within the leaf sheath or emerged only partially. Young panicles rotted completely. Profuse powdery growth of the fungus was found inside affected leaf sheaths.

Sheath rot-resistant cultures (score 0–3) from India. Nellore. India.

IET no.	Designation	Cross	Disease score[a]		
			Nellore	Rajendra-nagar	Patna
5938	CN44-33-3	NC1626/T(N)1	0	0	3
6470	TNAU18620	IR20/8Cll-6-3	3	0	0
6487	MR343-434-1	SR26 B/Waner 1	3	0	1
6754	OR129-1	OR10-26/RPW6-13	0	0	3
6775	OR149-7148-268	(MNP36/CR12)/Pankaj	0	3	0
6780	CR208-6467	Jagannath/Jayanthi	0	0	0
6781	CR208-7446	" "	0	0	0
6782	CR208-6462	" "	0	0	1
6830	IGP-1-2	Pankaj/Kamod 253	0	3	3
6927	RP992-30-10-6-1	Palman 579/IET2508	3	3	–

[a]Standard Evaluation System for Rice scale of 1–9: 1 = less than 1% (of tillers affected), 3 = 1–5%.

Sheath rot has been known to cause up to 85% loss in yield. At Nellore no seed could be collected from some entries because all panicles were completely damaged. Similar incidence of sheath rot during the same season was reported at Rajendranagar and Patna. Ten entries were found resistant in all the three locations where disease pressure was high (see table). ■

CAS 209—a new variety for differentiating virulence of *X. oryzae*

T. W. Mew, C. M. Vera Cruz, and R.C. Reyes, Plant Pathology Department, International Rice Research Institute

The work to identify rice varieties suitable for differentiating the virulence of *Xanthomonas oryzae* has been done at IRRI since 1976. CAS 209 from Senegal (IRRI Acc. no. 15793) showed susceptibility to strains of virulence groups I and III but varied reactions to group II strains. When evaluated against PXO 79, a strain of group II, CAS 209 was found susceptible, but was resistant to PXO 86 of the same virulence group. On the basis of this reaction, strains of virulence group II are suspected to be heterogeneous because of a lack of matching resistance or susceptibility in the set of differentials identified earlier.

Subsequently, a test designed to confirm the resistance or susceptibility of a cultivar to group II strains demonstrated that the strains could be further classified into two groups based on their virulence to CAS 209 and to their reaction to other differential varieties. Among 16 of group 11 strains evaluated, 5 were virulent to CAS 209 and 11 were avirulent. CAS 209, therefore, serves as a distinct variety for differentiation. While it is susceptible to groups I and III strains, it is completely resistant to some group II strains and susceptible to others. It is susceptible to the five pathotypes in Japan. ■

Amendments to *Acrocylindrium oryzae* spore suspension to induce sheath rot infection of ice

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The spraying of spore suspensions is usually an efficient inoculation technique for most foliar fungus diseases. But the method gave negative results for rice sheath rot in previous greenhouse studies. Because spraying a spore suspension is a rapid, practical, and convenient inoculation technique, more experiments with various amendments were conducted to improve the technique.

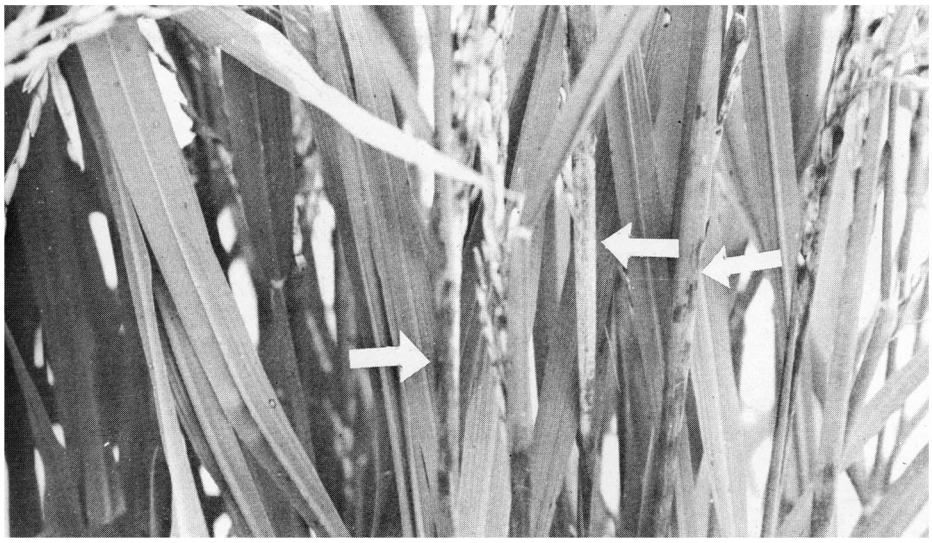
Seedlings of IR1487-372-1-1 (susceptible breeding line) were planted in 6.2-inch (15.75-cm) diameter Wagner pots (3 seedlings/pot) and grown in the phytotron. After 10 weeks they were transferred to the glasshouse. The potted plants were divided into two lots (whole plots). One lot was treated with silicon carbide powder (600 grit carborundum) before inoculation, and the other lot was left untreated. Carborundum was mixed with water (1 g/100 ml) and then sprayed on the plants at 19 lb (1.34 kg/cm^2) of pressure, starting from the boot and proceeding to the flag leaf. Each lot was further subdivided into 10 groups of 4 pots each to accommodate these subplot treatments: 25, 50, and 75% nutrient solution; 25 and 50% beef extract-peptone solution; 0.125% agar, 0.5% gelatin; 0.1% Tween 20; distilled water, and noninoculated.

Spores of *Acrocylindrium oryzae* from 1-week-old cultures were dislodged and suspended in the various solutions. They were used to inoculate both the carborundum-sprayed and nonsprayed plants. Inoculated plants were kept inside the glasshouse until sheath rot symptoms developed.

A spore suspension in 25% beef extract-peptone solution was the most effective subplot treatment: 88.3% of the carborundum-treated plants and 28.8% of the tillers/ plant exhibited sheath rot symptoms (see table). Sheath rot

Percent sheath rot infection as influenced by various spore suspension amendments on carborundum-treated and nontreated plants. IRRI, 1980.

Treatment	Carborundum-treated		Nontreated	
	Infected plants (%)	Infected tillers (%)	Infected plants (%)	Infected tillers (%)
25% nutrient solution	0	0	0	0
50% nutrient solution	0	0	0	0
75% nutrient solution	0	0	0	0
25% beef extract-peptone solution	83.3	28.8	0	0
50% beef extract-peptone solution	33.3	10.3	16.6	2.2
0.125% agar	16.6	1.4	0	0
0.5% gelatin	0	0	0	0
0.1% Tween 20	8.3	0.8	0	0
Distilled water	8.3	1.0	0	0
Noninoculated	0	0	0	0



Sheath rot symptoms (arrow) produced from spray inoculation of a spore suspension in 25% beef extract-peptone solution on carborundum-treated plants. IRRI, 1980.

appeared 2 weeks after inoculation and became progressively severe with time (see photo).

Wounding of the plants with carborundum before inoculation greatly increased disease development (see table). Plants not treated with carborundum remained disease-free; however, those sprayed with 50% beef extract-peptone amendment registered minimal infection (16.6% infected plants). ■

The International Rice Research Newsletter (IRRN) invites all scientists to contribute concise summaries of signigicant 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.

Life span of and tungro transmission by viruliferous *Nephotettix virescens* on 10 rice varieties at LPPM, Indonesia

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The life span and tungro transmission ability of *Nephotettix virescens,* collected and reared locally, were tested on seedlings of 10 rice varieties at LPPM Indonesia, from 20 October to 25 December 1978. There were two trials which involved 800 adult insects — 40 females and 40 males for each variety. After an acquisition access time of 4 days on tungro-diseased plants, the insects survived 1 to 25 days. The average life span was 5.6 days (6.1 days for female insects and 5.1 days for the male).

Considering the average life span of the insect, rice varieties Ptb 18, IR34, Gam Pai 30-12-15, and Pankhari 203 appeared more resistant than the other varieties in the test (see table).

Twelve percent of 2,803 seedlings inoculated by the insects became infected. The insects showed low efficiency in transmitting the tungro virus to Pankhari 203, Habiganj DW8, Kataribhog, Ptb 18, and IR34. Those varieties appeared more resistant to tungro than the others in the test. ■

Life span and tungro transmission of viruliferous *Nephotettix virescens* on 10 rice varieties at LPPM, Indonesia, in 1978.

Variety	Life span (days)		Infective insects (%)	Retention (days)		Infected seedlings		
	Longest	Av[a]		Longest	Av	%	No./ insect	No./ infective insect
Kataribhog	25	7.7 a	26	2	1.1	7	0.28	1.05
TN1	23	7.6 a	73	4	1.4	25	0.96	1.33
Latisail	21	7.3 a	56	2	1.2	15	0.61	1.09
IR26	14	7.1 a	64	4	1.5	22	0.84	1.31
Ambemohar 159	16	6.5 a	43	2	1.1	11	0.46	1.09
Habiganj DW8	22	6.4 a	14	1	1.0	4	0.14	1.00
Pankhari 203	15	4.2 b	6	2	1.4	2	0.06	1.00
Gam Pai 30-12-15	13	3.7 b	46	2	1.1	16	0.49	1.05
IR 34	10	3.1 b	23	1	1.0	10	0.29	1.05
Ptb 18	6	2.4 c	23	1	1.0	10	0.23	1.00
Max or av	25	5.6	38	4	1.2	12	0.44	1.10

[a]Means followed by a common letter are not significantly different from each other at the 5% level.

Rice cultivars with disease resistance

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Four hundred and ninety-one rice cultivars were screened under natural field infection during kharif 1980 for resistance to the following rice diseases: brown spot at 12 locations, bacterial blight at 15, and tungro at 5.

