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Style for IRRN Contributors

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

- 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.
- 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.
- Type all contributions double spaced.
- Indent first lines of each paragraph.
- Do not hyphenate words at the end of a line.

Genetic evaluation and utilization

OVERALL PROGRESS

The origin of semidwarf genes

Lu Yung-Ken, associate professor of genetics, Agronomy Department, South China Agricultural College, Kwangchow (Canton), People's Republic of China

The first Chinese semidwarf variety Ai-chiao-nan-te was derived from Nan-te 16. Most workers believe that it was the result of spontaneous mutation. The semidwarf gene of Ai-tsai-chan has not yet been studied in detail. As for Dee-geo-woo-gen, the records of Taiwan Fang-Chih (an 1871 book of local history) mention a rice variety called "Woo-gen" (which means brown apiculus) that was introduced from Fukien province; however, not one of the rice varieties had a name beginning with "Deo-geo," "I-deo," or "Hsia-geo" (all those prefixes mean "dwarf"), indicating that no dwarf variety was grown at that time. In 1906 both "Deo-geo-woo-gen" and "Woo-gen" appeared in the survey records of the Taipei agricultural experiment station the first clear indication of the existence of the semidwarf variety. Therefore, Dee-geo-woo-gen is generally assumed to have derived directly as a dwarf spontaneous mutant from Woo-gen Another possibility is that a semidwarf gene caused by spontaneous mutation first appeared in some other varieties, then was transmitted to Woo-gen through a natural cross.

Interestingly, except two from mainland provinces, the semidwarfs identified so far come from Taiwan province. Semidwarfs that originated from Taiwan include Dee-geo-woo-gen, I-geo-tze, Ti-chueh-hua-lo, Ai-chueh-ching-yu, and Ai-chueh-chan. Perhaps because typhoons often strike Taiwan, lodging resistance tends to be particularly important.

The semidwarf gene may have been conserved through natural and artificial selection. Rice productivity was low in old China. For example, average annual yields in Kwang tung province were less than 3 t/ha. The heavy-panicle-type varieties were adaptable to low-fertility conditions. Because the correlation between heavy panicles and long culms is highly significant, any semidwart mutant that might have existed at that time would not have been selected and conserved. ■

Semidwarf gene sources of rice in China

Lu Yung-Ken, associate professor of genetics, Agronomy Department, South China Agricultural College, Kwangchow (Canton), People's Republic of China

Until the 1950s, almost all the rice varieties grown in China were tall. Breeding for semidwarf rice varieties first started in 1956, when two farmers in Chao-yang County, Kwangtung Province, found a semidwarf plant in a plot of the tall indica variety Nan-te 16. That single semidwarf plant, which may have originated through spontaneous mutation, was selected. After thorough testing it was released as Ai-chiao-nan-te, the first semidwarf high yielding rice variety on mainland China. Its desirable features were its short culm, short and erect leaves, profuse tillering, heavy panicles, and high fertilizer response. Its average yield was 6 t/ha.

Ai-chiao-nan-te's popularity stimulated keen interest in semidwarf development. In 1957 the Kwangtung Academy of Agricultural Sciences used Ai-tsai-chan, a local semidwarf variety from Kwangsi Province, as the female parent in crosses with Kwang-chang 13 and Hui-yang-chen-chu-chao. The Academy named two progenies as the varieties Kwang-chang-ai and Chen-chu-ai in 1959 and 1962. By 1965, two semidwarfs were grown on about 160 million ha in China. They were extended throughout southern China in 1967. Their important characteristics, along with that of Dee-geo-woo-gen of Taiwan Province, are in Table 1.

Table 1. The main characteristics of Ai-chiao-nan-te, Ai-tsai-chan, and Dee-geo-woo-gen.[a] China.

Designation	Origin	Maturity (days to heading)	Plant (cm)	Panicles (no./plant)	1000-grain wt (g)	Grain/panicle	Hulled grains Length (mm)	Hulled grains Width (mm)	Hulled grains Length-width ratio
Ai-chiao-nan-te	Chao-yang County, Kwangtung Province	Early (73 days)	75.9	18.2	26.8	101.0	8.6	3.1	2.77
Ai-tsai-chan	Junghsien County, Kwangsi Province	Medium (101 days)	94.9	18.7	24.6	154.9	8.6	3.2	2.69
Dee-geo-woo-gen	Taiwan or Fukien Province	Medium-late (107 days)	102.0	15.3	27. I	161.8	8.3	3.2	2.59

[a] Seeded on 11 March and transplanted on 11 April. Plant spacing = 40 x 20 cm.

Ai-chiao-nan-te, Ai-tsai-chan, and Dee-geo-woo-gen, have been used in the breeding of almost all modern high yielding rice varieties (Table 2). ■

Table 2. The genealogical relations among the Chinese semidwarfs.

Important varieties	Direct or indirect derivatives of
Kwang-chang-ai, Chen-chu-ai, Kwang-lu-ai 4, Nanking 11	Ai-tsai-chan
Lung-Ke 113, Kwang-Hsuan 3, Te-ku-ai 31	Ai-chiao-nan-te
Er-chiu-ai, Hung-mei-Tsao, Er-chiu-nan 1	Both Ai-chiao-nan-te and Ai-tsai-chan
TN1, Taichung Sen 2, Kaohsiung Sen 2	Dee-geo-woo-gen[a]

[a] Virtually all semidwarf varieties developed at IRRI and in national rice improvement programs are also derivatives of Dee-geo-woo-gen.

Genetic analysis of dwarfism in Chinese rices

Lu Yung-Ken, associate professor of genetics, Agronomy Department, South China Agricultural College, Kwangchow (Canton), People's Republic of China

Parnell and associates were the earliest (1922) to conduct genetic analysis on rice dwarfism. In 1925 Akemine carried out a detailed genetic analysis of three dwarf mutants — Daikoku, Ebisu, and Kodaikoku—which had been isolated from the normal variety Akage. He pointed out that tallness was dominant to dwarfness and that the three dwarf mutants resulted from the interaction between two pairs of complementary genes. That type of dwarf mutant still cannot be used in breeding programs because of complicated inheritance and undesirable traits.

Semidwarfs used as parent materials in current rice breeding programs are generally about 75 to 100 cm tall. I shall present some of my genetical research work on dwarfism. Between 1976 and 1977, three semidwarf varieties were crossed with the same tall male parent. Leng-shiu-ma (a local variety from Hunan Province).

The height of the F_2 populations of the three crosses was greater than the mean height of their parents, but slightly less than that of the tall parent (Table 1), which shows the incomplete dominance of tallness.

The variation in plant height among F_2 populations of the various crosses was continuous, but all F_2 populations were characterized by a bimodal distribution.

Table 1. Plant height of F_1 and parents of various crosses.

Cross	Plant ht (cm)						Expression
	Female parent		F_1Male		parent		
	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$	
Ai-chino-nan-te/Leng-shui-ma	10	77.0	5	129.1	10	136.7	incomplete dominance
Ai-tsai-chan/Leng-shui-ma	10	68.0	8	125.6	10	136.7	”
Dee-geo-woo-gen/Leng-shui-ma	10	83.0	7	130.3	10	136.7	”

Table 2. The segregation ratio of plant height in F_2 of various crosses. Kwangchow, 1977.

Cross	Plants (no.)			Ratio (T:D)	X^2	P
	Tall form	Dwarf form	Total			
Ai-chiao-nan-te/Leng-shui-ma	210	62	272	3:1	0.75	0.50–0.30
Ai-tsai-chan/Leng-shui-ma	202	70	212	3:1	0.08	0.80–0.70
Dee-geo-woo-gen/Leng-shui-ma	210	62	272	3:1	0.75	0.50–0.30

So two rather distinct classes were considered to exist within the population.

Furthermore, transgressive segregation for plant height was observed in the F_2 population of various crosses. The occurrence of transgressive individuals indicates that, besides the major gene, some modifiers control semidwarfism. Those modifiers may exhibit positive or negative action. Segregation and recombination among modifiers result in the appearance of transgressive individuals.

The segregation between tall and dwarf forms in various crosses, when tested by *chi* square, coincides with a 3:1 ratio (Table *2).* That indicates that the semidwarfism of Ai-chiao-nan-te, Ai-tsai-chan. and Dee-geo-woo-gen is largely conditioned by a single pair of recessive genes. Our results agree with IRRI's findings of 1964–65.

GENETIC EVALUATION & UTILIZATION

Grain quality

A note on alkali test of rice using a petri dish

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The alkali-degradation test is popular for evaluation of rice quality. In the original method that Little, Hilder, and Dawson developed in 1958, a special plastic box was used in conducting the test. But because the boxes were neither easily available nor essential, researchers generally use a pair of petri dishes instead. The differences in geometry and size, however, require that the volume of KOH solution to use with the petri dish be carefully considered — a point that researchers have often ignored.

Three aspects should be considered: 1) the volume of alkali solution per grain, 2) the depth of alkali in the container, and 3) the surface area available per grain. Attention has usually been paid only to the first aspect, which is erroneous.

The scores of several rice samples in 7-cm-diameter petri dishes were compared with those obtained with the use of the original Little et a1 (1958) method, the revised Bhattacharya and Sowbhagya (1972) method, and several possible alternatives (see table). The scores in methods IV-A and IV-B were essentially lower than those in the two reference methods (I and II). The scores of the rest were essentially identical. The depth of alkali solution in the container is clearly the crucial factor. Once the depth is optimal, the volume of alkali per grain can vary fairly widely with no effect.

The other consideration is the available surface area per grain. In the revised procedure of Bhattacharya and Sowbhagya, the total diameter of the degraded grain mass is an important scoring criterion. In the final stages of degradation (scores 5–8), the degraded grain mass assumes a mean diameter of about 20 mm. To score by this method, therefore, sufficient area (πr^2) must be available for each grain to occupy a space of about 3.14 cm^2. Allowing for vacant intergrain space, that means that a 7-cm-diameter dish can accommodate not more than 7 (or at most 8) grains (see figure). That is why methods I, IV-C, V, and VII gave essentially identical extents of grain degradation. but were nevertheless insufficient for correct scoring of samples showing high degradation. In the limited space available, the collars merged so the correct mass diameter could not be measured.

It was concluded that for interlaboratory comparison using petri dishes of varying sizes for the alkali test, the two essential conditions are: 1) that sufficient alkali solution is added to maintain a liquid depth of 4.5 mm in the

Comparison of alkali test results under different test conditions[a], Karnataka, India.

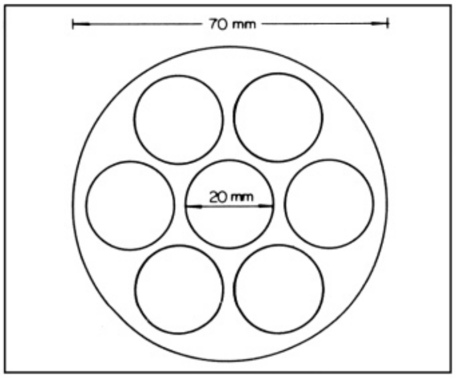
Testing method	Test condition					Result[a]
	KOH used (ml)	Grains (no.)	Depth of KOH (mm)	M1KOH/ grain	Cm^2/ grain	
I. Original box method[b]	10	6	4.4	1.7	3.8	(OK)
Petridish methods[c]						
II. Reference method[d]	20	6	5.0	3.3	6.7	OK
III. Excess alkali/grain	20	3	5.0	6.7	13.3	OK
IV. Volume/grain constant						
A	10	6	2.5	1.7	6.7	No
B	15	9	3.8	1.7	4.5	No
C	20	12	5.0	1.7	3.3	(OK)
V. Area/grain constant	20	10	5.0	2.0	4.0	(OK)
VI. KOH depth/grain constant	18	6	4.5	3.0	6.7	OK
VII. Volume, area, depth constant	18	10	4.5	1.8	4.0	(OK)
VIII. Suggested	18	7	4.5	2.5	5.7	OK

[a] OK = gives correct score; (OK) = correct at low scores, but incorrect at high scores for the available area is insufficient for optimal spreading; No = score is too low.

[b] Little, Hilder, and Dawson (Cereal Chem. 35, 111, 1958). Plastic box 4.75 × 4.75 × 0.75 cm used. Total area, 23 cm^2.

[c] Petri dish with a 7-cm diameter was used. Total area is 40 cm^2. Volume refers to that of the alkali solution. Constant means condition identical to that in the original box method.

[d] Bhattacharya and Sowbhagya (J. Food Technol. 7, 323, 1972).