The cultivars in the table were found resistant or moderately resistant to those diseases at Coimbatore as well as in other locations. ■

Cultivars found resistant at Coimbatore, Tamil Nadu, India.

Disease	Designation	Cross	Disease severity grade at Coimbatore[a] (0–7 scale)
Brown spot	IET7137	MTU15/Waikoku	1
	IET7145	T141/Baok//T141	1
	IET6753	Hema/RPW6-13	3
	IET7134	Shirauni/Goenchiew	3
	IET7117	Ratna/TKM6	
	IET6880	RP31-49-2/LMN	3
Bacterial blight	IET6361	IR24/TKM6	3
	ET5953	CR161-42-16 (Vijaya/W12708)	3
Tungro	IET6268	CR63-5218-1/Pankaj	3

[a]1 = resistant, 3 = moderately resistant.

Life span of and tungro transmission by viruliferous *Nephotettix virescens* on 10 rice varieties at CRRI, India

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The life span and tungro transmission of *Nephotettix virescens* collected and reared locally were tested on seedlings of 10 rice varieties in the CRRI greenhouse, Cuttack, India, 22 November to 14 December 1978. To study the insect's life span 400 adult insects — 20 females and 20 males for each variety — were given an acquisition access time of 2 days on tungro-diseased plants. The insects survived 1 to 22 days on 1-week-old seedlings. Their life span averaged 8.5 days — 8.9 days for female insects and 8.0 days for the male.

On the basis of average insect life span, Ptb 18, IR34, and Gam Pai 30-12-15 were more resistant than the other varieties in the test (see table).

Life span of and tungro transmission by viruliferous *Nephotettix virescens* on 10 rice varieties at CRRI, India, 1978.

Variety	Life span (days)		Infective insects (%)	Retention (days)		Infected seedlings		
	Longest	Av[a]		Longest	Av	%	No./insect	No./infective insect
Ambemohar 159	21	11.9 a	44	1	1.0	11	0.44	1.00
TN1	18	11.6 a	81	4	1.8	34	1.44	1.77
Pankhari 203	22	11.6 a	25	3	1.4	8	0.31	1.25
IR26	19	10.1 ab	84	3	1.6	34	1.38	1.63
Habiganj DW8	22	9.9 ab	0	0	0	0	0	0
Latisail	21	8.9 b	69	5	2.0	31	1.41	2.05
Kataribhog	22	8.8 b	6	1	1.0	1	0.06	1.00
Gam Pai 30-12-15	13	4.8 c	50	3	1.7	23	0.81	1.63
IR34	14	4.7 c	59	3	1.8	28	1.08	1.74
Ptb 18	5	2.6 d	9	1	1.0	3	0.09	1.00
Max or av	22	8.5	43	5	1.3	17	0.70	1.31

[a]Means followed by a common letter are not significantly different from each other at the 5% level.

The tungro transmission differed remarkably among the varieties. About 18% of 1,251 seedlings inoculated by 320 viruliferous insects became infected. But the insects were unable to transmit the tungro virus to Habiganj DW8 and were poor in transmitting it to Kataribhog, Ptb 18, and Pankhari 203 (see table). Those varieties were probably more resistant to tungro than the other six in the test. ■

GENETIC EVALUATION & UTILIZATION

Insect resistance

Rice yield losses due to gall midge infestation in northern Thailand

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The rice gall midge *Orseolia oryzae* has been an endemic pest of rice in northern Thailand for half a century. Although insecticides and resistant varieties have proved effective for gall midge control. they are not adopted widely by farmers.

An experiment was conducted in a farmer's field at Ban Parauk, Cheingrai Province, to determine if gall midge damage would reduce the rice yield and whether insecticide control was economically feasible.

Four rice varieties were studied: RD 1 (susceptible), Leaung-Laung (local), and Dok-Ma-Li 105 and Niew-San-Pa-Tong (recommended traditional). The experiment used a split plot and was replicated three times. The main plot was

Infestation and yield losses caused by rice gall midge on 4 rice varieties at Ban Parauk, Cheingrai, Thailand, 1979.

Treatment		Damaged tillers (%)		Tillers (no./hill)	Panicles (no./hill)	Yield (t/ha)	Yield loss (%)
Rice variety	Insecticide[a]	30 DT	55 DT	55 DT			
Leaung-Laung	treated	0.9	1.8	7.1	4.5	2.909	–
Leaung-Laung	untreated	2.4	25.0	8.4	3.1	1.951	32.9
RD1	treated	1.4	1.0	11.4	5.5	2.323	–
RD1	untreated	3.5	21.5	12.0	4.4	1.866	19.7
Dok-Ma-Li 105	treated	0.6	0.4	10.1	5.7	2.033	–
Dok-Ma-Li 105	untreated	0.9	19.2	10.7	4.9	1.828	10.1
Niew-San-Pa-Tong	treated	1.3	2.2	7.9	4.6	2.740	–
Niew-San-Pa-Tong	untreated	2.3	26.5	9.7	4.4	2.522	7.9

[a]For gall midge control, carbofuran 3% G was applied to treated plots at the rate of 1 kg a.i./ha 2 times – 20 and 40 days after transplanting (DT).

divided into 4 equal subplots where the 4 rice varieties were transplanted at 3 seedlings/ hill. Each replication consisted of 2 main plots, treated and untreated. The treated plots received carbofuran 3% G at 1 kg a.i./ha 2 times, 20 and 40 days after transplanting (DT).

The percentages of damaged tillers caused by the rice gall midge among the 4 untreated rice varieties were at the same level (see table). Carbofuran at 1 kg a.i./ha was effective for gall midge control. The damaged tillers for the treated plots averaged 1.4% at 55 DT. The average number of tillers per hill was higher in the untreated plots because gall midge infestation induced tillering. However, the number of panicles per hill and grain yield were higher in the treated plots. The percentages of yield losses due to gall midge damage vaned. Leaung-Laung showed the greatest yield loss, 32.9%, when 25% of the tillers were damaged, but Niew-San-Pa-Tong had only 7.9% loss at the same level of damage. ■

GENETIC EVALUATION AND UTILIZATION

Deep water

Effect of submergence tolerance screening during rapid generation advance on heading duration and productivity

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Heavy rainfall or sudden flooding often causes submergence of tropical rice. The flooding generally occurs during the early growth stages and seriously hampers crop growth.

Previous studies have shown that lines can be screened for submergence tolerance during rapid generation advance (RGA). This report covers the effect of early, total submergence on growth duration and productivity.

Seeds of 7 rice varieties were presoaked and sown in "square" pots (5.1 cm x 5 cm) and vials (3 cm diameter x 4.5 cm height). Only one plant was placed in each container. Ten days after sowing, the seedlings were subjected to 7 days of total submergence. The surviving plants were kept under normal greenhouse conditions, and the heading dates of each variety were recorded. The mature panicles were harvested and the percentage of seed fertility was recorded.

The same procedures were followed with a control group under normal greenhouse conditions.

Abnormality in flowering and a high degree of spikelet sterility were observed in both the control and submerged plants in the vials. These results were anticipated because of the small amount of soil in the vials and the nutritional requirements for normal plant growth. The results from the "square" pots are in the table.

The heading duration did not vary greatly between submergence-tolerant varieties. But 3 new semidwarf varieties susceptible to submergence showed 5- to 10-day delays in heading because of early submergence.

Spikelet sterility showed little change in tolerant varieties. In semidwarf varieties, however, change was conspicuous, ranging from 20 to 44

Mean heading duration and spikelet sterility of 7 varieties submerged at seedling stage.

Variety	Survival (%)	Heading duration (days)		Seed sterility (%)	
		Control	Submerged	Control	Submerged
Thavalu 15134	100	68	66	18	28
Thavalu 15235	100	63	65	26	26
FR13A	100	75	74	20	15
KDML 105	50	68	64	30	42
IR38	17	89	94	40	60
IR42	50	73	80	43	80
IR8	38	81	91	13	57
Mean		74	76	27	44
SEM ±		1.5		5.7	
Calculated "t"		2.6**		3.1**	

** Significant at 0.1 0 level.

percent. Thus, early seedling submergence has little effect on heading duration and productivity of submergence-tolerant varieties. The submergence of the seedlings would not interfere with or delay heading during RGA of tolerant lines. ■

Kneeing ability test of promising deep water rice selections

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Varieties for deepwater rice areas must be able to bend toward the vertical axis so the first three leaves are above the water level. This characteristic known as kneeing ability prevents seed damage by water and aquatic fauna.

Promising deepwater rice cultivars were tested for kneeing ability by a method proposed by Vergara et a1 (1976). Kneeing was scored on a scale of 1 to 9. Good kneeing ability was shown in 28 of the 58 entries tested (see table). Most entries, which scored 3 and 5, are either local cultivars or pure line selections. Thus, high-volume crossing is needed to create more variability for deepwater rices. ■

Kneeing ability scores of some promising deepwater rice cultures at Patna, India.

Score	Entries (no.)	Entries
3	7	CNL231 B/B, IET6890, KD7-9-20, IET6860, FRG 7, Tilokkachari, and CN603.
5	21	C64-117, BR14, BR46, KLG108-P, KLG173-P, Barobar, KR2-17, KR2-27, CNL108, CM5-13, CN539, CR1009, IET6857, IET6859, NPS7, CN540, CN643, NC486/77, Achra 108/1 and IR7732-RGA-13-A96-1.

Evaluation of rice cultures for submergence tolerance and grain yield under lowland conditions at Tripura

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Hills cover two-thirds of Tripura. The remaining one-third is valley. Most of the lowland valley becomes flooded because rainfall averages 2,000 mm/year. Tripura rice fields remain submerged 1-10 days after a rain, depending upon field drainage. The heavy rainfall and poor drainage prevent high yielding, semidwarf varieties from getting established or giving good yields.