Bhattacharya alkali test of rice

dish, and 2) that the number of grains per dish should be such as to leave a minimum mean space of 5–6 cm^2/grain. Once these conditions are met (it is immaterial if the limits are slightly exceeded), the volume of alakali per grain can be ignored. We have been using reference method II in our routine work. However, alternative VIII might be optimal, because it is closest to the original Little et al method (I) while allowing sufficient space for maximum kernel spreading. ■

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GENETIC EVALUATION & UTILIZATION

Disease resistance

Varietal reaction to the kresek phase of bacterial blight

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Bacterial blight of rice caused by *Xanthomonas oryzae* exhibits two distinct types of symptoms: leaf blight and kresek or wilt. Leaf blight occurs in almost all of rice-growing India. Kresek is occasionally observed in experimental plots and in farmers' fields, particularly in isolated patches. Although kresek is more severe than leaf blight. information on it is limited. Therefore a study was initiated to artificially induce the disease and investigate the susceptibility of some popular rice varieties.

The roots of 15-day-old TN1 seedlings were washed thoroughly. The root tips were finely trimmed with scissors and dipped for 30 minutes in a 48-hour-old bacterial suspension (about 10^9 cells/ml) grown on potato sucrose agar medium. The treated seedlings were transplanted in pots. Wilting symptoms began to appear 10 days after inoculation and continued appearing up to 20 days, by which time the maximum number of seedlings had collapsed. But not all the inoculated seedlings exhibited kresek; some surviving plants exhibited leaf blight symptoms. Bacteria reisolated from the wilted leaves were confirmed to be *X. oryzae* on the basis of physiological characters and pathogenicity on rice plants.

Reaction of some rice varieties to kresek. Central Rice Research Institute. Cuttack, India.

Varieties	Wilted plants (%)
Lacrosse Zenith/Nira, Nagarbhog	0
BJ1, CO13, Krishna, Zukkoku, Sachikaze, Chinsurah Boro II, Raminad Str. 3, Kanto 51	2.0-8.5
TN1, Jamuna, Malagkit Sungsong, NP125, Cauvery, Kalinga I, Kalinga II, TKM6, Padma	10.0-18.5
IR8, Sigadis, Zenith, IR30, NC1281, Sona, Karuna, IR22, Katna, Kanchi, Rajeswari	22.0-38.5
Pusa 2-21, SLO 16, Jagannath, MTU 17, Supriya, IR24, Semora mangga, Pankaj. Sakti, Vijaya, Jaya	40.0-92.0

Sixty-four indica and japonica varieties were inoculated using the above method. Ninety-two percent of the plants of the variety Jaya wilted, and 70% of Tadukan and Vijaya plants died. The varieties Lacrosse Zenith/Nira and Nagarbhog showed no wilting symptoms, indicating high kresek resistance. Wilting was minimal (2-6%) in BJ1, Chinsurah Boro II, Krishna, and Zukkoku. But TN1, which is highly susceptible to leaf blight, has only 12% wilting (see table). That indicates that the varietal reaction to the leaf blight phase is not similar to that to the kresek phase. ■

Resistance to sheath blight disease in India

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One hundred and thirty-four entries from the International Rice Sheath Blight Nursery (IRSHBN), 30 cultures from the All India Coordinated Rice Improvement Project (AICRIP) program, Hyderabad, and 6 entries from local collections were tested for resistance to sheath blight from March to July 1978 at the Maduravoil Field Research Laboratory, University of Madras, Madras, India. Checks were the resistant IR20, the moderately resistant IR1487-194-5-3-2, and the susceptible Pankaj. The inoculum was autoclaved rice stem cuttings (about 3–4 cm) with 5% dextrose, inoculated with a virulent isolate of *Corticium sasakii* and incubated for 15 days. Among the methods tried, the stem-tape inoculation technique was the most efficient for artificial inoculation. The sheaths of 90-day-old plants were inoculated 5 cm above the water level. They were scored for reaction 12 days later when the disease intensity was maximum in most cultivars.

The following entries were rated as highly resistant and resistant.

Highly resistant: BR4-30-51-2, BR51-49-6, IR2796-44-2, ARC 5925, and ARC 5943.

Resistant: B1757d-Sm-6-1, B1757d-Sm-47-1, B1757d-Sm-47-3, B1757d-Sm-47-6, B1757d-Sm-50-6, B2012d-SM-52-1-2, BR51-26-10, BRS1-95-2, BR51-196-2, BR52-85-7, IET4154 (CR44-121-1), IET4834 (CR117-1), IET 5126 (RP661-12-4-4-2), IR20, IR532-1-18(S), 1R203.5-244-3-2-3, IR2053-200-4, IR2070-132-2-2-5, lR2070-747-6-3-2-1 (IR32), IR2071-588-4-4, IR2071-803-5-2-6, IR2071-843-1-1-6, IR2328-198-1-1-1, IR2793-97-3-2, IR2798-115-2-3, IR2817-117-2-1, IR2832-172-6-2, OR4422-98-3-6, IR4531-10057-5-1-1, IR4531-10057-5-1-2, A 15-100-1-3-1, ARC 10618, ARC 10836, DA 29, IR2071-648-4-4-6, IR3464-149-3-2, IR4641-143-1, Nizersail, Rajasail, Tabend, Ta-poo-cho-z, ARC 14342, ARC 14529, ARC 10572, TKM6, and Kattichamba. ■

Donors of bacterial blight resistance

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In 1978 kharif we screened 885 lines from our germplasm collection for bacterial blight resistance at the Kapurthala station. Ten plants of each line were inoculated with a pure culture of *Xanthomonas oryzae* by the clipping method, and scored 15 days later. Seventeen lines were found resistant (score of 3 on the Standard Evaluation System scale): Norin 18, Hokkaido, Tainan 3, Taichung 65, IR878B-45-1, IR9880, IR1712-166-1, IRl634-520-1-2, IR1614-605-3-4, Zinnya 31, CK10-152, Norin 18-LC-5, OR45-61-23, A/R-248, CP231, Chung-Lin-Chun, and Kachamota. Those lines are being used as resistance donors in the breeding program.

Of the others, 360 were scored 5; 456, 7; and 52, 9 (see table). ■

Distribution of scores of resistance donors of bacterial blight inoculated artificially at the Regional Rice Research Station, Kapurthala, Punjab, India.

Score[a]	Leaf area infested (%)	Collections	
		No.	%
1	1	0	0.0
3	1–5	17	1.9
5	5–25	360	40.7
7	25–50	456	51.5
9	50	52	5.9

[a] Standard Evaluation System scale.

Suggested revision of scoring system for rice sheath rot disease

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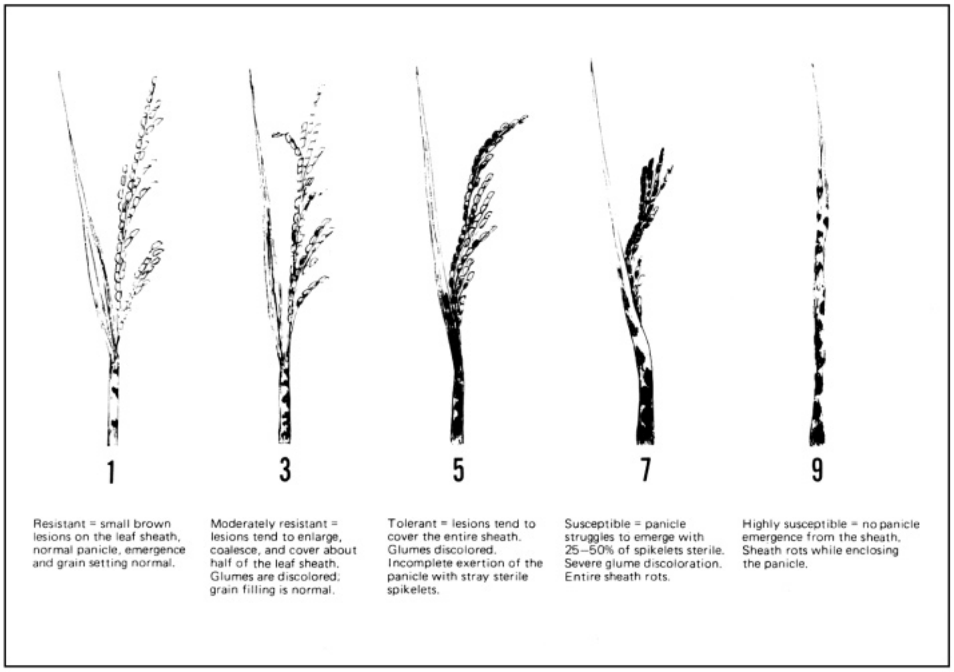
Many commercial varieties in the intensive rice-growing areas of India, especially in the rabi or late kharif crop, are susceptible to sheath rot disease caused by *Acrocylindrium oryzae.* To incorporate a high degree of resistance into high-yielding varieties, scientists need a systematic approach with a standard scale to screen germplasm and determine resistant genotypes.

The Standard Evaluation System designed by IRRI does not adequately identify resistant donors because the scale is based on the percentage of tillers affected. That gives insufficient information on resistance or susceptibility because if all tillers in a clump are infected to a low degree, we grade that genotype as "9" — regardless of panicle damage. Furthermore, the percentage of affected tillers shows the prevalence of the disease — not its severity.

A scale showing the coverage of lesions on the sheath and their effect on the emerging panicle would more appropriately identify the resistant lines.

We suggest the scale given in the figure. ■



Resistant = small brown lesions on the leaf sheath, normal panicle, emergence and grain setting normal.

Moderately resistant = lesions tend to enlarge, coalesce, and cover about half of the leaf sheath. Glumes are discolored; grain filling is normal.

Tolerant = lesions tend to cover the entire sheath. Glumes discolored. Incomplete exertion of the panicle with stray sterile spikelets.

Susceptible = panicle struggles to emerge with 25–50% of spikelets sterile. Severe glume discoloration. Entire sheath rots.

Highly susceptible = no panicle emergence from the sheath. Sheath rots while enclosing the panicle.

GENETIC EVALUATION & UTILIZATION

Insect resistance

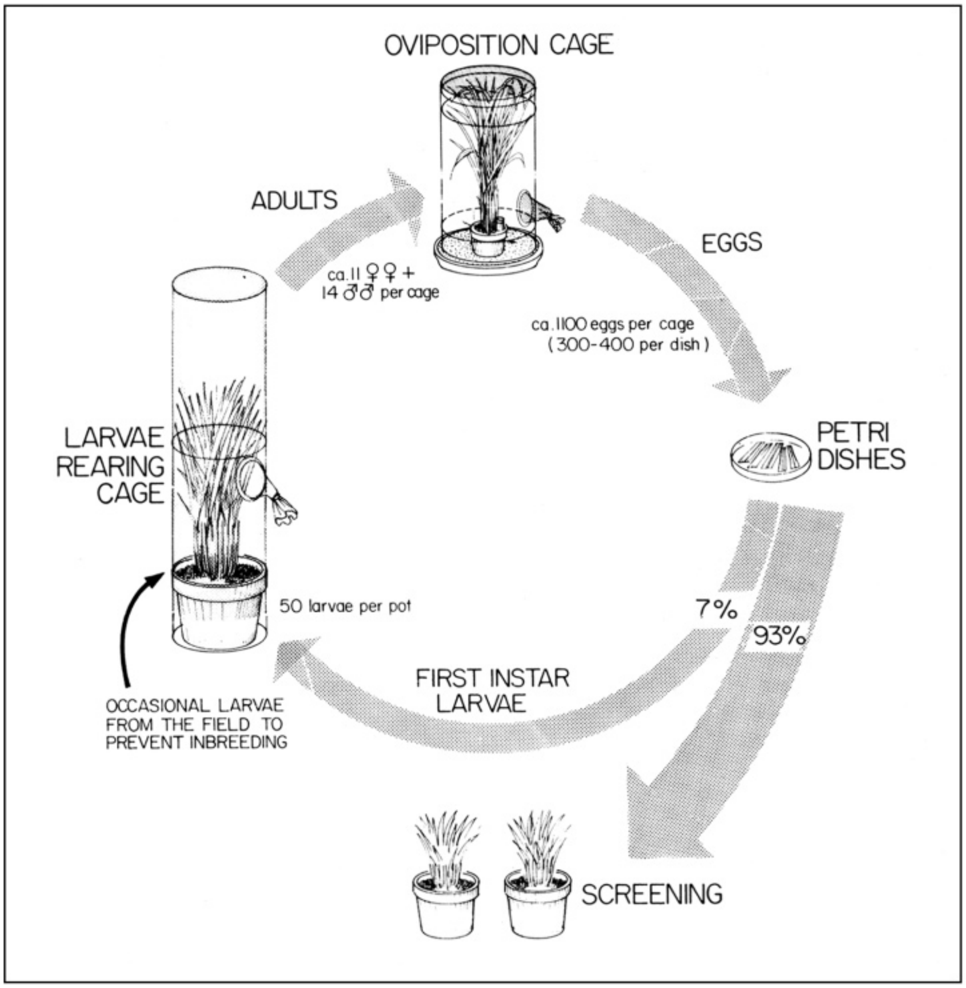
Mass rearing of the rice leaf folder

G. P. Waldbauer, visiting scientist from the University of Illinois, and A. P. Marciano, research assistant, Entomology Department, International Rice Research Institute.