To select a suitable rice variety, 60 new cultures and 13 local varieties were screened for submergence tolerance and grain yield during the rainy seasons of 1978 and 1979. The testing submerged 10- and 20-day-old seedlings in a water tank for 7 days. The water depth ranged from 25 to 30 cm above the seedlings.

Seedling survival increased with age. Most of the varieties showed poor recovery after submergence; however, a few – CR149-5010-228, CR149-3295-4-205, CR210-1005, CR210-1009, CR213-1020-374, and IR2071-176-1-2 – were promising (see table). Some of the cultures gave higher yields than Jagannath, Mahasuri and other local varieties under lowland situations (25-50 cm). Culture CR 149-5010-228 gave the highest average yield during the rainy season.

A seedling emergence percentage count taken on the fourth and seventh days revealed some varieties had faster seedling elongation in water, but reduced survival. They included Jalaplaban, Chenab 64-117, CR149-1744, RAU21-68-1-2, FR13A, Madhukar and Chakia 59. These are all tall traditional varieties and are more suitable for deep water conditions (50-100 cm). ■

Submergence tolerance of some rice cultures and their average grain yield under medium lowland condition, 1978, 1979 rainy season, Tripura, India.[a]

Variety	Seedling survival (%)		Av grain yield (t/ha)	Seedling emergence (%) of 10-day-old seedlings	
	10 DS	20 DS		4th day	7th day
CR149-5010-228	68(5)	80(3)	4.4	13	23
CR149-3295-4-205	54(6)	98(2)	3.4	8	11
CR149-1744	68(5)	80(3)	1.5	20	28
CR213-1020-374	40(7)	92(2)	3.5	9	15
RAU21-68-1-2	40(7)	96(2)	2.9	17	34
CR213-1021	27(9)	83(3)	3.2	2	2
CR210-1009	34(8)	69(5)	3.9	–	4
CR210-1005	17(9)	78(4)	3.8	–	4
IR2071-176-1-2	44(7)	89(3)	3.4	2	10
Jagannath[b]	6(9)	81(3)	3.1	–	4
RP1064-14-2-2	38(8)	94(2)	2.7	–	4
Mahasuri[b]	42(7)	87(3)	2.7	12	15
Pijum	21(9)	72(4)	2.4	–	8
Majirsail	19(9)	74(4)	1.7	2	4
BR46	29(9)	68(5)	1.3	6	9
BR14	12(9)	70(5)	1.4	–	–
Chenab 64-117	44(7)	85(3)	1.2	23	30
FR13A	25(9)	76(4)	2.6	10	30
Madhukar	33(8)	75(4)	–	15	25
Chakia 59	51(6)	80(3)	–	13	27
Jalaj	36(8)	54(6)	1.4	15	22
Jaladhi 1	24(9)	44(7)	0.7	8	13
Jaladhi 2	11(9)	78(4)	1.4	9	14
Jalaplaban	37(8)	78(4)	1.8	24	33
C.D. (5%)	–	–	.393	–	–
C.V. %	–	–	15	–	–

[a] Figures in the parentheses indicate score value of survival (%). DS = date of seeding. [b] Check variety.

Cold tolerance

A method for testing cold tolerance of rice at early seedling stage

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Non-germination of seeds at low temperature is not a serious problem in rice culture even in low-temperature areas, unless rice is direct seeded. The farmer ordinarily soaks and incubates the rice seeds in a warm place so that it is the growth of the pregerminated seeds when broadcast in the nursery bed or main field that is affected by the low temperature. Rice farmers in China often broadcast pregerminated seeds when the temperature fluctuates around 8°C. Such low temperature either kills the pregerminated seeds or retard their growth. Cold tolerance at this stage is necessary.

This report describes the method that was developed for testing cold tolerance — the ability to maintain cellular integrity at low temperature and resume active growth when temperatures subsequently increase — at the early seedling stage. This method was used in screening 700 rice varieties from China.

1. Soak around 50 uniform seeds per variety for 24 hours in ordinary glass bottles.

2. Drain the water, wash the seeds thoroughly using sterile water during the last washing if possible. Cover the seeds with moist tissue paper.

3. Incubate the seeds for 3 days at room temperature, remove the tissue paper, add water to submerge the germinated seeds to a 3-cm depth, and place in the refrigerator (4°C) for 10 days.

4. Remove the bottles from the refrigerator and keep in a warm room for a day before placing under full sunlight. Score the entries 10 days after removal from the refrigerator.

Table 1. Cold tolerance score of 691 Chinese varieties at early seedling stage. IRRI, 1980.

Score	Indica		Sinica		Total	
	No.	%	No.	%	No.	%
1	10	2	74	35	84	12
3	15	3	49	23	64	9
5	30	6	30	14	60	9
7	121	25	36	17	157	23
9	303	64	23	11	326	47
Total	479	100	212	100	691	100

The criteria for scoring at early seedling stage are as follows:

Score	*Description*
1	All seeds germinated, seedlings with green leaves.
3	Less than 30% of the seedlings are dead.
5	30 to 50% of the seedlings dead.
7	Over 50% dead seedlings.
9	100% dead seedlings.

Table 2. Indica varieties with a score of 1 at early seedling stage and their score for seedling vigor. IRRI, 1980.

Accession no.	Variety	Seedling vigor
01140	Chang jo	1
01145	Chiu Chiu ku	3
01179	Hung Chao Lu Yu	3
01198	Yang Ku Tsi	3
01226	Ti Ho Hung	1
01240	PI 160639	1
01261	PI 160662	5
01518	PI 160968-2	5
01597	96-48-1	1
01599	97-51-2	1

While scoring for cold tolerance, one can score for seedling vigor in this test. The scoring criteria for seedling vigor follow:

Score	*Description*
1	Seedling height exceeds the height of the bottles (10 cm).
3	Seedling height is 8-10 cm.
5	Seedling height is 5-7 cm.
7	Seedling height is 3-4 cm.
9	Seedling height is less than 1 cm.

Table 1 shows the number of indica and sinica entries and their score at early seedling stage. A score of 1 was obtained by 2% of the indica varieties and 35% of the sinica. The indica varieties with a score of 1 are listed in Table 2; the sinica varieties are in Table 3.

In the development of this testing method, different number of days of incubation were tried and 3 days was found optimum. The amount of water added to the seeds at low temperature did not matter much; no significant

Table 3. Sinica varieties with a score of 1 for early seedling stage and seedling vigor.

Accession no.	Variety	Accession no.	Variety
01045	Yen Tiao Hsien	01278	PI 160677-5
01120	Marratilli	01304	Shen Li Ping Hsing
01220	PI 160615	01305	Chiang Li 3
01244	PI 160643	01323	AI Chih Hsu
01245	Pao Tswan	01337	Yen Fang Chu 1
01247	San Pao	01338	Yen Fang Chu 1
01249	Moh Tsu Ju	01342	Pai Mang Jh Pen
01250	Shih Chien	01472	Chung Ta 312/Binastian
01251	I 24-255 Chiu Tien	01485	AI Yen Lu
01255	Hsin Nung Ju	01612	Ta Hai
01273	AI Kwoh 4	01616	Bassetze
01277	PI 160677-4	03502	CI 7739

difference in results was obtained.

Although there was a significant positive correlation ($r^2 = 0.439^{**}$) between cold tolerance at early seedling stage and seedling stage (10 to 30 days after sowing), the low correlation warrants the two different screenings for elite lines or varieties and possible donor varieties. ■

Pest management and control DISEASES

Widespread occurrence of sheath rot in Bihar

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Sheath rot of rice caused by *Acrocylindrium oryzae* (revised as *Sarocladium oryzae*) was observed in Bihar for the first time during kharif 1977 at ARI, Mithapur, in national screening nursery (NSN) and International Rice Yield Nursery (IRYN) trials.

In the 1979 kharif, sheath rot was reported at the RAU Regional Research Institutes at Sabour, Bhagalpur; Dholi, Muzaffarpur; Kanke, Ranchi; and Mithapur, Patna. The symptoms are limited to complete discoloration of the ultimate leaf sheath, a high proportion of unfilled grains, grain discoloration, and choking of panicles. ■

Effect of some fungicides on the control of narrow brown leaf spot of rice

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Narrow brown leaf spot of rice caused by *Cercospora oryzae* occurs in severe proportion during samba (Aug-Jan) and thaladi (Oct-Feb) seasons. A pot culture experiment during 1979 thaladi studied fungicides for controlling the disease. The rice variety IR20, which is susceptible to narrow brown leaf spot, was raised in concrete pots. The test fungicides — carbendazim, carboxin, zineb, edifenphos, and Cuman L at 0.2% levels were sprayed on the rice plants twice at 10-day intervals at maximum tillering. The natural occurrence of the disease was rated according to the 1975 Standard Evaluation System for Rice.

Foliar spray with fungicides significantly reduced the narrow brown leaf spot. Among the fungicides, carbendazim was the most effective, followed by carboxin (see table). ■

Fungicides for control of narrow brown leaf spot of rice. Tamil Nadu, India.

Fungicide	Mean disease incidence (%)
Carbendazim	5.2
Carboxin	8.7
Zineb	10.5
Edifenphos	13.8
Cuman L	28.3
Untreated control	39.3

Influence of neem cake and coal-tar-coated urea on bacterial blight of rice

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A glasshouse experiment investigated the effect of slow-release nitrogenous fertilizers, such as neem cake + coal tar and coal-tar-coated urea, on the incidence of bacterial blight of rice on Taichung Native 1.

Two levels of nitrogen — 100 and 200 kg N/ ha — were applied separately as basal and 3 split doses. In the split application, 25% was applied at transplanting, 50% at maximum tillering, and 25% at the time of inoculation. Sixty-day-old plants were clip-inoculated with a virulent strain of *Xanthomonas oryzae.* The lesion length, plant height, and tiller numbers were recorded 14 days after inoculation.