A method for mass rearing of the rice leaf folder *Cnaphalocrosis medinalis* has been developed at IRRI. It consists of the following steps (see figure):

1. In a greenhouse, larvae are reared on rice plants growing in earthenware pots 30 cm in diameter. Each pot is covered with a mesh sleeve supported by a wire frame. Access into the sleeve is through a side sleeve.
2. Newly emerged adults are transferred from the sleeves to cylindrical plastic oviposition cages (27 cm in diameter and 65 cm tall) fitted with sleeves. Each cage has a pot of rice plants and a feeder containing cotton batting saturated with a solution of honey in water (25% by volume). We designed two types of oviposition cages. One with few mesh openings for air circulation is for use in the dry, airconditioned laboratory. The other with extensive mesh areas is for the humid, screened insectary.
3. Eggs are collected from the oviposition plants daily for the first 7 days (when 85% of the eggs are laid) and are placed in petri dishes on wet filter paper.
4. Newly hatched larvae are transferred daily with a fine-pointed, wet camel's hair brush from the petri dishes to the sleeved potted plants.

An average of about 120 eggs/female initially put into the oviposition cages is obtained. The egg hatching rate was 91.7%; the eggs hatched in the morning of the 4th day at a mean temperature of about 23°C. Survival from the first instar to the adult ranged from 78.6% to 97.3%, averaging 87.0%.



Procedure for rearing rice leaf folders and the relationship to varietal screening.

The yield of insects from a culture that can be maintained with 84 working hours in a 7-day week has been calculated.

If 15 sleeves with larvae are set up each week, 60 sleeves will always be on hand. Each sleeve will accommodate 50 larvae. With an average of 87% survival about 650 adults/week will be produced — more than enough to set up 15 oviposition cages with about 25 adults/cage. If the cages average 11 females each, more than 16,000 eggs/week should be produced. With a hatching rate of about 92%, about 15,000 first-instar larvae/week should be available. About 7% of them are needed to continue the culture; 93% can be used to screen varieties for resistance. Thus it may be possible to screen 400 varieties/week in the greenhouse by artificial infestation with first-instar larvae, using 3 pots, each with 5 plants of each variety and 2 first-instar larvae/plant. Infested plants are allowed to remain in the greenhouse until the larvae are in the 5th and 6th instar, about 16 days. Then the varieties are scored by determining the percentage of folded leaves and the number of surviving larvae. ■

Susceptibility of promising rice cultivars to whitebacked planthopper

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The whitebacked planthopper (WBPH) *Sogatella furcifera,* previously a minor rice pest, is becoming a threat at the crop's early tillering stage with the introduction of high yielding varieties and high-input technology. Thirty-nine rice cultivars (see table) were evaluated against WBPH attack in the field in 1977 kharif. The rices were transplanted in two advanced trials in the last week of June in a completely randomized block experiment with three replicates. The pest population on 15 hills/replication was recorded in the last week of August when pest incidence was at its peak. RP633-519-1-3-4-1 harbored the lowest population (6.5) and IR36 the next lowest (8.5). The maximum infestation was on Prasad (47.3). No cultivar was immune to WBPH attack. Rasi (IET1444), which was planted in an agronomic trial, suffered heavily; it had 400 to 500 insects/hill or more. ■

Whitebacked planthopper populations on promising rice cultivars. Uttar Pradesh, India.

Designation	Av population (no./hill)
Medium duration	
RP6-516-31-4	34.4
UPR103-44-1-1-1-1-2	32.5
Jaya	32.3
UPRI 73-23	38.8
CR75-93	29.4
CR167-10	28.3
BG90-2	26.9
IR2153-26-3-5-2	25.9
UPR84-30-1-2-1-3	25.2
UPR70x30-4-1	24.2
CR164-12	24.1
UPRI 73-18	22.7
IR2151-190-3-5	22.5
CR94-MR 1550	21.3
CR129-118	21.0
UPR243-247-1	20.6
RP632-94-1-2-1-7	16.1
BG35-2	15.9
S52134	15.6
TC-A-l-P2-5-2	15.3
BR 34-13-5	15.1
IR36	8.5
RP633-519-1-3-4-1	6.5
C.D. at 5%	11.85
Early duration	
Prasad	47.3
UPR103D-7-1	37.7
Pusa 33	35.6
UPRI75-4	33.0
CR142-3-2	31.9
UPR221-124-1	31.6
UPR103-80-1-2-1-2	31.0
UPR83D-8-1	31.0
UPR4D-1-3-1	29.3
OR34-16	23.4
UPR190D-17-1	22.0
Pusa 2-21	22.0
UPR4D-1-1	17.7
IR2061-487-1-19	17.4
UPR82-1-7	13.2
RP1158-85-1	12.1
CD at 5%	10.99

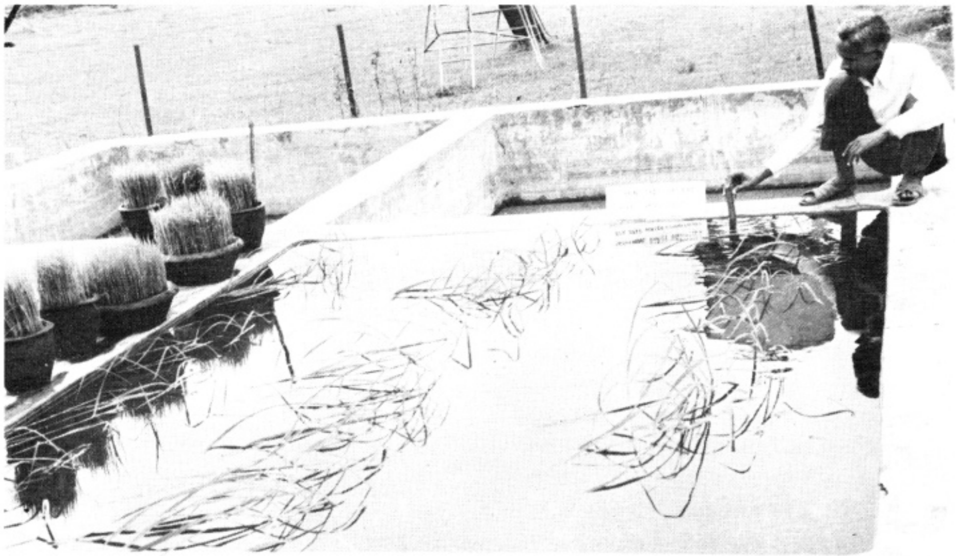
GENETIC EVALUATION & UTILIZATION

Deepwater

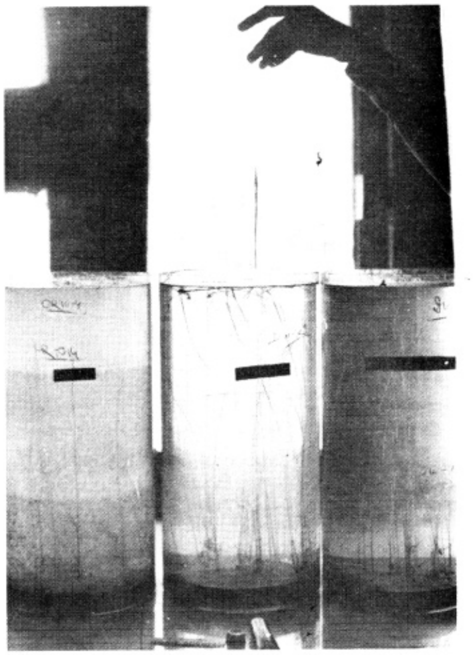
Screening deepwater rice varieties in different water regimes

R. S. Tripathi and M. J. Balakrishana Rao, Central Rice Research Institute, (CRRI), Cuttack, India

Twenty-five deepwater rice varieties, along with Pankaj, were screened for elongation capacity, nodal differentiation, and internode elongation in two sets of experiments. In the first set, 30-day-old potted seedlings were suspended in a water column 80 cm deep in cement tanks (Photo 1). In the other set the seeds were germinated in a 40-cm water column in glass jars in the laboratory (Photo 2). One set of potted plants was also grown under normal conditions.



1. Cement tank used in screening deepwater rices. CRRI, Cuttack, India.



2. Glass jars used in screening deepwater rices. CRRI, Cuttack, India.

Nageribao, Habiganj DW2, and Molladigha grew and elongated to the surface of the 80-cm water column in 24 hours. They elongated fastest. Nhok Nhounh and Khao Gaew reached the surface in 36 to 48 hours. Pankaj did not reach the water level and it died. Elongation of the leaf sheaths and, in a few varieties, of the internodes caused the growth that enabled varieties to reach the water surface. In the glass jars as in the cement tank Nageribao, Sampatti, Habiganj DW2, and Molladigha grew relatively faster than the other varieties. Pankaj did not elongate beyond 15 cm.

Internode differentiation and elongation occurred earliest in Nageribao – 30 days after germination. Aswina 322, Habiganj DW1, Habiganj DW2, Sampatti, and Molladigha took 40 days; the other varieties, 50 to 60 days. In Jalmagna, a popular deepwater variety from Uttar Pradesh, internodal differentiation took place 50 days after germination. Nodal rooting was profuse and nodal tillering high in Nageribao, followed by Habiganj DW2, Sampatti, and Molladigha. Good segregants from crosses involving Nageribao can be obtained at CRRI.

The seed of 23 deepwater varieties were received from IRRI. Nageribao (from Assam), Jalmagna, and Pankaj were obtained locally. ■

GENETIC EVALUATION & UTILIZATION

Temperature tolerance

Two extremely cool-tolerant varieties

Tetsuo Satake and Kunio Toriyama, Hokkaido National Agricultural Experiment Station (HNAES), Hitsujigaoka, Toyohira, Sapporo 061-01, Japan

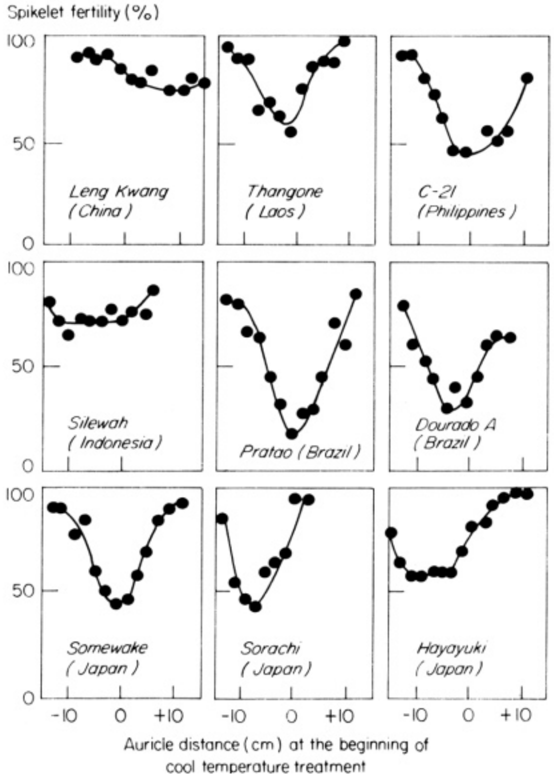
In 1976, IRRI selected 6 cool-tolerant indica rice varieties from 12,200 entries of the germplasm bank on the basis of growth duration, plant height, spikelet sterility, leaf color, and anthesis. The cool tolerance of the six varieties at booting stage was rechecked in the phytotron of the HNAES.

The materials tested were the six indicas and three japonicas found to be cool-tolerant in Japan. The indicas were Leng Kwang, Thangone, C-21, Silewah, Pratao, and Dourado Agulha; the japonicas were Somewake, Sorachi, and Hayayuki. Twenty seeds were sown in a circular pattern in a 4-liter plastic pot. The plants were grown at 26º/20ºC day/night temperature in an artificial light room for 12 hours at an intensity of 27.6 klux.

Auricle distance was used as a criterion to show the panicle developmental stage at the beginning of cooling. Plants at different panicle developmental stages were cooled at 12ºC for 4 consecutive days in the natural light room. After the treatment, the plants were returned to the artificial-light room. At maturity, spikelet fertility was determined for panicles of main stems grouped by auricle distance.

Cool tolerance was highest in Leng Kwang and Silewah, and intermediate in Thangone and C-21 (see figure). The latter two indica varieties had about the same cool tolerance as the three japonicas. Pratao and Dourado Agulha, which were highly cool tolerant in the IRRI test (15ºC), were susceptible in this test (12ºC).

Results at IRRI and at HNAES showed



Fertility of spikelets in rice plants subjected to cool temperature (12°C for 4 days) at different panicle developmental stages indicated by auricle distance of –5 to +10 cm. Hokkaido Experiment Station, Japan.

Leng Kwang and Silewah as extremely cool tolerant. The two varieties were crossed with a japonica breeding line, Hokkai 241, to incorporate their tolerance into japonica rices. The F_1 plants of the cross Leng Kwang/Hokkai 241 had high spikelet sterility, and those of Silewah/Hokkai 241 had high spikelet fertility. Leng Kwang is a promising parent for indica rice breeding programs to improve cool tolerance; Silewah is promising for japonica breeding programs.

Pest management and control

DISEASES

Effect of nontoxic chemicals on brown spot disease in rice seedlings

D. N. Giri and A. K. Sinha, Plant Pathology Department, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Kalyani 741235, West Bengal, India

The performance of 15 chemicals, known as phytoalexin inducers for different plant species, in inducing resistance to the brown spot pathogen *Helminthosporium oryzae* in susceptible rice plants was evaluated.

Three-week-old seedlings of the rice variety Dharial were sprayed with solutions of the test chemicals at concentrations that have little or no effect on spore germination at 2 days before inoculation. Promising chemicals were used in subsequent 24-hour seed soaking before sowing and in 24-hour root-dip treatment of 3-week-old seedlings before transplanting. The transplanted seedlings were left exposed to natural infection and the disease reaction was assessed 2 to 5 weeks later. The seedlings raised from treated seeds were grown in pots and spray inoculated, and the disease reaction was assessed 3 or 5 weeks later. Most of the test chemicals gave considerable protection to rice seedlings in different treatments (see table).

With foliage spray, symptoms were reduced by 42-92%. The most ef'fective chemicals were sodium malonate, DL-methionine, and indole-3-acetic acid (IAA).

The seedlings derived from seed treatments developed 35 to 60% fewer symptoms after 3 weeks. In the field, such seedlings also showed considerable resistance; they had 33 to 88% fewer symptoms after 3 weeks. The protective effect declined with time, particularly for barium chloride and nickel nitrate.

Transplanted seedlings in different treatments developed 19 to 50% fewer symptoms after 2 weeks and 12 to 32% fewer symptoms after 5 weeks.

The effectiveness of the phytoalexin inducers in developing resistance in rice seedlings is evident. Although foliage spray is effective, the significant persistence of the induced protective effect in the seedlings until 3 to 5 weeks after the seed treatment and, to a lesser

Mean disease index[a] of *Helminthosporium oryzae* infection[b] in rice seedlings (variety Dharial) treated with chemicals known as phytoalexin inducers.

Chemical	Concn.	Mean disease index (%)					
		Foliage spray (pot experiment)	Seed soaking			Seedling root-dip (field expt)	
			Pot expt (3 weeks)	Field expt			
				3 weeks	5 weeks	2 weeks	5 weeks
Water (control)		100.0	100.0	100.0	100.0	100.0	100.0
Barium chloride	10^{-3}M	42.3	51.9	66.0	90.6	62.1	13.5
Ferric chloride	10^{-4}M	43.2	40.0	11.3	56.5	65.1	78.4
Cadmium chloride	10^{-4}M	49.8	53.4	63.2	62.1	53.4	14.7
Mercuric chloride	10^{-5}M	58.2	64.5	41.2	55.2	81.1	88.0
Chromium chloride	10^{-3}M	55.0	–	–	–	–	–
Nickel nitrate	10^{-5}M	31.7	43.0	67.0	90.4	73.8	83.2
Sodium malonate	10^{-4}M	8.0	54.1	58.5	68.3	50.0	61.4
Sodium molybdate	10^{-4}M	41.6	43.7	44.3	92.4	56.8	71.3
Sodium iodoacetate	10^{-4}M	49.4	–	–	–	62.1	80.8
Sodium fluoride	10^{-3}M	65.9	–	–	–	–	–
DL-methionine	10^{-2}M	20.3	46.1	52.8	74.5	61.7	80.8
DL-norleucine	10^{-2}M	34.0	–	–	–	–	–
DL-norvaline	10^{-2}M	49.4	–	–	–	–	–
Indole-3-acetic acid	10^{-4}M	21.1	55.1	55.1	55.2	65.6	16.0
2,4,5-trichlorophenoxy-acetic acid	10^{-4}M	32.5	62.5	–	–	–	–

[a] Disease index was calculated for each plant taking into consideration both the number and size of brown spot lesions.
[b] In most experiments, plants were artificially inoculated with a heavy inoculum; only in root-dip treatment were they left exposed to natural infection.

extent, after the root-dip treatment, appears to have more practical significance. In most treatments the number of infections was reduced, but in some, lesion expansion was also inhibited significantly. The more promising among the chemicals appear to be sodium malonate, sodium molybdate, cadmium chloride, ferric chloride, and DL-methionine. ■

Sporulation in *Drechslera oryzae*

Srikant Kulkarni and K. Ramakrishnan, Department of Plant Pathology, College of Agriculture, Dharwar 580005, Karnataka, India

Brown leaf spot of rice caused by *Drechslera oryzae* is an important disease of rice in Karnataka, India. The pathogen causes small spots or lesions on the leaves. The isolated spots are oblong or oval, dark brown, and scattered along the leaf. *D. oryzae* does not sporulate on infected green leaves or senescent leaves. But when such leaves were detached and the water-soluble components leached out, then sporulation was abundant. Infected leaves are not the inoculum source for glume infection in Karnataka, as the pathogen does not sporulate on the leaves. Hence, a water-soluble component of the leaf spot was presumed to inhibit sporulation. Therefore, the effect of leaching this component with water was tested.

The cut ends of rice leaves were immersed in distilled water in a flask for 48 hours at room temperature and at 30, 35, 40, and 45°C. Water in the flask was changed at six hourly intervals. The leaves were then removed and kept in a moist chamber. Abundant sporulation from the leaf spots was evident within 48 hours, but the pathogen was killed at 45°C. That indicates that the leaf spots may contain a water-soluble component that inhibits sporulation. ■

Effect of carbon sources on sporulation of *Drechslera oryzae*

Srikant Kulkarni and K. Ramakrishnan, Department of Plant Pathology, College of Agriculture, Dharwar 580005, Karnataka, India

The effect of arabinose, carboxy-cellulose, fructose, galactose, glucose, mannose, rhamnose, ribose, starch, sucrose, and xylose on sporulation was tested from 0.5 to 9.0% levels by replacing sucrose in Richard's medium. Sporulation was observed in the media containing mannose, starch, and sucrose. The fungus showed limited sporulation in the media with sucrose at 2.5% level. Sporulation was completely suppressed at 3.5%. Maximum sporulation was obtained with mannose at 2.5% concentration and with starch at 6.5%. ■

Antagonistic action of soil microbes on *Drechslera oryzae*

Srikant Kulkarni and K. Ramakrishnan, Department of Plant Pathology, College, of Agriculture, Dharwar 580005, Karnataka, India

Trichoderma sp. isolated from semidry and puddled soils parasitized *Drechslera oryzae* (Breda de Haan) Subram and Jain, whereas *Streptomyces* sp. isolated from the two soils showed inhibitory action on *D. oryzae, Bacillus* sp.— present in puddled soil, but not in semidry soil — showed inhibitory action when inoculated on *D. oryzae* on petri plates.

Survival of *Drechslera oryzae* in an aerobic condition

Srikant Kulkarni and K. Ramnakrishnan, Department of Plant Pathology, College of Agriculture, Dharwar 580005, Karnataka, India

An experiment on the growth and survival of *Drechslera oryzae* was conducted with the following treatments.

1. Slants with agar medium plugged with cotton dipped in pyrogallic acid + 1 N NaOH (to create complete anaerobic conditions).
2. Mouth of the test tube covered with paraffin (to create partial anaerobic conditions).
3. Control (without above treatments).

The pathogen did not grow in the first treatment and was killed in less than 7 days. When the mouth of the test tube was covered with paraffin, there was growth and the pathogen survived for 4 weeks. But in the control treatment, growth was excellent and *D. oryzae* survived for 18 weeks. This experiment was conducted to verify whether *D. oryzae* can survive in completely or partially anaerobic conditions, as those that prevail in puddled soils. According to these results it can be assumed that *D. oryzae* may not survive for a long time in paddy soil and the fungus in the soil may not serve as a source of inoculum. ■

A soft rot disease of rice observed at IRRI

T. W. Mew and M. H. Rosario, Plant Pathology Department, International Rice Research Institute

In 1978, a soft rot disease was observed on plants of IR129-192-2 in the International Rice Yield Nursery grown at IRRI. Infection was evident from the early to the maximum tillering stages. The infected plants' leaf sheaths and tissues from the basal internodes showed browning and water soaking, accompanied by rotting and a foul odor. The symptoms suggested that bacteria caused the infection, which was similar to an infection observed on IR36 in 1977.

Infected tissues were isolated on potato sucrose agar and incubated at 30°C for 48 hours. Two distinct colony types, Type A and Type B, were apparent on the agar plates. Type A colony was milky white and flat with irregular margins. Type B colony was creamy yellow and slightly raised with irregular margins. On peptone sucrose agar plates, Type B was creamy white to very light yellow. Its surface was slightly raised and rough; the margin was irregular. In addition, a brown pigment diffused to the medium 3 days after incubation. Both colony types produced gas on Wakimoto's medium, produced fluorescent pigment on the same medium under ultraviolet light, and caused potato slices to rot.

A pathogenicity test with 24-hour

cultures was made on a detached stem. Inoculated tissues were discolored from light to dark brown. Four days after pot-grown plants of IR8 were inoculated at the maximum tillering stage, symptoms began to appear. A lesion extended upward and downward from the inoculation point; the leaf sheath became brown. But the lesion was restricted only to the inoculated internodes in which the stem tissues as well as the leaf sheath became rotten and discolored. The outer leaves of infected plants senesced rapidly.

Initial bacteriological studies indicated that the causal bacterium may be similar to that which causes "bacterium bruzone disease" of rice in Hungary or "sheath brown rot'' of rice in Japan. According to Goto, the pathogen was closely related to *Pseudomonas marginalis,* but different from the "sheath rot" caused by a strain of *Erwinia carotovora* in Indonesia in 1964. The etiology and identification of the bacterium are being studied. ■

Occurrence of rice ragged stunt disease in West Bengal, India

R. Naik, Rice Production Training Institute, FP & ARC, Durgapur, Burdwan, India

In the 1978 wet season, natural infection of rice ragged stunt disease was observed on Jaya in a trial plot of the Rice Production Training Institute farm. About 50% of the rice hills were affected. The population of brown planthopper *Nilaparvata lugens* was low at the time. Scattered diseased plants were later found in isolated pockets in the region. This is the first report of ragged stunt in West Bengal. The primary symptoms of the disease observed were stunting (photo 1), vein-swelling on ragged leaves (photo 2), distorted twisting of the flag leaf, and incomplete emergence of the panicle (photo 3).

1. Healthy plant (right) and stunted plant (left) infected with ragged stunt disease.

2. Vein-swelling on ragged leaves.

3. Incomplete emergence of panicle and twisted flag leaf.

Serological studies of rice ragged stunt virus

R. G. Milne and E. Luisoni, Laboratorio di Fitovirologia applicata del Consiglio Nazionale delle Recerche, Torino, Italy; and K. C. Ling, International Rice Research Institute

Crude or partially purified material containing B-spiked subviral particles (SVP) of rice ragged stunt virus (RRSV) from diseased plants (mailed to Italy from the Philippines) was injected into rabbits for antiserum production. When tested by the gel diffusion method, the antiserum had a titer of 1/16 against healthy rice material, and at least 1/64 against RRSV preparations. When the antiserum was tested by inmunoelectron microscopy using the decoration technique, specific antibody halos around SVP of RRSV were detected up to a dilution of 1/256. Preparations of SVP of maize rough dwarf virus (MRDV), oat sterile dwarf virus (OSDV), and pangola stunt virus (PSV) were not decorated by the RRSV antiserum. Likewise, the antisera of MRDV, OSDV, PSV, and sugarcane Fiji disease virus failed to decorate SVP of RRSV. Thus, RRSV is not serologically related to those viruses that make up the fijiviruses group, but might be a new member of a plant reovirus group having affinities with the fijiviruses. Furthermore, the antiserum reacted positively to diseased materials collected in India, Indonesia, Philippines, and Thailand. Hence. in addition to being similar in symptomatology and transmission, the RRSV in those countries are serologically related.