There were 13 treatments in the experiment, including uncoated urea and the control.

The results indicated that disease incidence, plant height, and tiller number were maximum in treatments with 200 kg N and neem cake and coal tar and were lowest in the control. There is evidence that slow release of nitrogen as urea or neem cake or coal-tar treated urea increased lesion length.

Field trials are in progress to confirm the study and yield in different treatments. ■

Effect of the application of neem cake + coal tar and coal-tar-coated urea on bacterial blight incidence, plant height, and tiller number of rice plants. Andhra Pradesh, India.

Treatment	Application time	Nitrogen (kg/ha)	Lesion length (cm)	Plant ht (cm)	Tiller no.
Uncoated urea	Basal	100	5.4	75.6	5.3
Uncoated urea	Split	100	8.5	80.6	4.7
Uncoated urea	Basal	200	6.1	78.4	5.8
Uncoated urea	Split	200	9.6	83.2	7.2
Neem cake + coal-tar-coated urea	Basal	100	6.3	77.5	5.0
Neem cake + coal-tar-coated urea	Split	100	10.6	83.1	5.8
Neem cake + coal-tar-coated urea	Basal	200	8.3	84.2	8.1
Neem cake + coal-tar-coated urea	Split	200	10.9	88.2	8.7
Coal-tar-coated urea	Basal	100	10.1	82.1	5.3
Coal-tar-coated urea	Split	100	8.4	80.6	5.8
Coal-tar-coated urea	Basal	200	10.2	86.4	9.8
Coal-tar-coated urea	Split	200	8.8	81.1	6.8
Control		0	5.2	71.0	3.5

Incidence of bacterial blight of rice in the Punjab (Pakistan)

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Bacterial blight of rice caused by *Xanthomonas oryzae* is not generally found in Pakistan, but Mew et al reported its occurrence during 1976 kharif in the rice fields of Kala Shah Kaku, Punjab [IRRN 2 (1) (1977)]. In 1980 because of heavy monsoon rains and frequent windstorms, the pathogen has reappeared. Its incidence was observed in the experimental fields of the Rice Research Institute, Kala Shah Kaku, and in farmers' fields. The disease was noted on the rice varieties IR6, Palman, and Basmati 198. Infected leaf samples were examined microscopically, and the bacterial ooze at the junction of the infected and healthy parts of the cut leaves was observed.

Among the various climatic factors that favor the development of bacterial blight, temperature and humidity seem to be more important.

During July-August 1976, the amount of rainfall was 413 mm and the weather remained cloudy most of the time. The appearance of the disease was recorded under such weather conditions. In July-August 1980, rainfall was 886.3 mm and the weather was similar to that in 1976. The disease seems to flourish in highly humid and cloudy conditions.

During 1980, windstorms frequently accompanied rain showers and the injury they caused on the leaves provided openings for the entrance of the pathogen.

During the infection period, the temperature ranged from 25 to 32 ± 1°C, which is highly conducive to the spread of the disease.■

Fungicidal control of sheath blight

V. Viswanathan and V. Mariappan, Plant Pathology Department, Tamil Nadu Agricultural University, Coimbatore, India

The efficiency of fungicides applied as prophylactic and therapeutic sprays and as soil drench in the control of sheath blight disease was studied. The variety ADT31 sown in pots was fertilized with 120-6040 kg N-P-K/ ha. The fungicides carbendazim (0.01%), carboxin (0.01%), Kitazin (0.02%), Panolil (0.02%), Syllit (0.02%), Mancozeb (0.02%), and Daconil (0.02%) were sprayed on the plants as protective and curative treatments. For the prophylactic treatment the fungicides were sprayed on 60-day-old plants. Two days later the plants were inoculated with the pathogen by the pinprick method (2-3 pin–pricks/plant on the leaf sheath 6-10 cm above the water level). Sclerotia were immediately applied on the pricked surface and covered with moist cotton. For the therapeutic treatment, the 60-day-old plants were inoculated; 2 days later the fungicides were sprayed. For drenching, carbendazim (0.01%), carboxin (0.01%), wet Ceresan (0.0 1%), and PCNB (0.01%) were applied to the soil of the 60-day-old plants immediately after inoculation. The control was plants inoculated with the pathogen but not protected with fungicides. Each treatment had three replications. Ten days after inoculation, disease incidence was recorded and disease severity (0-9 scale) was determined. The percentage of the disease index (PDI) was determined:

$$\text{PDI} = \frac{\text{total ratings} \times 100}{\text{no. of tillers} \times \text{maximum grade}}$$

Both as prophylactic and therapeutic spray, carbendazim, carboxin, and Kitazin most effectively controlled the disease (Table 1). As soil drench, carbendazim, carboxin, wet Ceresan, and PCNB were equally effective (Table 2). Both carbendazim and carboxin, however, were effective as a spray and as a drench.■

Table 1. Percentage of disease index (PDI) when fungicides were applied as prophylactic and therapeutic sprays. Coimbatore, India.

Fungicide sprayed	PDI value[a]	
	Prophy-lactic spray	Thera-peutic spray
Carbendazim (0.01%)	24.92	25.49
Carboxin (0.01%)	26.08	27.08
Kitazin (0.01%)	27.09	28.09
Panolil (0.027%)	49.07	49.49
Syllit (0.02%)	42.67	44.81
Mancozeb (0.02%)	49.49	50.77
Daconil (0.02%)	40.51	40.51
Control (no fungicide)	54.75	55.66
S.E.D. =	1.30	1.06
C.D. =	2.80	2.28

[a] Transformed values. Mean of 3 replications. (P = 0.05% level)

Table 2. Percentage of disease index (PDI) when fungicides were applied as soil drench. Coimbatore, India.

Fungicide used for drenching	PDI value[a]
Carbendazim (0.01%)	27.72
Carboxin (0.01%)	27.72
Wet Ceresan (0.01%)	29.17
PCNB (0.01%)	28.47
Control (no fungicide)	58.33

[a] Transformed values. Mean of 3 replications. S.E.D. = 1.48; C.D. = 3.23 at P = 0.05% level.

Effect of nitrogen and spacing on sheath blight incidence in rice

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In a fertilization-spacing trial conducted during 1979 kuruvai, the incidence of sheath blight was assessed. There were 4 spacings (10 x 10, 20 x 20, 30 x 30, and 40 x 40 cm) and 4 levels of nitrogen (0, 50, 100, and 200 kg/ha) applied as full basal, 2 splits (75 + 25%), 3 splits (50 + 25 + 25%), and 4 splits (40 + 20 + 20 + 20%). Phosphorus and potassium were applied at 98% sufficiency level of the field. Data on sheath blight incidence are in the table.

With zero nitrogen, there was no disease incidence at all spacings.

With 50 kg N/ ha, disease incidence ranged from 16.2 to 21.6% for the 10- x 10-cm spacing and 1.8 to 2.7% for 20 x 20 cm. No incidence was noted at the 30- x 30- and 40- x 40-cm spacings. With 100 kg N/ ha, disease incidence was 49.5-59.4% for the 10– x l0-cm spacing, 4.5-6.3% for 20 x 20 cm and only 0.7-1.0% at 30 x 30 and 40 x 40 cm.

With 200 kg N/ ha, disease incidence was 53.1-60.3% for the 10–x 10-cm.

spacing 5.4-8.1% for 20 x 20 cm, and only 0.7-1.6% for 30 x 30 and 40 x 40 cm.

At the 10- x 10-cm spacing the increase in disease incidence was 171.1% from N_{50} to N_{100} but only 7.6% from N_{100} to N_{200}.

At the 20- x 20-cm spacing the increase in disease incidence was 137.4% from N_{50} to N_{100} and 29.1% from N_{100} to N_{200}. ■

Data on sheath blight incidence in Aduthurai, Tamil Nadu, India.

Treatment	Sheath blight incidence (%) at spacing of			
	10 x 10 cm	20 x 20 cm	30 x 30 cm	40 x 40 cm
N_0 – Full basal	–	–	–	–
N_0 – 2 splits	–	–	–	–
N_0 – 3 splits	–	–	–	–
N_0 – 4 splits	–	–	–	–
N_{50} – Full basal	16.2	2.7	–	–
N_{50} – 2 splits	21.6	1.8	–	–
N_{50} – 3 splits	19.8	2.6	–	–
N_{50} – 4 splits	20.7	2.0	–	–
N_{100} – Full basal	51.3	4.5	0.9	0.8
N_{100} – 2 splits	59.4	5.4	0.8	1.0
N_{100} – 3 splits	52.2	6.3	0.8	0.9
N_{100} – 4 splits	49.5	5.4	0.7	0.8
N_{200} – Full basal	58.5	8.1	0.9	1.1
N_{200} – 2 splits	56.7	7.2	0.8	0.7
N_{200} – 3 splits	60.3	5.4	1.6	0.9
N_{200} – 4 splits	53.1	7.2	0.9	0.8

Rice blast — races or virulence frequencies?

K. M. Chin, Rice Research Branch, Malaysian Agricultural Research and Development Institute, Bumbong Lima, P. W., West Malaysia

A recent article on races of *Pyricularia oryzae* raises several interesting questions about the current state of understanding of the population genetics and dynamics of the pathogen (Wu, H. K. 1979. Rice blast disease in Taiwan — Race and variety resistance. Tech. Bull. ASPAC Food Fert. Tech. Cent. 48.).

The author advocated the use of the international differential set of rice varieties to monitor changes in the racial composition of blast in Taiwan. He concluded that "race distribution was stable" because the predominant races in 1975-78 were similar to those in 1966.

This conclusion is not necessarily valid because the race frequencies studied involved only the characterization of virulence frequencies corresponding to those of the international differentials. Substantial changes in the racial composition in Taiwan could conceivably have been detected if relevant local varieties had been used as differentials.