Effect of nitrogen on lesion development in rice resistant to bacterial blight

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

It is generally believed that increases in nitrogen fertilizer increase bacterial blight infection. If rices with different resistance genes and pathotypes with specific virulence are identified, then scientists can evaluate interactions among nitrogen fertilizer and those factors. Initial greenhouse experiments showed that the lesion length on varieties with intermediate (moderate or partial) resistance, such as Pulo and Sailboro 302, increased with increased nitrogen level. But the total lesion length was considerably less than that on rices with no functional resistance (IR8 and TN1). When rices with adult plant resistance (IR1698 and IR944) were infected at tillering stage (45 days after seeding), lesion length did not differ from that on rices (IR8) with no resistance to pathotypes 1 and 2. High nitrogen levels did not affect lesion length on varieties with specific resistance. But lesion length increased if the variety-pathotype combination was compatible (i.e. the varieties' resistance was overcome by pathotypes of different virulence). Thus, when IR20 was infected with pathotype 1 (to which it is resistant), lesion length did not significantly increase. But when infection was caused by Pathotype 2 (to which IR20 is susceptible), lesion length increased proportionally with increased nitrogen. When IR1545-339 was infected with both pathotypes (to which the breeding line was resistant), lesion length did not increase. ■

Effect of fungicides on the inactivation of sclerotia and mycelia of *Rhizoctonia solani*

S. Kannaiyan and N. N. Prasad, Microbiology Laboratory, Agriculture College, Annamalai University, Annamalainagar 608101, Tamil Nadu, India

Sheath blight disease caused by *Rhizoctonia solani* is severe in many rice-growing areas of Tamil Nadu. The effect of certain fungicides on the viability of sclerotia and mycelia of *R. solani* was studied.

Soil was well sieved and air-dried, then placed in 25-ml vials and autoclaved for 1 hour at 15 lb. An 8-mm agar disc of the pathogen was placed on the soil and then covered with 2.5 cm sterilized soil. Similarly sclerotia were placed on the soil surface of another set of vials and covered with soil.

The fungicides Bavistin, Benlate, Demosan, Hinosan, wettable Ceresan, Brassicol, Kitasin, Vitavax, and thiabendazole were tested at 0.05, 0.1, and 0.2% levels. Five milliliters of each fungicidal solution was applied to the soil surface with a pipette. The vials were incubated for 24 hours at room temperature. Then they were emptied and the soil was washed off with running water. The mycelial discs and sclerotia were removed with sterile forceps, plated on Czapek's agar medium, and observed for viability.

All the fungicides except wettable Ceresan completely inhibited mycelial growth at all the concentrations. Hinosan, Kitazin, and Vitavax completely inhibited sclerotial germination at all concentrations. Bavistin at 0.2% inhibited sclerotial germination. Benlate, Demosan, Brassicol, thiabendazole, and wettable Ceresan did not effectively inhibit sclerotial germination. ■

In vitro effect of certain fungicides on the growth and sclerotial production of *Rhizoctonia solani*

S. Kannaiyan and N. N. Prasad, Microbiology Laboratory, Agriculture College, Annamalai University, Annamalai Nagor 6081 01, Tamil Nadu, India

Sheath blight disease of rice caused by *Rhizoctonia solani* is serious in Tamiladu. The efficacy of certain fungicides against *R. solani* was tested. The fungicides EL-273, N.F. 48, Bavistin. Vitavax, Difolatan, Agallol, Plantvax, Benlate, Agrosan GN, Fytolan, Brestan, Brassicol, thiabendazole, Hinosan, Kitazin, Daconil, Demosan, Macuprax, wettable Ceresan, Dithane D-14, Dithane M-45, Dexon, captan, thiram, and Dithane Z-78 were incorporated in Czapek's medium at 0.025%, 0.05%, 0.l%, and 0.2% levels. The medium was seeded with *R. solani.* After 15 days of incubation the dry weight of the fungus was determined.

All of the fungicides tested inhibited the pathogen growth at all concentrations. The fungicides N.F. 48, Bavistin, Vitavax, Benlate, Brassicol, thiabendazole, Hinosan, Kitazin, Daconil, and Demosan completely arrested growth and sclerotial production, even at 0.025%. On the other hand, Agallol, EL-273, Agrosan, Dexon, captan, and thiram completely inhibited the growth and sclerotial production of the pathogen only at the 0.2% level. The other fungicides decreased growth as concentration was increased. ■

Root injury and kresek development on rice

B. A. Zaragoza and T. W. Mew, Plant Pathology Department, International Rice Research Institute

In the field, kresek infection on rice plants usually occurs 1 to 6 weeks after transplanting. An early study suggested that root injury is related to kresek infection. In this study, kresek developed on seedlings raised in a seedbed infested with bacterial cells of *Xanthomonas oryzae.* The percentage of kresek was high when the seedbox was infested near transplanting time, but was minimal when the seedbed was infested at the time of sowing and the seedlings were transplanted 21 days later.

More kresek was produced in transplanted than in direct-seeded rice when the seedbox soil was infested with the bacterial pathogen by incorporating bacterial suspension at different concentrations. The percentage of kresek infection and inoculum dosages were linearly correlated in transplanted rice.

Two types of seedbeds were compared. In the ordinary seedbed, kresek incidence was similar regardless of whether the roots of seedlings were injured by clipping or not. Among seedlings raised in the dapog bed, those with uninjured roots had considerably less kresek infection than those with injured roots. ■

Seed pathology of rice in Indonesia, 1975–78

J. Supriaman and L. T. Palmer, Plant Pathology Section, Central Research Institute for Agriculture, Sukamandi Branch, Sukamandi, W. Java, Indonesia

The fungi incidence was analyzed in 133 seed samples of rice from Java, Bali, and South Sulawesi (Indonesia) from 1975 to 1978. The samples were obtained from 13 commercial and 40 local varieties or promising lines. Fifteen fungal genera and

21 species were isolated through standard seed pathology techniques. The most common were *Trichoconis padwickii, Drechslera oryzae, Curvularia lunata,* and *Fusarium semitectum* in 86, 78, 77 and 65% of the samples, respectively. Varietal differences in the fungi isolated were noted. IR26 and C4-63 had lower incidence than the other cultivars; IR5 had higher. Kernel smut *Tilletia barclayana* was isolated from seven lines grown in a Central Java nursery in 1977. ■

Pest management and control

INSECTS

Major insect pests of rainfed wetland rice in tropical Asia

Summarized by J. A. Litsinger, Cropping Systems Program, International Rice Research Institute

Rice is a highly adaptable crop and is cultivated over a wide range of environments. Rice culture is classified on the basis of water availability into four major environments: 1) deep water, 2) irrigated wetland, 3) rainfed wetland, and 4) dryland. Within tropical Asia, rice entomology research has concentrated on irrigated wetland and dryland environments, and little attention has been given to deepwater and rainfed wetland environments.

Recent statistics show that the rainfed wetland environment occupies 46% of the land area devoted to rice in Asia exclusive of the People's Republic of China. Within this classification rice is usually grown as a single crop during the monsoon season and is subject to periodic and unpredictable drought and flooding. These areas are typified by a

Insect pests of rainfed wetland rice in tropical Asia as determined by a survey of rice entomologists,[a] 1978.

Pest[b]		Country[c]							
Scientific name	Common name	Bangladesh	Burma	India	Indonesia	Malaysia	Philippines	Sri Lanka	Thailand
Tryporyza incertulas (Walker)	Yellow rice borer	**	**	**	**		**		*
T. innotata (Walker)	White rice borer			*	**		**	0	
T. nivella (Fabricius)	Top borer	0				0		0	*
Chilo suppressalis (Walker)	Striped rice borer		*	*	*		*		*
C. polychrysus (Meyrick)	Dark-headed rice borer	*				*			**
Sesamia inferens (Walker)	Pink borer	*		*		*	*		
Orseolia oryzae (Wood-Mason)	Rice gall midge	*		**	**	0	0	**	**
Nymphula depunctalis Guenee	Rice caseworm	*	*	**	**	*	**	*	*
Cnaphalocrosis medinalis (Guenee)	Rice leaf folder	*		**	**	*	**	**	**
Mythimna separata (Walker)	Rice ear-cutting caterpillar	*	*	*	*		*		*
Spodoptera mauritia (Boisduval)	Rice swarming caterpillar			**				*	**
Pelopidas mathias (Fabricius)	Rice skipper			*					*
Melanitis leda ismene Cramer	Rice green-horned caterpillar			*			*		*
Rivula near *atimeta* Swinhoe	Rice hairy caterpillar	0	0	0	0	0	*	0	0
Susumia exigua (Butler)	Fijian leaf folder	0				0		0	*
Leptocorisa acuta Thunberg	Rice bug	*	*		**		**	*	**
L. oratorius (Fabricius)	Rice bug	*	*		**	*	**	0	**
Scotinophora coarctata (Fabricius)	Malayan black rice bug					*		0	*
S. lurida (Burmeister)	Japanese black rice bug							*	*
Hieroglyphus banian (Fabricius)	Large rice grasshopper			*	*	0			*
Patanga succincta (Linnaeus)	Bombay locust	0		*	*			0	*
Locusta migratoria manilensis (Meyen)	Oriental migratory locust	0		*	*			0	*
Oxya chinensis (Thunberg)	Small rice grasshopper			*	*			0	*
Nephotettix virescens (Distant)	Green rice leafhopper	*		*	*	*	*		*
N. nigropictus (Stal)	Green rice leafhopper	*		*	*		*		*
Recilia dorsalis (Motschulsky)	Zig-zag rice leafhopper			*				*	*
Nilaparvata lugens (Stål)	Brown rice planthopper			**	**	*		**	*
Sogatella furcifera (Horvath)	Whitebacked rice planthopper			*		*		*	*
Hydrellia spp.	Rice whorl maggot			*	*		**		
Atherigona oryzae (=exigua) Stein	Rice shoot fly			*	*			*	
Baliothrips biformis (Bugnall)	Rice thrips			*		0	0	**	*
Brevennia rehi (Lindinger)	Rice mealy bug			*		0		0	*
Dicladispa armigera (Oliver)	Rice hispa	*		*		0	0		*
Echinocnemus oryzae (Marshall)	Rice root weevil	0		*		0	0	0	

[a] Bangladesh (S. Alam, H.D. Catling, A.N.M. Rezaul Karim), Burma (U Mya Thwin), India (N. Panda, K.C. Mathur), Indonesia (I. Manwan, A. Kartohardjono, O. Mochida), Malaysia (G.S. Lim), Philippines (J.A. Litsinger), Sri Lanka (N. Wickremasinghe), Thailand (W. Katanyukul, S. Pongprasert). [b] Pawar, A.D. 1975. The rice Entomology Newsletter No. 2. Updated by A.T. Barrion, Entomology Department, IRRI. [c] ** = major insect (perennial yield losses of 5% in at least 1 major region within the country), * = minor pest (variable year-to-year infestations resulting in yield losses of 5% in at least 1 major region within a country), 0 = pest not recorded on rice from the country.

distinct rice-free dry season. The extreme variations in rainfall and growing season profoundly affect rice insect pests. The fact that rice fields are flooded during part of the growing season eliminates many soil-inhabiting pests common to dryland environments.

A survey of rice entomologists in eight Asian countries yielded a list of insect pests common to rainfed wetland environments in the region. Most important were yellow rice borer, rice gall midge, rice leaf folder, rice bug, and rice caseworm, which are also major pests of irrigated wetland environments, but, with the exception of rice bug and rice leaf folder, not of dryland environments. Thirty other pest species were important on a country-to-country basis.

Because of the locational intermingling of rainfed and irrigated environments, it is difficult to state that a pest is indigenous to rainfed wetland environments. For example, the brown planthopper is capable of migrating long distances and may disperse to rainfed environments from nearby irrigated areas.

Only two pests are thought to be unique to rainfed wetland environments — the rice root weevil and white stem borer. These insects normally estivate and are culturally controlled if a second rice crop is grown in the dry season. ■

Evaluation of granular insecticides for rainfed wetland rice in the Philippines

J. P. Bandong, research assistant; and J. A. Litsinger, associate entomologist, Entomology Department, International Rice Research Institute

Rainfed wetland rice is subject to both drought and flooding. In the Philippines, these extreme conditions influence the performance of insecticides used in controlling the key vegetative pests: whorl maggot, caseworm, and stem borer. Against this insect complex, foliar sprays are inferior to granular insecticide formulations because:

1. Frequent and heavy rainfall reduces the residual activity of sprays, and the need to reapply the sprays makes this form of protection more costly,
2. Larvae of the whorl maggot and stem borer are sheltered within young plants, which protect them from foliar sprays, and
3. Rainfed farmers do not have ready access to water for sprayers.

During the 1977–78 crop year we evaluated the granular insecticides lindane, diazinon, and carbofuran, which are currently recommended in the Philippines for irrigated rice against the early-season pest complex in rainfed wetland paddies.

Diazinon and lindane granules were broadcast at 1.5 kg a.i./ha 3 days after transplanting. Carbofuran granules were incorporated into the soil at 1.0 kg a.i./ha during the last harrowing before transplanting. Previous studies have shown that soil incorporation of carbofuran was superior to broadcasting into the paddy water after transplanting.

The first trial, replicated over five farms planted to IR28, compared lindane to carbofuran. Lindane was totally ineffective against the whorl maggot and caseworm, but carbofuran controlled both pests adequately and produced significant yield increases (see table).

Comparison of carbofuran, lindane, and diazinon granules for whorl maggot and caseworm control on IR28 and IR36.[a] Pangasinan, Philippines, 1977–78.