The author also commented that "a lot of labor would be saved" if the international differentials were used instead of 12-16 local differentials. Although the labor saving is undeniable, much important information might be lost. It seems more logical to concentrate in the future on the frequencies of relevant pathogen genes rather than on frequencies of largely irrelevant genotypes.

The paper further contended that the disease severity on a rice variety was determined by the "number of its existing virulent races." A more accurate statement may be that disease severity is determined by the frequency of the corresponding virulence in the pathogen population. This virulence may be present in one or many races. That there is often a direct correlation between the number of virulent races (as determined by an arbitrary set of differentials) that can attack a variety and its susceptibility is merely a statistical artifact of the race concept.

If a variety is susceptible, it may be assumed that the corresponding virulence is high in frequency. There is then a correspondingly high probability of it being combined with other virulences in the pathogen population. ■

Rice ragged stunt disease in Annamalainagar, Tamil Nadu, India

P. Narayanasamy and P. Baskaran, Entomology Laboratory, Faculty of Agriculture, Annamalai University Annamalainagar, Tamil Nadu

References to large-scale occurrence of viral and mycoplasmal diseases on rice have lately been frequent. During routine field visits at the Agricultural Experimental Farm of Annamalai University, the authors detected diseased and stunted plants (culture ARC5752 from IRRI). The leaves were ragged and serrated, and vein-swelling was marked on the outer surface of the leaf sheath. Flag leaves were small, twisted, and malformed and showed incomplete emergence. Panicle emergence was incomplete and panicles bore mostly chaffy grains. Most of the tillers were branched and produced many panicles. Flowering was delayed and the diseased plant was totally unproductive.

With those characteristic symptoms the disease was suspected to be ragged stunt as described by K.C. Ling [IRRN 2(5) (1977): 6-7]. The disease is reported for the first time from this part of India; however, its occurrence in Coimbatore has been mentioned in a publication of Tamil Nadu Agricultural University. The disease is transmitted and spread by the brown planthopper (BPH) *Nilaparvata lugens* Stal. As the BPH population is increasing in the Cauvery delta, large-scale recurrence of the disease is possible. Hence, suitable prophylactic control measures will be taken up to reduce the BPH populations. ■

Studies on udbatta disease in Karnataka, India

S. Sanne Gowda, pathologist, All India Coordinated Rice Improvement Project (AICRIP), University of Agricultural Sciences, Regional Research Station (RRS), V. C. Farm, Mandya, Karnataka, India

Udbatta disease caused by *Ephelis oryzae* has occurred in Karnataka State for more than three decades and caused

considerable loss in grain yield of local improved and high yielding rice varieties. Recorded observations show that disease intensity is generally higher during kharif in the cooler climatic regions than during summer in hotter climates. The disease has been observed in varying intensity at all altitudes. It is not specific to any soil type nor to paddy variety. Some varieties, e.g. IET1444 and FTB20, were continuously infected during kharif; others – e.g. IET3626, IET5725, and IET4107 – had maximum disease infection in 1 year but were absolutely free from the disease during subsequent years. Thus, it is difficult to judge a variety for its susceptibility.

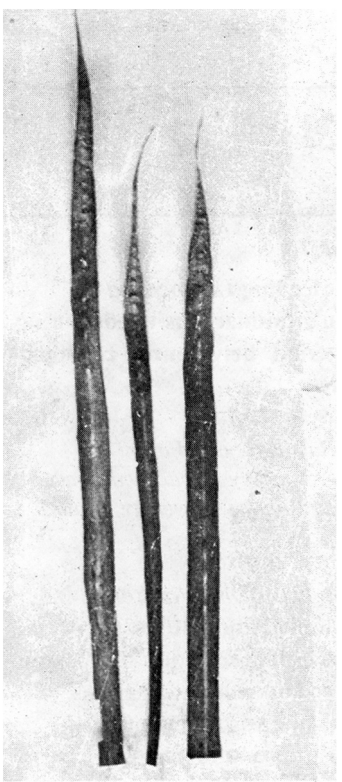
The studies on disease control by seed treatment carried out for several years at the RRS indicate that only the hot-water treatment at 54°C for 20 minutes gives good control. Other studies carried out with systemic fungicides indicate that carboxin and carbendazim are second to the hot-water treatment in checking the seedborne infection.

Further detailed investigations on the etiology of the causal organism and its mode of infection are needed to understand the disease. ■

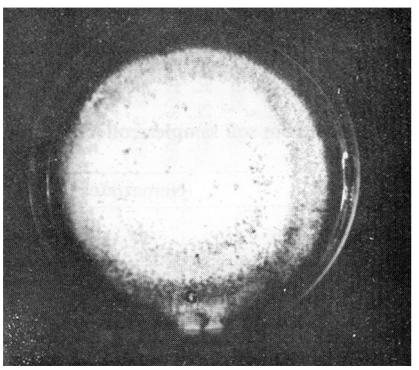
Echinochloa crus-galli (L.) Beauv. — a new host for *Rhynchosporium oryzae* Hashioka and Yokogi

S. Amu Singh and P. K. Sen Gupta, Plant Pathology Department, Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani, Nadia, West Bengal, India

During a search for collateral hosts of *Rhynchosporium oryzae* (the causal organism of rice leaf scald disease) severe leaf scald disease was observed in October 1978 at Takyel, Manipur, on the leaves of the graminaceous weed *Echinochloa crus-galli* (L.) Beauv. The weed was growing in a field of the local rice variety Chahao, which was also severely infected. The typical light- to dark-brown zonate symptoms identical to those of rice leaf scald disease as described in Japan were produced on leaf tips (photo 1). Each successive band was accompanied by narrow, light-brown halos. The average lesion was 2.58 cm long, ranging from 1-4.5 cm. Five to 10% of the leaf area was infected.



1. Symptoms produced on the grass host *Echinochloa crus-galli* (L.) Beauv.



2. Fungal growth on the PDE.

The fungus, when isolated in pure culture, produced luxuriant white growth on potato dextrose agar amended with 2% hot water extract of rice leaf (PDE) and copious bicelled, slightly falcate conidia within 4-6 days of incubation at 25±1°C (photo 2). The conidia were borne directly on the hyphae or on short conidiophores and they germinated readily in water within 6 hours of incubation at 25±1° C. The mean conidial size was 11.82 × 3.62 µ on the leaf lesions and 12.28 × 4.0 µ on PDE. The mycelium from the host tissue was hyaline, septate, and branched.

When artificially inoculated on the susceptible rice cultivar Jaya, the fungus produced typical leaf-tip blight, reddish-brown lesions on the leaf sheath, and water-soaked lesions (like those of rice leaf scald disease) on the margins of the leaf blade.

A culture of the fungus, sent to the Commonwealth Mycological Institute, Kew, England, was confirmed as *R. oryzae.* This is the first report of a collateral host for *R. oryzae.* ■

Survey of rice nematodes in deepwater rice fields

Suree Sukapanpotharam, Luechai Arayarungsarit, Chalit Setabutara, and Praphas Weerapat, Rice Division, Department of Agriculture, Bangkok, Thailand

A survey of parasitic nematodes in deepwater rice fields was conducted in Thailand from January 1979 to January 1980.

Samples of soil and plant materials were collected from farmers' fields at nine sites in Ayuthaya and two in Prajinburi province at four times: before planting, before the floodwaters rose (about 45 days after seeding), after the floodwaters receded (about 3 mo after seeding), and at harvest.

Each sample was randomly collected from four spots in a field and then composited. Nematodes were extracted from soil, roots, and leaves by Baermann's funnel technique and identified at the Plant Pathology Division. The genera identified are listed in Table 1.

Only *Hirschmanniella, Tylenchorhynchus,* and *Meloidogyne* were abundant in the soil. They represented 11.4, 41.5, and 47.1% of the total population sampled (Table 2). *Hirschmannielia* was abundant in the

Table 1. Genera of nematodes found in deepwater rice fields near the capitals of Prajinburi (PJB) and Ayuthaya (AYT) provinces, Thailand.

Genus	In the soil before planting		Before floodwaters				After floodwater recedes				In the soil at harvest	
			soil		Root		soil		Root			
	PJB	AYT	PJB	AYT	PJB	AYT	PJB	AYT	PJB	AYT	PJB[a]	AYT
Hirschmanniella	X	X	X	X	X		X	X	X	X		X
Tylenchorhynchus	X	X	X	X			X	X				X
Meloidogyne		X	X	X	X		X	X	X	X		X
Helicotylenchus	X	X	X	X								
Tylenchus	X	X	X	X								
Aphelenchoides		X										X
Criconemoides	X			X				X				X
Aphelenchus		X										
Ditylenchus		X		X				X				
Pratylenchus								X		X		
Lengidorus								X				

[a] No sampling.

Table 2. Average percentage of three genera of nematodes obtained from soil samples collected from deepwater rice fields during 1979 in Prajinburi (PJB) and Ayuthaya (AYT) provinces, Thailand.