Insecticide	Whorl magot[b] damage 30 DT	Caseworm (% defoliation) 25 DT	Yield (t/ha)
	IR28		
Carbofuran[c]	1 a	2 a	4.67 a
Lindane[d]	8 b	16 b	3.54 b
Untreated	9 b	23 b	3.48 b
	IR36		
Carbofuran[c]	1 a	3 a	4.43 a
Diazinon[d]	7 b	11 b	3.99 b
Untreated	8 c	15 c	3.86 b

[a] IR28 — av of 5 fields, IR36 — av of 7 fields. DT = days after transplanting. In a column any 2 means followed by a common letter are not significantly different at the 5% level. [b] 1–9 scale: 1 = negligible, 9 = severe. [c] 1.0 kg a.i./ha, soil incorporated. [d] 1.5 kg a.i./ha. broadcast at 3 DT.

The second trial, replicated over seven farms planted to IR36, compared diazinon to carbofuran. Diazinon reduced whorl maggot and caseworm infestation only slightly — not enough to significantly increase yield. But carbofuran again gave excellent control and significantly higher yields.

We believe that the failure of both lindane and diazinon granules was due to the shallow paddy water, which characterizes rainfed wetland fields. We monitored the water depth daily for 30 days after transplanting. The mean depth per field ranged from 1.0 to 5.8 cm. Neither insecticide is truly systemic. Once applied to the fields the insecticides move up the plants in the capillary film between the leaf sheath and the culm. The degree of movement depends on the depth of the paddy water. In rainfed areas the paddy water is normally too shallow to allow adequate movement up the plants. Therefore lindane and diazinon should not be recommended if the paddy water levels cannot be adequately maintained. ■

A new record of the cricket *Euscyrtus concinnus* Hanu (Eneopterinae)

K. Sasisharan Pillai and K. Saradamma, College of Agriculture, Vellayani, India

A number of field crickets (Gryllidae) and several grasshoppers defoliate the paddy crop. The gryllids reported on paddy are *Brachytrupes portentosus* Licht, *Gryllus conspersus Schaum.*, *Liogryllus bimaculatus* de Geer., and *Trigonidium cicindeloides* Serv.

A new cricket has been found feeding on paddy leaves at the Instructional Farm, College of Agriculture, Vellayani. The Zoological Survey of India identified it as *Euscyrtus concinnus* Hanu.

Both nymphs and adults feed on the

leaves. Although all crop stages are susceptible, the infestation rate and feeding are heavier in nurseries about to be transplanted and in the early transplanted crop. During heavy incidence, almost all leaves are infested. Feeding symptoms are narrow linear holes in the interveinal areas that leave the veins intact. Such holes are distributed along the entire leaf lamina and resemble those made by grasshoppers.

A field trial was conducted to determine suitable insecticides for controlling crickets as well as other insects. Six insecticide granules were tried at 2 levels:

- Carbofuran at 0.5 kg and 1.0 kg a.i./ha
- Phorate at 1.0 kg and 2.0 kg a.i./ha
- Mephosfolan at 0.5 kg and 1.0 kg a.i./ha
- Disulfoton at 1.0 kg and 2.0 kg a.i./ha
- Quinalphos at 1.0 kg and 2.0 kg a.i./ha
- Chlordimeform hydrochloride at 0.5 kg and 1.0 kg a.i./ha.

Of these carbofuran at 1.0 kg a.i./ha was the most effective in pest control, followed by phorate at 2.0 kg a.i./ha. ■

Occurrence of the rice ear-cutting caterpillar in the Punjab of Pakistan

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The rice ear-cutting caterpillar *Pseudaletia unipuncta* has never been a serious rice pest in the Punjab Province of Pakistan. The first observation of serious damage was reported on berseem fodder *(Trifolium alexandrinum)* in 1972. That crop is sown after rice harvest in the rice tract of Pakistan. At that time only a few larvae and pupae are observed in rice stubble. An unusual upsurge of the pest was noticed in the area of the Institute in October and November. Attacks of the pest were also recorded in Narang and Kamoke areas (Sheikhupura District). The pest attacked the rice crop when routine insecticide applications were halted after the third week of September.

Observations of ear-cutting caterpillars, Punjab, Pakistan.

Variety	Visual assessment of damaged panicles (%)	Insects (av no./hill)
BR2360-6-5-1-10	95	5.4
BR51-46-5	90	4.6
IET6073	70	1.8
BP919-24-7-1	50	2.2
B541-B-KN-22-7-2	30	3.0
B441-B-126-3-2-1	15	1.2
B541-B-KN58-5-3	10	1.6
IET3363	5	1.4

The larvae damaged some varieties considerably. The insect preferred semidwarf varieties, particularly those that were relatively green. Panicles of such varieties were completely denuded.

Observations on the number of insects per hill were recorded in a field sown to different varieties. Five hills per sample were checked. The results are in the table.

From 1.2 to 5.4 insects/hill, averaging 2.6/hill. were present (see table). As expected, varieties with more insects were damaged more; the soil surface was completely covered with cut panicles and grains.

In a preliminary trial, dusting the crop with a mixture of BHC (0.25 kg a.i./ha) + DDT (0.75 kg a.i./ha) killed 95% of the larvae within 24 hours of the application. Water was completely drained before dusting.■

Two subterranean pests of upland rice in Papua New Guinea

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Two rice pests newly identified in Papua New Guinea can severely damage upland rice in the seedling and tillering stages.

Infestation symptoms are similar to those of kresek, a systemic symptom caused by *Xanthomonas oryzae.* Seedlings that are attacked at an early age die, and more mature plants that are attacked have fewer tillers and fewer spikelets per panicle. The younger tillers are affected most severely. Widespread infestation can destroy as much as 90% of the crop.

Caenoblissus pilosus (Hemiptera: Lygaeidae), a chinch bug previously reported from the western Carolines, is related to *Blissus* sp., a pest of maize. small grains, and turf grasses.

In appearance and life cycle it is similar to *Blissus* sp. At the youngest stage it is 0.7 mm long. At adult stage, the insect is about 3 mm long, with silver wings on a black body. At the juvenile stage it is red with black markings.

Chinch bugs inhabit the root zone immediately adjacent to the base of the plant within 1 or 2 cm of the soil surface. They may be visible on the soil surface in the early morning or late afternoon.

Mealy bugs (family Pseudococcidae) have also been observed in most fields that are attacked by chinch bugs. They are often found on nearby plants, but not on the same plants as chinch bugs. Ants, which tend the mealy bugs, are usually present on the soil surface at the base of the plant.

The adult mealy bug is 2.5 cm long and off-white to pink. Both the chinch bug and the mealy bug damage the plant by extracting moisture and nutrients from the roots. They also attack maize and sorghum, but because the infestation level is lower, damage symptoms are not visible.

Puspalum sp. and other soft-stemmed grasses are alternate hosts of the chinch bug.

Chinch bugs and mealy bugs have been observed damaging rice in New Ireland, East New Britain, Morobe, Madang, and Central Provinces. Probably they are widely distributed throughout the lower elevations of Papa New Guinea.

No effective control measures have been determined, although the chinch bug is known to be susceptible to lindane (gamma-BHC). Spraying of the affected plant and of the soil at the plant's base has been unsuccessful, but seed treatments with appropriate pesticides may be suitable. Additional studies to determine appropriate control techniques are required if the area planted to upland rice expands. ■

Rice leaf miner damage — a problem in Guyana

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

The rice leaf miner was first noted as a serious rice pest in Guyana in 1975. Leaf miner epidemics have since occurred regularly, especially on late-sown crops. Recent surveys have revealed that only one species of *Hydrellia* (Diptera: Ephydridae) (described by the author as *H. deonieri* n. sp.) is endemic to Guyana and damages rice throughout the rice-growing belt. Damage can appear as a deadheart, mining, and dying of leaves on plants 7 to 32 days old. Damaged plants are stunted and less vigorous, and yields are reduced. The main reasons for the increasing importance of this pest are presumed to be a change in cultural practices (from dry to wet sowing) and the introduction of double-cropping.

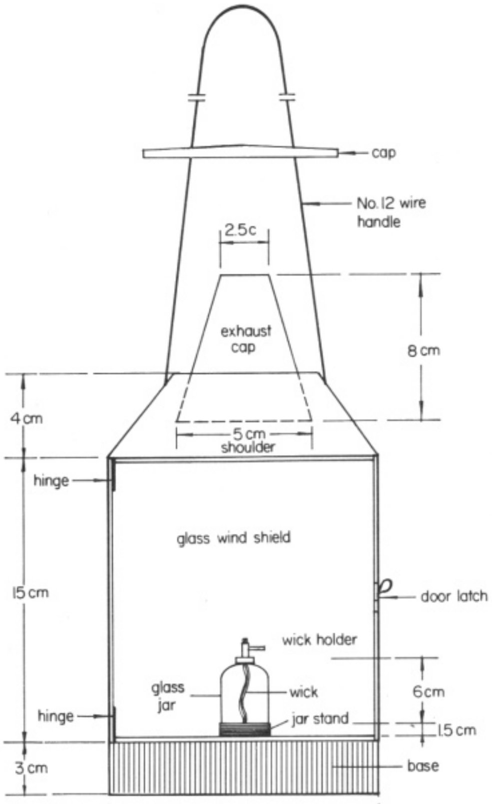
Two rice crops per year are now grown in Guyana: the main or autumn crop, harvested June–July, and the small or spring crop, harvested in December–January. Young rice seedlings that can be mined by the pest are present for a maximum of 3 to 4 months annually. A number of alternate host plants, all of the family Gramineae, help maintain the population level during the off-crop season. All varieties grown in Guyana are susceptible. In severe attacks, fields up to 40 ha have been completely destroyed. ■

An inexpensive kerosene light trap to monitor rice insects

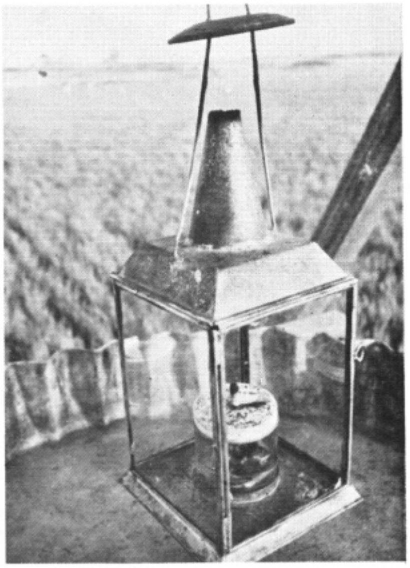
Entomology Department, International Rice Research Institute

An inexpensive kerosene light trap tested in Philippine rice fields in 1978 is highly attractive to the following insects: *Tryporyza incertulas, T. innotata, Chilo suppressalis, Sesamia inferens, Nymphula depunctalis, Cnaphalocrosis medinalis, Nilaparvata lugens, Nephotettix virescens, N. nigropictus, Sogatella furcifera, Cyrtorhinus lividipennis, Naranga aenescens,* and *Rivula* nr. *atimeta.* The lantern is an improvement of that presented in the *1970 Rice production manual.*

The light source is a fisherman's kerosene lantern designed for outdoor use. Village tinsmiths can easily make it with locally available materials. Each lantern costs about US$4. It uses only a few cents worth of kerosene per night and produces a bright white light. The funnel-shaped exhaust cap extends 4 cm down into the lantern body and efficiently removes the small amount of soot that accumulates on the inside of the glass (see figure). Rain does not affect the lantern's performance. The lantern, attached to a wooden or bamboo support frame, hangs above the rice crop. The frame has a platform that supports a basin of water (see photo). Cooking oil that is added covers the water surface and immobilizes fallen insects. Experience shows that baffles are not necessary. The insects hit the lantern and fall into the water basin below.



1. Design of the lantern with handle. IRRI Entomology Department.



The kerosene lantern can he made inexpensively from local materials. lRRl Entomology Department.

Farmers who have been taught to recognize each important species can recover and count insects daily. We are now correlating daily catches with field populations. We hope that farmers and extension technicians can use the trap as a tool in forecasting. ■

Natural enemies of the rice leaf folder *Cnaphalocrosis medinalis* in the Philippines

A. T. Barrion. J. P. Bandong, M. D. Lumaban, P. C. Pantua, R. A. Apostol, and J. A. Litsinger, Entomology Department, International Rice Research Institute

Only a braconid (*Apanteles angustibasis* Gahan) and a chalcid (*Brachymeria excarinata* Gahan) have been reported to parasitize the rice leaf folder *Cnaphalocrosis medinalis* in the Philippines.

From 1976 to 1978 we expanded the list of parasites of the rice leaf folder by including data on its natural enemies at its four life stages, from four Philippine provinces representing irrigated (Laguna), rainfed wetland (Iloilo and Pangasinan), and dryland (Batangas) rice improvements (see table). We exposed rice plants laden with eggs in the field but recoverd no egg parasites. We held field-collected larvae and pupae and recorded seven new parasites. Through field observation and follow-up laboratory studies we determined seven new predators of the larval or adult stages. ■

List of parasites and predators of the rice leaf folder, Philippines, 1976–78.