Genus	Nematodes (av %)											
	In the soil before planting		Before floodwater				After floodwater recedes				In the soil at harvest		Percent of total population in soil
			Soil		Roots		Soil		Roots				
	PJB	AYT	PJB	AYT	PJB	AYT	PJB	AYT	PJB	AYT	PJB[a]	AYT	
Hirschmanniella	22.5	13.1	9.1	1.2	'few'	0	18.6	7.0	'many'	'many'		22.4	11.4
Tylenchorhynchus	8.1	5.7	22.1	17.7	0	0	11.8	16.1	–	–		18.5	41.5
Meloidogyne	–	0.4	19.9	1.0	0	0	4.0	13.6	'many'	'few'		61.0	47.1

[a] No sampling.

roots after the flood in both provinces. *Ditylenchus,* a predominant rice parasitic nematode in some countries, was found only in Ayuthaya in small amounts. Only *Aphelenchoides* was found in the leaves, and in small numbers. Plans are to continue this work and conduct surveys in additional provinces during the 1980 growing season.■

Pest management and control INSECTS

Egg parasites of yellow stem borer in southern Sri Lanka

Rohan H.S. Rajapakse and Varuni L. Kulasekera, Agronomy Department, Faculty of Agriculture, Ruhuna University College, Matara, Sri Lanka

A survey of parasites of yellow stem borer *Tryporyza incertulas* Wlk. eggs was conducted in 1979 in southern Sri Lanka. Parasites were reared from egg masses in June-July and November-December, during the major cultivation seasons. Parasitization of yellow borer egg masses averaged 88%. The parasites were identified from IBP Handbook 14 as *Trichogramma minutum* Riley,

Parasitization of yellow stem borer egg masses in southern Sri Lanka, 1979.

Location	Egg masses	
	Total sampled (no.)	Parasitization (%)
Kamburupitiya	37	86
Matara	26	81
Ambalantota	26	81
Kekanadura	69	97
Denipitiya	13	77

Tetrastichus schoenobii Ferr, *Tetrastichus israeli* M. & K, *Telenomus dignus* Gahan. *T. dignus* was the most prevalent species, occurring on more than 65% of the total egg masses counted (see table). ■

Survival of rice bug *Leptocorisa oratorius* on graminaceous weeds during the fallow period between rice cropping in Sri Lanka

Rohan H.S. Rajapakse and Varuni L Kulasekera, Agronomy Department, Faculty of Agriculture, Ruhuna University, Matara, Sri Lanka

The rice bug *Leptocorisa oratorius* in both the nymphal and adult stage prevents rice grain formation by sucking the milky juice of developing grains. The ability of the pest to survive on an alternate host poses a major problem in control strategies. A survey was carried out to find the alternate hosts of the rice

bug in southern Sri Lanka. The pest was detected feeding on graminaceous weeds, and laboratory trials on the insect's survival on the following weeds gave positive results: *Panicum repens, Panicum maximum, Echinochloa crus-galli, Echinochloa colona, Dactyloctenium aegyptium, Alloteropsis cimicina, Axonopus affinis, Chloris barbata, Paspalidium punctatum, Brachiaria miliiformis, Brachiaria mutica, Ischaemum muticum, Setaria glauca, Bothriochloa pertusa, Eleusine indica, Dicanthelium clandestinum.*

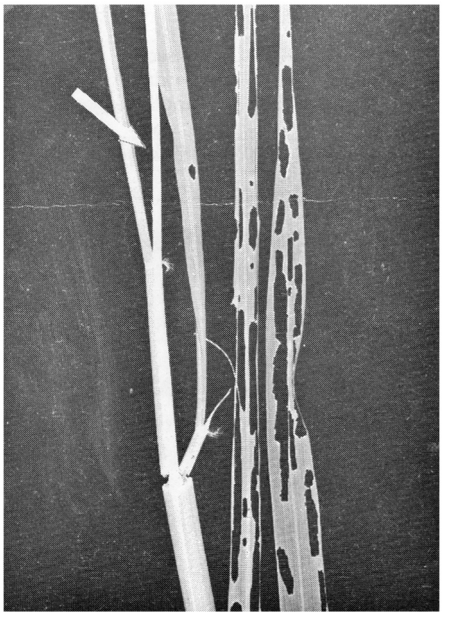
The weed population on bunds and in the rice paddies could facilitate insect survival and help continue its life cycle, especially during the off-season. The insect survived during the off-season of rice cropping (Jul-Sep) soon after the yala season (Apr-Jul) and before the maha season (Nov-Feb) which are the main rice cropping seasons in Sri Lanka, Since weeds grow in rice fields throughout the year, eliminating them on bunds and rice fields will help in effective insect pest management. ■

Euscyrtus concinnus (Orthoptera: Gryllidae) – a new rice pest in the Philippines

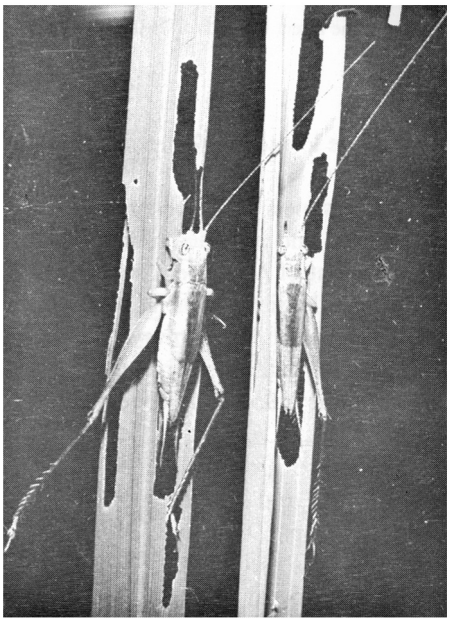
Alberto T. Barrion, research assistant, and J.A. Litsinger, entomologist, International Rice Research Institute

A survey of irrigated rice fields in Batangas province revealed the occurrence of a leaf- and stem-feeding gryllid recently identified as *Euscyrtus concinnus* de Haan (Orthoptera: Gryllidae). This is the first account of the insect as a rice pest in the Philippines.

E. concinnus makes irregular to longitudinal holes in the leaves, leaving the margins almost intact. Intense stem feeding sometimes causes deadhearts (photo 1). An average of 18-34 nymphs and adults/m^2 were found during November. Although both are pestiferous, the nymphs cause more damage than adults and prefer to feed on seedbeds and transplanted rice. The pest does not generally attack the rice plant beyond 75 days after transplanting, but in the absence of alternate hosts or young rice plants, it may feed on the very young rice panicles.



1. Damage on the stem (resulting in deadheart) and leaves caused by feeding of *E. concinnus* nymphs and adults.



2. Adults of *E. concinnus.* female (left) and male (right).

The following grasses and sedges were observed to be alternate hosts: *Echinochloa* spp., *Dactyloctenium aegyptium* (L.) Beauv., *Cyperus rotundus* L., *Digitaria sanguinalis* (L.) Scop., *Eleusine indica* (L.) Gaertn., *Paspalidium flavidum* (Retz.) A. Camus, and *Rottboellia exaltata* L.f.

The adults (photo 2) are 1-1.8 cm in length and pale brown in color, with long antennae and legs that easily detach from the body. The females are longer than the males and can easily be distinguished by their long, spear-shaped ovipositor. This species is also recorded in India, Thailand, and Bangladesh as a pest of rice. ■

Stylectomy of plant-sucking insects using a YAG laser to collect rice phloem sap

Susumu Kawabe, Rice Research Division, lohoku National Agricultural Experiment Station, Omagari, Akita 014-01 Japan; Tomoyoshi Fukumorita and Mitsuo Chino, Faculty of Agriculture, University of Tokyo, Bunkyo-ku, Tokyo 113, Japan

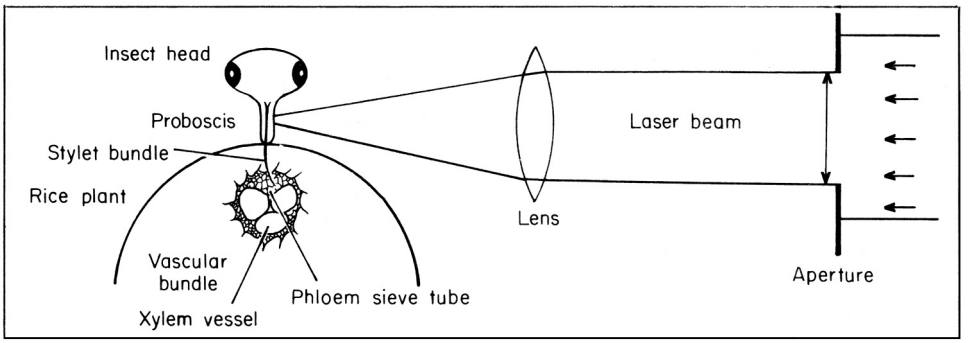
The lack of technique to selectively collect phloem sap from the rice plant has hampered investigation of the chemical basis of plant resistance to planthoppers and leafhoppers.

The use of YAG (Yttrium Aluminum Garnet) laser made it possible to sever the stylet bundle (stylectomy) of the brown planthopper *Nilaparvata lugens* and green leafhopper *Nephotettix cincticeps* while in the process of probing the rice plant. This allowed pure rice phloem sap to be collected from the excised stylets for the first time.

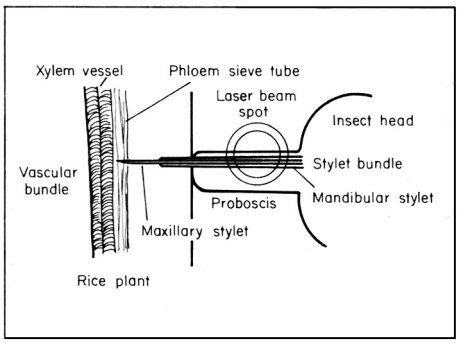
The laser beam (energy 0.1 joule and pulse width 0.2 m sec) emitted from the YAG laser system (Toshiba Inc., model LAY-508, wavelength 1.064 μm) was focused by a condensing lens and hit the proboscis of the insect feeding on the rice leaf sheath (Fig. 1). An aperture reduced the diameter of the beam so that the beam spot on the proboscis at the focal point in front of the lens was about 0.13 mm in diameter (Fig. 1,2).

An optical apparatus was attached to the system to display the image of the probing insect on the plant onto a cathode ray tube. By observing this image, the focused beam was aimed to hit the upper portion of the proboscis where the stylets are located (Fig. 2). The beam is also aimed to hit the halfway point of the proboscis between the plant tissue and the head of the insect.

Almost every pulsing successfully



1. Diagrammatic representation of a cross section of the rice plant. the insect head, and YAG laser beam focused on proboscis for stylectomy.



2. Diagrammatic representation of a longitudinal section of the rice plant, the insect mouthparts showing the proboscis, the stylets, and the laser beam spot. The stylets reach the sieve tube.

severed the stylet bundle without injuring the semitransparent stylet sheath (which did not absorb the beam). Phloem sap exuded from the cut end of stylets embedded in the phloem sieve element. The electronic measurement of insect feeding behavior (EMIF) improved by Kawabe and McLean in 1980 was useful for determining the tissue in which the stylets were located at the moment of amputation.

Severed stylets of *N. lugens* were more firmly fixed and provided more phloem sap than that of *N. cincticeps.* Turgor pressure in the sieve element often forced out the stylets of *N. cincticeps.*

The senior author is currently collecting the phloem sap of resistant and susceptible rice plants through the cut stylets of *N. lugens* to determine the chemical bases of resistance. Besides its use in entomological studies, stylectomy with the YAG laser would help plant pathologists studying disease transmission by sucking insects. ■

Effectiveness and economics of granular insecticides for control of hispa

K. Budhrqja, R. R. Rawat, and O. P. Singh, Entomology Department, J. N. Agricultural University, Jabalpur, Madhya Pradesh, India

The effectiveness of five granular insecticides – quinalphos 5G, thiodemeton 5G, carbofuran 3G, phorate 10G, and disulfoton 5G – for control of hispa *Dicladispa armigera* (Oliv.) was assessed in the 1978 wet-season rice crop at Jabalpur. The factors measured were population of adult hispa beetles, percentage of leaf damage, and height and length of tillers. The adult beetle population was assessed by visual counts of 10 random hills in each plot. Net profit was determined by subtracting the cost of insecticide application from the income from increased yield at $136.47/t.

The granules were applied to Ratna in standing water at 1.5 kg a.i./ha 38 days

Relative performance of some granular insecticides against adults of *D. armigera,* Jabalpur, Madhya Pradesh, India, 1978.[a]

Treatment	Adult population (av no./10 hills)				Damaged leaves (%)				Yield (t/ha)	Cost of insecticidal application ($/ha)	Net profit ($/ha)
	Pre-treatment	Post-treatment			Pre-treatment	Post-treatment					
		10 days	20 days	30 days		10 clays	20 days	30 days			
Quinalphos	3.8 (1.9)	7.5 (2.8)	1.3 (1.2)	0.0 (0.7)	15.2 (22.8)*	19.9 (26.1)*	6.5 (13.9)*	3.1 (9.6)*	2.0	70.89	19.49
Thiodemeton	4.0 (2.3)	2.5 (1.6)	0.0 (0.7)	0.0 (0.7)	16.0 (23.4)*	9.0 (17.3)*	4.9 (12.5)*	1.1 (5.0)*	2.2	50.43	56.02
Carbofuran	3.0 (1.8)	0.0 (0.7)	0.0 (0.7)	0.0 (0.7)	13.7 (21.7)*	5.8 (13.2)*	1.6 (6.2)*	0.2 (1.7)*	2.3	74.97	45.12
Phorate	5.3 (2.3)	3.0 (1.8)	0.8 (1.1)	0.0 (0.7)	17.9 (25.0)*	8.3 (16.4)*	4.2 (**1** 1.4)*	2.4 (8.9)*	2.0	43.09	35.41
Disulfoton	3.8 (1.9)	0.0 (0.7)	0.3 (0.8)	0.0 (0.7)	10.3 (18.5)*	8.5 (16.5)*	4.0 (10.9)*	1.8 (7.6)*	1.9	54.66	18.24
Control	3.0 (1.6)	7.0 (2.7)	26.3 (5.1)	20.5 (4.4)	17.4 (24.4)*	48.6 (44.6)*	67.5 (56.7)*	82.0 (71.2)*	1.4	0.00	0.00
S.Em.	0.394	0.211	0.213	0.272	1.66	3.80	4.15	4.81	0.13	–	–
C.D. at 5% level	N.S.	0.640	0.640	0.820	N.S.	11.44	12.50	14.51	0.40	–	–

[a] ( ) = $\sqrt{x + 00.5}$; ( )* = mean of percentages transformed to angle; N.S. = not significant.

after transplanting – just as adult beetles were migrating from adjacent heavily infested fields and beginning to infest the crop.

Carbofuran-treated plots had no *D. armigera* population throughout the 30-day experimental period (see table) and yielded the highest (2.3 t/ ha), although the insecticidal treatments did not give statistically different yields. The minimum number of damaged leaves was found in the carbofuran treatment, but treatments again did not differ significantly. Thiodemeton gave the highest net profit ($56.02/ha). ■

Infuence of ammonium phosphate levels rice leaf roller incidence

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The rice leaf roller Cnaphalocrocis medinalis Guenée (Lepidoptera; Pyralidae) seriously damaged rice plants in a fertilizer experimental plot at Ubon Rice Experiment Station, Rice Fertilizer Branch (Rice Division), in northeastern Thailand during the 1979 wet season. The experiment was in a randomized complete block design with 4 replications and 14 ammonium phosphate (16-20-0) levels. Twenty-eight-day-old seedlings of RD2 rice were transplanted in 3- x 5-m plots. Half the fertilizer with 37.5 kg K_2O/ ha was basally applied and the rest was applied 30 days after transplanting.

Effect of nitrogen fertilizer levels on rice leaf folder damage, Ubon Rice Experiment Station, Thailand, 1979.

Nitrogen treatment (kg/ha)	Damaged leaves[a] 52 DT (%)
0	5.4 a
15	9.4 ab
30	10.2 ab
45	14.1 abc
60	12.8 abc
75	22.9 bcd
90	26.5 cd
105	33.2 d
120	34.3 d
135	33.1 d
150	52.8 e
165	62.2 e
180	56.9 e
195	64.2 e
C.V. = 37.0%	

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

The leaves damaged by the leaf roller and those undamaged on 30 hills randomly selected from each plot were counted.

The result showed that the percentages of damaged leaves rose proportionally with increasing nitrogen levels from 0 to 195 kg N/ ha (see table). At 0 nitrogen the damaged leaves were only 5.34% while at 195 kg N/ ha the damage was greatest (64.2%). The percentage of damaged leaves sharply increased at 75 kg N/ ha level and was siginificantly different from that in the untreated control treatment.

Increased outbreaks of the rice leaf roller and other rice insects in recent years were believed related to increased use of nitrogenous fertilizer among farmers. How nitrogenous fertilizer affects the insect is not known. It has been reported the insect would oviposit more on dark-green rice plants than on greenish or yellow ones. ■

Soil and crop management

Effect of liming on the control of green algae in blue-green algae multiplication fields

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Green alga (GA) is a problem in paddy fields because it chokes the crop in initial stages, retarding tillering and removing considerable quantities of applied nitrogen. GA are becoming a problem in fields where blue-green algae (BGA) are multiplied. GA appear earlier and grow more luxuriantly in red or sandy soils than in clay soils. Lime, which is commonly used to control GA, was tested for algae control in BGA multiplication units.

Superphosphate fertilizer was applied at 50 g/m^2. For pest control 25 g of carbofuran 3% G was applied to each plot. Water was maintained continuously at 5 cm. The field was rich in BGA inoculum, so no fresh seed material was applied. Lime was applied at 1,250 - 10,000 kg/ ha with graded increases of 1,250/ kg. The BGA yield was measured

Yield of blue-green algae (BGA) and information on it and on green algae (GA). Aduthurai, India.

Levels of lime (kg/ha)	BGA yield (kg/m^2)	Appearance of GA (days after experiment initiation)	Types[a] of RGA in descending order of abundance
1,250	0.64	23	Ao, Ad, M1, Cm, Afu
2,500	0.52	21	Ao, Cm, M1, Ad, Afu
3,750	0.42	18	Ao, Ad, M1, Cm
5,000	0.29	16	Ao, Ad, M1
6,250	0.16	13	M1, Ao, Ad
7,500	0.10	10	M1, Ao
8,750	0.07	9	M1
10,000	0.05	9	M1
Control	0.17	28	Ao, Ad, M1, Afu
CD	0.055		

[a] Ad = *Anabaena doliolum,* Afu = *Anabaena fuelleborni,* Ao = *Anabaena oscellarioides,* Cm = *Cylindrospermum muscicola,* M1 = *Microcoleus lacustris.*

on the 20th day (see table).

Even low lime levels of 1,250 kg/ha inhibited BGA growth significantly; BGA inhibition increased as lime increased.

Contrary to general belief, lime application did not control GA in the BGA multiplication units (see table). ■

Response of rice varieties to zinc treatment in farmers' fields at DND irrigation project, BWDB, Bangladesh

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Zinc deficiency in Bangladesh rice fields seems to be more acute in the irrigated areas (where the lands are kept wet for longer periods than in other areas) and in calcareous soils. In 1979, zinc deficiency was suspected in the BRRI-BWDB collaborative cropping systems research site at Shimrail in the DND irrigation project of the BWDB. A superimposed zinc treatment used 2% ZnO solution as seedling dip for 4 rice varieties grown by farmers in the area. Crop-cuts were made and grain yields adjusted at 14% moisture to determine the effect of zinc treatment on grain yield. 1R8 responded tremendously to zinc treatment, yielding an extra 1.1 t/ha over the control (see table). The response of the local varieties to zinc application, in terms of increased grain yield, was only 0.1 t/ha. Studies on the problem are being continued. ■

Effect of dipping roots of rice seedlings in 2% ZnO on yield at Dacca-Narayanganj-Demra irrigation project, BWDB. 1979 transplanted aman season, Bangladesh.