Parasite	Life stage of leaf folder	Predator	Life stage of leaf folder
Hymenoptera		Coleoptera (det. A.T. Barrion)	
Braconidae (det. A.T. Barrion)		Carabidae	
Apanteles angustibasis Gahan	Larva	*Desera geniculata* ^{a} (adult)	Larva
Cardiochiles philippinensis Ashmead ^{a}	Larva	*Chlaenius* sp. ^{a} (larva)	Larva
Macrocentrus philippinensis Ashmead ^{a}	Larva	Hymenoptera (det. A.T. Barrion)	
Ichneumonidae (det. G. Chandra)		Formicidae	
Temelucha stangli (Ashmead) ^{a}	Larva	*Odontomachus* sp. ^{a}	Larva
Trichomma cnaphalocrosis Uchida ^{a}	Larva-pupa	*Solenopsis germinata rufa*	Larva
Xanthopimpla flavolineata Cameron ^{a}	Larva	Araneida	
Chalcididae (det. A.T. Barrion)		Oxyopidae	
Brachymeria excarinata Gahan	Larva-pupa	*Oxyopes javanus* Thorell ^{a}	Larva & adult
Bethylidae (det. A.T. Barrion)		Argiopidae	
Goniozus nr. *indicus* Muesebeck ^{a}	Larva	*Argiope amulus* ^{a}	Adult
Diptera		*Nephila maculata* ^{a}	Adult
Tachinidae (det. H. Shima)			
Argyrophylax nigrotibialis (Baranov) ^{a}	Larva		

^{a}New Philippine record.

Publication list on rice insects available at IRRI

The IRRI Entomology Department has developed a list of publications on rice insects that were authored by IRRI staff members or were presented at IRRI-supported conferences.

Interested persons are invited to write to the Entomology Department, IRRI, P.O. Box 933, Manila, to receive the list and an order form for requesting reprints. Persons who request the list will automatically be placed on the entomology mailing list to receive future lists and order forms, which will be issued annually.

A new record of *Megoselia scalaris* on *Chilo suppressalis* in the Philippines

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

Although natural enenlies of *Chilo suppressalis* have been investigated in the Philippines since 1930, no phorid parasites associated with this stem borer species have been reported. We reared *Megaselia scalaris* (Loew) for the first time from striped rice borer larvae and pupae collected in Laguna province, Philippines. The species was previously reported on the yellow rice stem borer *Tryporyza incertulas* (Walker) in China and Bangladesh.

The parasite was identified by the senior author as *Megaselia scalaris* (L.), which, according to the literature, is cosmopolitan, breeding in cattle wounds or in rotting animals, or plant debris. The adult fly (2.5 mm long) can be distinguished from closely related species by its yellow body and legs, transparent wings, and the lack of a distinct black spot on the apex of each middle femur.

Percentage of parasitization by *Megaselia scalaris* (Loew) of striped stem borer *C. suppressalis* (Walker). IRRI, 1978.

Sampling date	Parasites (%) that emerged ^{a} from	
	Larvae	Pupae
10 Jan	5 (20)	0 (10)
17 Jan	0 (10)	0 (2)
31 Jan	0 (22)	3 (18)
7 Feb	7.14 (56)	0 (62)
14 Peb	1.8 (56)	1.6 (62)
28 Feb	8.2 (98)	1 (104)
7 Mar	2.2 (87)	0 (91)

^{a}Numbers in parentheses refer to the number of host borers successfully reared.

Stem borer larvae parasitized by the fly became immobile, and parasitized pupae turned darker than normal. Just before the host died, 10 to 15 phorid larvae, each about 5 mm long and dirty white in color, emerged from the host and immediately pupated. Laboratory rearing of field-collected borers at IRRI from 10 January to 7 March 1978 showed that the percentage of parasites that emerged from larvae was higher than the percentage that emerged from pupae.

Ichneumonid parasitoids of the rice yellow borer in West Bengal, India

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The yellow stem borer population has often been low in the multiple rice cropping system on the alluvial soils of West Bengal. One reason for the low insect density may be the many parasitoids that attack yellow borer larvae or pupae. Parasitoids have also been found in sweep-net collections. The ichneumonid parasitoids found at the Chinsurah station, and identified after the type specimens by the Commonwealth institute of Biological Control, Bangalore, and by the key in IBP Handbook 14 are listed below. Further work on the host range and relative abundance of the parasites is in progress. ■

Parasitoid	Host stage	Time of collection	Remarks
Temelucha philippinensis (Ash.)	Larva and Pupa	Feb, Aug, and Dec	Also found in light trap
Temelucha stangli (Ash.)	Pupa	July	
Isotima javensis (Rohw.)	Larva and pupa	Feb, May, and Nov	
Amauromorpha sp.	Pupa	Apr	
Trathala flavoorbitalis (Cam.)	–	Aug to Nov	Only in sweep net
Eriborus sp.	–	Aug to Nov	Only in sweep net
Xanthopimpla spp.	–	Aug to Nov	Only in sweep net
Goryphus mesoxanthus maculipennis (Cam.)	–	Nov	Only in sweep net

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Effects of spacing on rice hispa incidence

G. S. Dhaliwal and Jaswant Singh, Punjab Agricultural University, Regional Rice Research Station, Kapurthala 144601, Punjab, India

A field trial was laid out in *kharif* 1978 to study the effect of spacing on rice insect incidence. Forty-five-day-old seedlings of PR106 were transplanted in 5- × 4-m plots at 3 spacings. Each spacing was replicated three times. Recommended agronomic practices were followed (120 kg N, 30 kg P_2O_5, and 30 kg K_2O/ha). The rice hispa Dicladispa armigera was the predominant species attacking the crop. The damaged leaves on selected 10 hills from each plot were counted.

Although the differences in hispa-damaged leaves in 3 spacings were significant only at 40 days after transplanting, the widely spaced plants were damaged more severely. There were 9.2, 14.1, and 21.2 hispa-damaged leaves per 10 hills in the 10- × 10-cm, 20- × 15-cm, and 30- × 30-cm spacing, respectively. The rice hispa prefers widely spaced plants probably because it lays eggs on leaf tips, which are better exposed in widely spaced plants. ■

Incidence of rice hispa in different spacings (mean of 9 observations). Kapurthala, Punjab, India.

Spacing (cm)	Damaged leaves[a] (av no./10 hills)				Mean
	20 DT	40 DT	60 DT	80 DT	
10 × 10	12.0 (3.43)	3.9 (1.96)	10.0 (3.15)	10.9 (3.28)	9.2
20 × 15	17.2 (4.14)	6.8 (2.56)	15.3 (3.80)	17.2 (4.13)	14.1
30 × 30	34.8 (5.79)	11.8 0.42)	15.2 (3.90)	23.0 (4.70)	21.2
C.D. (P = 0.05)	(n.s.)	(1.39)	(n.s.)	(n.s.)	

[a] Figures in parentheses arc$\sqrt{n}$ transformations. DT = days after transplanting. n.s. = nonsignificant.

Some new weed hosts of rice hispa recorded in India

G. S. Dhaliwal, Punjab Agricultural University, Regional Rice Research Station, Kapurthala-144601, Punjab, India

The rice hispa *Dicladispa armigera,* previously a minor rice pest in the Punjab, recently has become serious.

In 1978 kharif the weed flora at the Kapurthala Rice Research Station was intensively surveyed to determine if they serve as food plants for rice hispa. Adult hispa beetles were found on some common Gramineae weeds such as *Echinochloa crus-galli, E. colona. Paspalum distichum.* and *Cynodon* dactylon. *E. crus-galli* and *E. colona* were generally found in and around rice fields, but *P. distichum* and *C. dactylon* were found mostly on bunds around the fields. The leaves of the attacked plants showed characteristic hispa feeding injury. There were, on the average, 29, 12, 12, and 11 adult beetles/10 plants on *E. crus-galli, E. colona, P. distichum,* and *C dactylon,* respectively.

E. crus-galli, P. distichum, and *C dactylon* are new additions to the list of weeds known to host the rice hispa in India. ■

Rice green leafhopper susceptibility to vamidothion in central Taiwan

H. T. Feng, L. R. Kao, S. M. Chou, Y. J. Tseng, T. C. Chung, C. F. Chen, H. L. Kao, and C. N. Sun, Entomology Department, National Chung-Hsing University, P.O. Box 17-2 7, Taichung, Taiwan 400

Rice green leafhoppers (GLH) collected at 5 locations within a 30-km² area in central Taiwan were tested by topical application for susceptibility to vamidothion, an organophosphorus insecticide for GLH control in Taiwan. Populations from two locations (A and E, see table) were resistant to the chemical when compared with the most susceptible population (C), and using a resistance ratio of 5 as the demarcation.

No apparent relationship between susceptibility to this compound and the cholinesterase activity of the populations could be found, although the most resistant population (E) showed the lowest cholinesterase activity, and the least sensitivity to vamidothion. When populations E and B were compared, a resistance ratio of about 6 was found associated with an I_{50} ratio of about 5. The results indicate that reduced cholinesterase activity and a change of the target site sensitivity could play a considerable role in vamidothion resistance in GLH. Electrophoretic studies revealed qualitative differences in esterase zymograms among the populations. ■

Vamidothion susceptibility, cholinesterase activity, and sensitivity of rice green leafhoppers in central Taiwan.

Population	Location	LD_{50} (µg/g)	Resistance ratio	Cholinesterase	
				Activity (µmol/min)	I_{50} M
A	Shu-wang	10.57	8.7:1	0.069	4.40×10^{-4}
B	Wu-fu	5.53	4.5:1	0.093	2.70×10^{-4}
C	Hsia-tien	1.22	1.0:1	0.054	3.60×10^{-4}
D	Nay-hsin	4.07	3.3:1	0.057	5.00×10^{-4}
E	Lu-tsun	32.10	26.3:1	0.050	1.44×10^{-3}

Effect of selected insecticides on striped stem borer eggs

S. L. Valencia and E. A. Heinrichs, Entomology Department, International Rice Research Institute

Eggs of the striped stem borer *Chilo suppressalis* in the blackhead stage were treated with candidate insecticides at 0.04% concentration. Before treatment, each egg mass was examined under the microscope to determine the initial number of eggs per mass. Three egg masses were dipped in insecticide solutions for 5 minutes then transferred to a petri dish with moistened filter paper and kept in an insectary for 48 hours. The eggs were counted again to determine the number that were unhatched. Larvae that emerged and died alter hatching were considered hatched. Each treatment was replicated four times. The table shows the results. ■

Effect of selected insecticides on eggs of the striped stem borer. IRRI 1979.

Insecticide	Formulation	Eggs (initial no.)	Unhatched eggs (no.)	Ovicidal[a] activity (%)
Methyl parathion	50 EC	661	622	92.9
Carbofuran	12 F	596	593	99.4
Methomyl	90 WP	619	600	96.5
Triazophos	40 EC	656	588	89.1
Control		586	163	26.4

[a] Av of 4 replications, each containing 3 egg masses.

Soil and crop management

Preference for ammonium sulfate as first topdressing in lev method of rice cultivation

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Farmers in Karchhana Tahsil, Allahabad district, commonly direct-seed rice with little field preparation after the onset of the monsoon. To control weeds, they then plow the crop with a deshia plow and plank it under flooded conditions when plants are about 1 month old or 15–21 cm tall. The practice is locally called *lev*. Progressive farmers in the area claim that ammonium sulfate is superior to urea as the first topdressing in that rice-cultivation method. An experiment in farmers' fields was conducted to investigate the claim.

Sixteen farmers' fields, selected during 1978 kharif, were prepared with two cross plows. No basal fertilizers were applied. The variety Saket 4 was broadcast seeded at 100 kg seed/ha in the first week of July. Five weeks after sowing the plots were plowed twice with a deshia plow and planked under flooded conditions. In the first eight plots, ammonium sulfate was topdressed immediately after plowing; in the other eight plots, urea was topdressed a week after plowing. Both fertilizer treatments were at 40 kg N/ha. The second topdressing was applied uniformly in all plots about 10 weeks after sowing with 30 kg N/ha as urea.

Visual observations 2 weeks after the first topdressing showed that weed re-establishment, weed density, and weed growth were less in the plots that received ammonium sulfate than in the plots that received urea. Ammonium sulfate also helped decompose weeds. Urea applied a week after crop plowing did not influence weed decomposition, so most of the weeds re-established. Grain yields were also remarkably increased. Average grain yield was 3.26 t/ha for the ammonium sulfate treatment, and 2.4 t/ha for urea. Since no additional input costs are involved, extension agencies may consider suggesting the method to farmers. ■

Influence of soil moisture regime on iron and manganese release in soil and on the growth of upland rice

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A pot experiment, conducted on Vertic Ustropepts (medium black clay: pH 8.5; $CaCO_3$, 6.0%; and organic carbon, 0.5%) in the 1977 rainy season, studied the influence of soil saturation and submergence for 10 and 20 days before sowing on the supply of iron and manganese in the soil and on the dry matter yield of upland rice. The variety used was Karjat 184.

The iron and manganese supply in the soil increased with the duration of soil saturation or submergence (see table). The increase may have been caused by moderately reduced soil conditions that resulted from soil saturation or submergence before sowing (Eh values decreased from 501 mV to 369 mV and pH decreased from 8.6 to 7.6). Iron and manganese contents in the soil were higher after submergence for 10 or 20 days than after soil saturation. The dry-matter yield increased — probably because of the higher supply of iron and manganese. ■

Iron and manganese contents in soil and dry matter yield of rice as influenced by soil moisture regimes before sowing. Mean of 5 replications. Maharashtra, India

Soil water treatment before sowing	Iron content (ppm)		Manganese content (ppm)		Dry matter yield of rice at harvest (g/ 5 plants per pot)
	Initial (immediately after soil water treatment)	Fiinal (at the end of soil water treatment period 10 or 20 days)	Initial (immediately after soil water treatment)	Fiinal (at the end of soil water treatment period)	
Soil saturation, 10 days	2.4	2.6	0.7	1.0	5.3
Soil submergence, 10 days	2.6	3.2	0.7	1.3	7.6
Soil saturation, 20 days	2.4	3.6	0.7	1.2	7.5
Soil submergence, 20 days	2.6	4.1	0.7	2.1	8.9
Control (dry soil)	1.2	1.2	0.7	0.7	5.2

A simple test for available zinc and copper in wetland rice soils

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Zinc deficiency is a widespread nutritional disorder of wetland rice. It occurs on alkali, calcareous, poorly drained mineral, and peat soils. Copper deficiency limits rice yields on peat soils and also, perhaps, on other zinc-deficient soils. The need for simple, rapid, and reliable method for estimating zinc and copper in soils used for wetland rice is pressing.

Because the widely used DTPA and EDTA methods consume too much time and chemicals, 0.1 *N* HCl and 0.05 *N* HCl as extractants for available zinc and copper were compared with DTPA and EDTA in a laboratory and greenhouse study of 32 soils covering a wide range of pH and organic matter content.

The 0.1 *N* HCl method consisted of shaking 2 g air-dry soil with 20 ml 0.1 *N* HCl for 5 minutes. The 0.05 *N* HCl method used 10 g air-dry soil. 20 ml 0.05 *N* HCl, and 5 minutes shaking. The extracts were filtered and zinc and copper determined by atomic absorption spectrophotometry, along with the DTPA and EDTA extracts obtained by shaking for 2 hours and 30 minutes, respectively. Rice plants grown on the flooded soils were wet-ashed and the concentrations of zinc and copper measured.

The 0.05 *N* HCl method gave the best correlation between extractable zinc and copper and their concentration in the plant:

Method	Concn of element in extract vs concn in plant	
	Zn	*Cu*
ESDTA-$(NH_4)_2CO_3$	.43**	.28ns
DTPA/TEA	.31 ns	.20ns
0.1 *N* HCl	.55**	.64**
0.05 *N* HCl	.88**	.74**

On 13 of the 16 soils that contained less than 1 ppm Zn extractable with 0.05 *N* HCl, plants showed zinc deficiency symptoms or contained < 27 ppm zinc. Although no copper deficiency symptoms were recognized, plants growing on 13 of 15 soils with <0.1 ppm Cu by the 0.05 *N* HCl method contained < 5 ppm copper.

Available zinc (0.05 *N* HCl) correlated highly with available copper (0.05 *N* HCl) with $r = .58$**. So did plant zinc and copper, with $r = .52^{**}$. Apparently, because of similarities in their chemical behavior, copper deficiency may occur in zinc-deficient soils.

The 0.05 *N* HCl extraction appears to be an accurate, simple, rapid, and inexpensive method of measuring available zinc and copper in soils used for wetland rice. ■

Summer plowing overcomes zinc deficiency

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The problem of zinc deficiency (khaira) with high yielding rice varieties is widespread in Allahabad district, India. Applications of farmyard manure and of zinc sulfate are commonly used to overcome the problem. Farmers have also noted beneficial effects from summer plowing.

During 1977–78 kharif rice plots were selected and observed in national demonstrations and in farmers' fields. The plots that were plowed in summer had no severe deficiency problems even when planted to high yielding, semidwarf rice varieties. Some demonstration plots without summer plowing showed severe zinc deficiency even when supplied with 40 kg $ZnSO_4$/ha as a basal dressing. They needed a topdressing of an equal amount of $ZnSO_4$ to overcome the problem.

In a few demonstration plots that were plowed in summer and received 40 kg $ZnSO_4$/ha as a basal dressing, plants showed no traces of zinc deficiency. Rice plants grown in the plots that were plowed in summer had profuse and deep roots, regardless of other treatments. Presumably the increased root growth helped the plants escape zinc deficiency.■

Scanning electron micrographs of rice primordia

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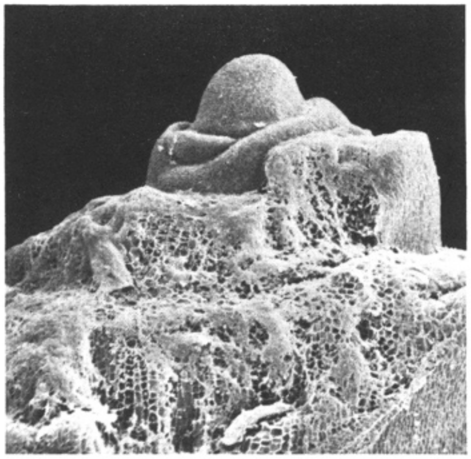
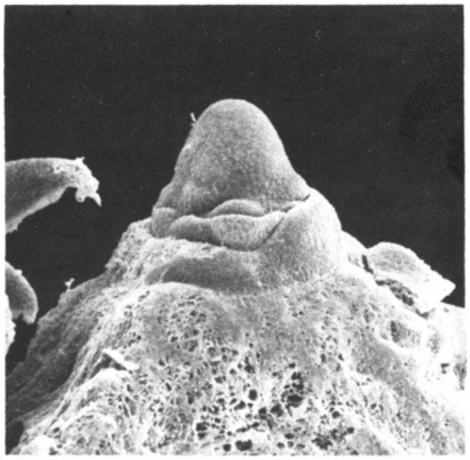
The primordia of only a relatively few species of crop plants have been studied in detail. The Division of Land Use Research has a project, nearing completion, to produce a photographic atlas illustrating generally acceptable definitions of floral initiation for the major field crops. The atlas will set standards for agronomists and other scientists studying the development of field crops.

Floral initiation is defined as the first structural change in the apex. In rice the change from the vegetative to the reproductive stage is marked by the initiation of microscopic bracts on the main culm (Photo 2). Panicle development continues and the young panicle primordium eventually becomes visible to the naked eye as a hyaline structure 1-2 mm long with a white fuzzed trip (Photo 4).

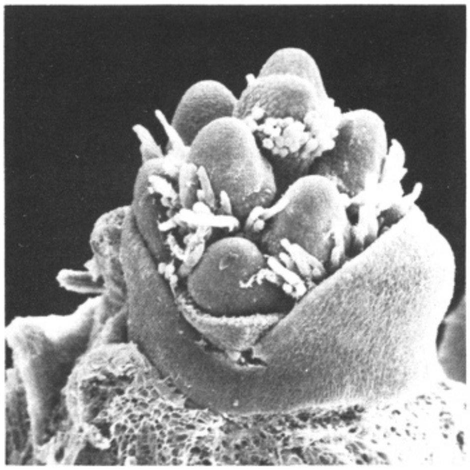
Panicle initiation in the field is commonly identified by the appearance of the white fuzzed structure. At temperatures ranging from 25 to 35°C, this stage occurs about 2-3 days after first bract initiation. At lower temperature it occurs much later. The photographs show that the primary branches differentiated before the white fuzzed tip became visible to the naked eye. The yield potential is therefore largely determined by this stage.■



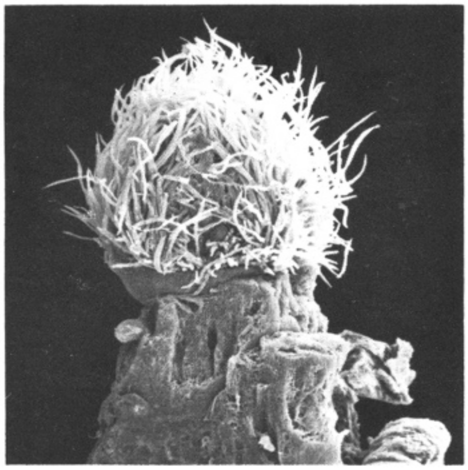
1. Vegetative apex (x75)



2. Several bracts initiated (x75)



3. Bract hairs developing (x75)



4. Approximately 1 mm long and visible as a white fuzzed tip (x25)

Rice-based cropping systems

Relay cropping of Nendran banana in rice fields in Kerala, India

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Rice cultivation is becoming less profitable in Kerala because of rising costs of labor and inputs. Inflow from other Indian states has also depressed rice prices. Farmers are switching their better drained, terraced rice fields to cassava, sweet potato, Nendran banana (which belongs to the Horn-plantain group), and vegetables. A 2-year rotation of Nendran banana, cassava, and medium-duration rice is now common in terraced rice tracts. Other short-duration vegetable crops such as colocasia, sweet potato, cucumber, okra, or amaranthus are also grown between the banana plants, making it a 3- or 4-tiered cropping pattern. The growing of different crops with canopies of varying heights simultaneously on the same land optimizes exploitation of available solar energy.

But some farmers in the terraced rice fields of Malappuram district practice an unusual system – relay-cropping of rice and Nendran banana (see photo). Beside the usual single rice crop, a crop of Nendran banana is also raised yearly, bringing a net profit of about $1,200/ha.

Nendran banana and rice in fields of Kerala, India.

After the onset of the southwest monsoon, the autumn rice crop is transplanted as usual. Once seedlings are established, fresh Nendran banana suckers with pseudostems 40 to 50 cm in height are thrust in the standing rice crop, spaced 2 m apart. The bananas receive no attention until harvest. Rice is cultivated as usual. By the time of rice harvest, each banana sucker has produced 3 or 4 small leaves (on which birds perch to eat rice insect pests).

Stagnant water is drained after the rice harvest. The field is gradually converted into beds and furrows with spades, thus placing the banana suckers in beds that are gradually raised by applying green leaf manure and earth. The beds and furrows serve as both drainage channels in rainy months and as channels for furrow irrigation in summer.

After beds and furrows are formed, seeds of intercrops such as cucumber and okra are dibbled and colocasia corn is planted between banana suckers. A farmyard manure-ash mixture is usually applied in the bed for both the banana and intercrops; nitrogen and potassium fertilizer are sometimes applied. The banana suckers grow vigorously and begin to shoot about 7 months after planting. The crop is irrigated by furrows or furrows combined with splash irrigation. Each banana plant is propped for wind protection. The bunches mature 3–3.5 months after shooting. Some farmers claim that they harvest banana about 1 month earlier by using the system. This type of relay cropping is practiced only on alternate years in double-cropped rice fields. With moderate fertilizer application, the rice crop that succeeds the banana crop gives bumper yields. ■

CORRECTIONS

IRRN 3:5 (October 1978)

Page 7. In A.K. Roy, *Reaction of rice cultivars to rice sheath and leaf blight,* paragraph 1. line 9, should read: "Twenty-day-old seedlings were transplanted in small plots (5 rows each), replicated twice."

Page 7. Paragraph 6. line 11, of A. K. Roy's article – Delete "Sikirimonko."

Page 22 – The legend *Plant ht (cm)* on the upper part of the figure should read *Root wt (g).*

IRRN 3:6 (December 1978)

Page 12 – In the figure legend, ■ *Biotype 3* should read ■ *Biotypeshifting.*

Announcements

IRRI Entomology Department offers index of literature

As a service to rice entomologists the IRRI Entomology Department is cross-indexing current literature on arthropods in rice-based agroecosystems received at IRRI. Scientists interested in receiving a list of publications on a particular topic are invited to write to the Entomology Department. The request should be highly specific because more than 12,000 articles are currently in the system.

The indexing system involves several thousand key words, including arthropod groups or species, crop or weed species, country, author, methods, and detailed aspects of taxonomy, biology, morphology, physiology, ecology, pest management, chemical control (including each pesticide), host-plant resistance, cultural control, and biological control. The following examples show how requests can be made specific.

1. *Nilaparvata lugens* x alternate weed host
2. Rice stem borer x economic threshold
3. *Tryporyza* x cropping system
4. Rice insects x stored product x India
5. Rice bug x chemical control x carbaryl
6. Rice armyworm x biocontrol x parasite

A list of key words is available on request, but only one copy can be sent to each institution. IRRI is soliciting published or unpublished papers for inclusion in the system. ■

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