Variety	Grain yield (t/ha)		
	With zinc	Without zinc	Difference
IR8[a]	3.8	2.7	1.1
Pajam[b]	3.0	2.9	0.1
Nizersail[b]	3.4	3.3	0.1
Pagu[c]	3.2	3.1	0.1

[a] Av of trials in 3 plots. [b] Av of trials in 2 plots. [c] Trial in 1 plot.

Role of direct-seeded rice in Sudan Gezira crop rotation

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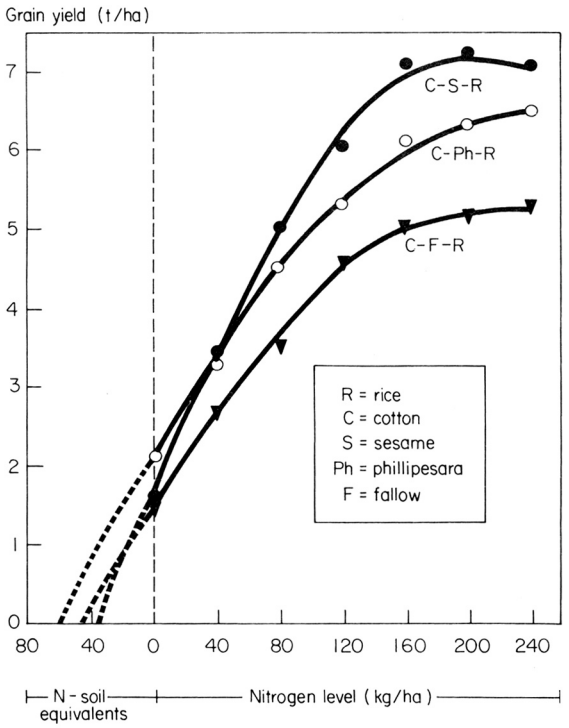
Rice is cultivated in the Sudan Gezira as an irrigated, direct-seeded crop in a four-course rotation (cotton-wheat-groundnuts-fallow). Although the role of rice in this rotation has not been investigated in depth, the current practice is to grow rice instead of groundnuts or fallow. Apparently, this practice is not very appropriate because numerous studies carried out at GRS have shown that the soil nitrogen content is usually too low to sustain a rice crop under these conditions, considering the high nitrogen losses in this environment. Therefore, relatively high rates of nitrogen fertilizers are required to attain high rice yields; 140 kg N/ha is considered as the optimum level for rice. Furthermore, there are some indications that a preceding crop does not influence rice performance solely through its effects on soil nitrogen content but, even more important, through effects on soil physical and chemical characteristics.

IR2053-206-1-3-6 was grown at seven nitrogen levels after phillipesara, sesame, and fallow at GRS for three seasons, 1977-79. The nitrogen treatments were arranged in four replications in a randomized complete block design.

Rice yields increased progressively and significantly ($P = 0.001$) with increased nitrogen levels up to 160 kg N/ha. Beyond that level, yield increases were nonsignificant. But rice yield potentials differed greatly: 7.0 t/ha after sesame, 6.1 t/ha after phillipesara, and 5.0 t/ha after fallow. The increases in grain yield with an increase in applied nitrogen were generally similar in each rotation. The beneficial effects of sesame as an excellent precursor to other crops in the Sudan's central rain lands and of phillipesara in the Gezira were well established. From extrapolation of the results (see figure), it appears that only phillipesara increased soil nitrogen content. But because the application of higher nitrogen levels did not compensate for the differences in observed yield potentials, a preceding crop's influence on rice may be due to other physical or chemical soil properties. Integration of rice in a suitable rotation currently dominated by other crops is an important consideration. ■



Response of IR2053-206-1-3-6 grown as irrigated direct-seeded crop after phillipesara, sesame, and fallow at different nitrogen levels. Gezira Research Station, Sudan, 1977—79.

Effect of phosphorus fertilization on "priming" of native phosphorus by rice in acid soils of Assam

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Four typical rice-growing soils of Assam received three levels of phosphorus under continuous submergence and continuous moist conditions in the greenhouse. The uptake of soil phosphorus was determined by radiochemical analysis. The quantity of "primed native phosphorus" was calculated:

$$\text{"Primed native phosphorus" (uptake in mg/pot)} = [(\text{Total-P uptake} - {}^{32}\text{P tagged fertilizer-P uptake}) - \text{Soil-P uptake (control plot)}]$$

Fertilization with phosphorus as superphosphate increased the dry matter yield of rice and phosphorus (see table) uptake. The contribution of superphosphate not only was direct but was due to its "priming effect" on the uptake of native soil phosphorus — probably by helping in the early vigorous growth of roots to exploit more soil. Under continuous submergence, the quantity of primed soil phosphorus of different levels of phosphorus fertilization was significant compared to the fertilizer phosphorus uptake by the crop at those levels. The results suggest that fertilizer phosphate application under continuous submergence is a beneficial practice that allows use of the immobilized soil phosphorus by the rice crop. ■

Quantity of "primed native soil phosphorus" at various rates of phosphate fertilization (SSP)[a] under different moisture regimes during 1978. India.

Location	Uptake of "primed native soil phosphorus" (mg/pot) by the rice crop								
	Continuous submergence (M1)			Continuous moist (M2)			Av of M1 + M2		
	P1	P2	Mean of P1 + P2	P1	P2	Mean of P1+ P2	P1	P2	Mean of P1+ P2
Titabar	23.76	33.15	28.45	8.80	7.40	8.10	16.28	20.28	18.28
Dergaon	19.76	48.31	34.03	5.32	5.07	5.19	12.54	26.69	19.61
Golaghat	31.07	24.17	27.62	1.36	1.20	1.28	16.22	12.69	14.45
Tengakhat	31.06	33.58	32.32	10.60	7.65	9.13	20.83	20.61	20.72
Mean for all soils	26.41	34.80	30.61	6.52	5.33	5.93	16.47	20.07	–

[a] SSP = single superphosphate. Phosphorus levels were P1 (60 kg P_2O_5/ha) and P2 (120 kg P_2O_5/ha). The rice was Pusa 2-21.

Rice-based cropping systems

Effect of rainfall pattern on the shift in farmers' rice cropping patterns in Bangladesh

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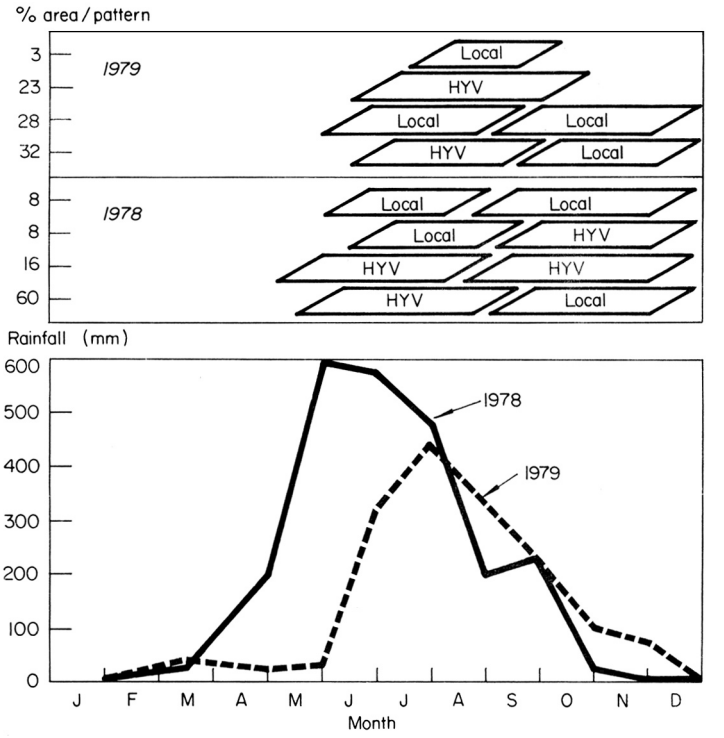
A severe and prolonged drought in 1979 affected the cropping patterns and crop yields in many areas of Bangladesh. The rainfall pattern and the cropping patterns that farmers followed were monitored at a rainfed, double-rice crop (aus-T. aman) cropping systems research site at Bhogra, Joydebpur, Dacca, and compared with those of 1978.

The 1978 rainfall pattern was normal and unimodal (see figure). The fields received enough rainfall by April to



Rainfall pattern and farmers' rice cropping patterns in 1978 and 1979 at a rainfed double-rice-crop area, Bhogra, Joydebpur, Dacca, Bangladesh. Areas of other cropping patterns are not shown in figure (1978 = 8%, 1979 = 14%). HYV = high yielding varieties.

enable the farmers to transplant the first rice (aus) crop. The farmers grew a double rice crop on 92% of the area. Sixty percent of the area was planted to a high yielding variety (HYV) aus rice — local t. aman rice followed by a pattern of HYV aus—HYV t. aman (16% of the area). In 1978, the ratio of land under HYV and local varieties was 10:8.4.

In 1979 an early season drought lasted until June. The total rainfall in 1978 and 1979 were 2,389 mm and 1,668 mm. Precipitation was higher (182 mm) in the last 3 months of 1979 than in that period in 1978 (12 mm). Although the HYV aus—local t. aman pattern remained the main cropping pattern in 1979, its area decreased to 32%. The hectarage under the local aus—local t. aman pattern increased from 8% in 1978 to 28% in 1979. The HYV aus—HYV t. aman and local aus—HYV t. aman pattern used in 1978 completely disappeared in 1979, and a new cropping pattern emerged —a single HYV or local rice crop. The delayed onset of the 1979 rains delayed the start of the first crop, which ultimately affected the entire cropping pattern, often making a second rice cro impossible. The ratio of HYV to local variety hectarage in 1979 was 5.5:9.1.

The experience left a challenge for cropping systems scientists: to develop suitable alternative cropping patterns for suboptimum weather conditions. ■

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