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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-f ive 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

Portable vacuum emasculator

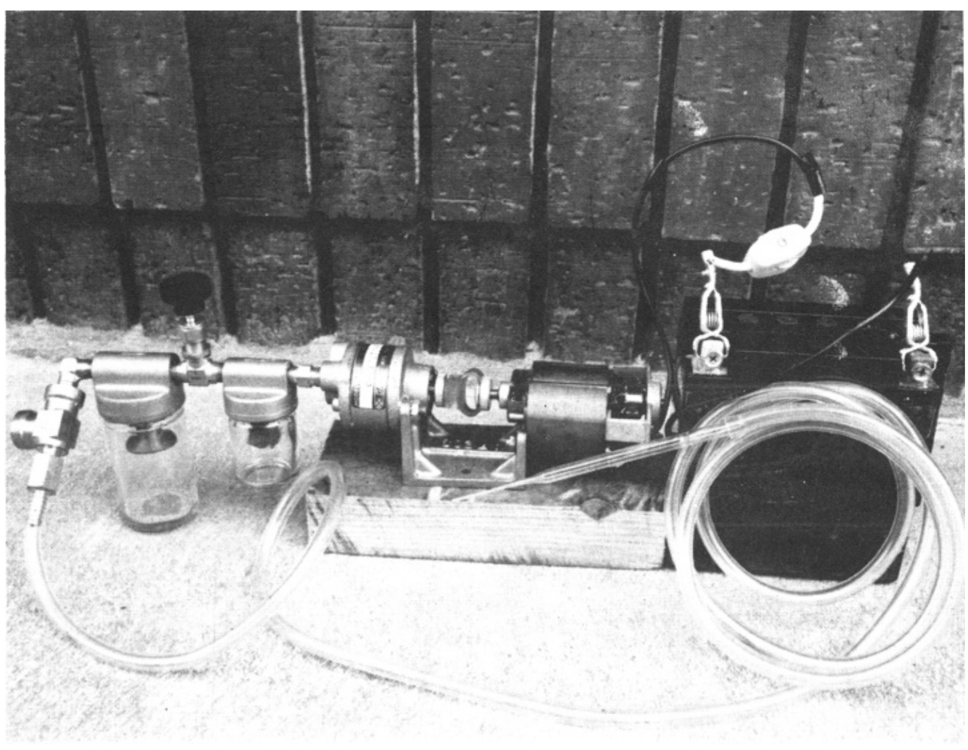
W. R. Coffman, plant breeder, International Rice Research Institute

The first vacuum emasculator was developed by L. E. Kirk in 1930. J. G. Van der Meulen first used one with rice in 1933 in Indonesia. The vacuum emasculator was not used extensively on rice (except in the US) until it was modified by R. M. Herrera and the author in 1974. Since that time several major rice improvement programs in Asia have obtained emasculators through IRRI and used them effectively in their crossing programs. But the IRRI model is expensive (more than US$500) and not portable. Essentially, its use is limited to greenhouses or screenhouses with 220-V AC. That makes the vacuum emasculator impractical for many smaller programs.

The first portable vacuum emasculator for rice was designed in the early 1950s by L. E. Crane and H. M. Beachell of Beaumont, Texas; it was later modified by J. E. Scott of the Beaumont station. Many of their ideas were used in the construction of a newer portable emasculator (Photo 1). The new model consists of a rotary vane vacuum pump that develops a continuous vacuum of 508 mm/Hg. The 12-V DC electric motor that develops 1/25 hp at 4,000 rev/min is powered by a small 12-V motorcycle battery that must be recharged periodically. Accessories include an air filter, an anther trap, tygon tubing, disposable pipette, and appropriate fittings.

The pipette is breakable. If a ready supply is not available, a large bore (#16) veterinary needle may be used instead.

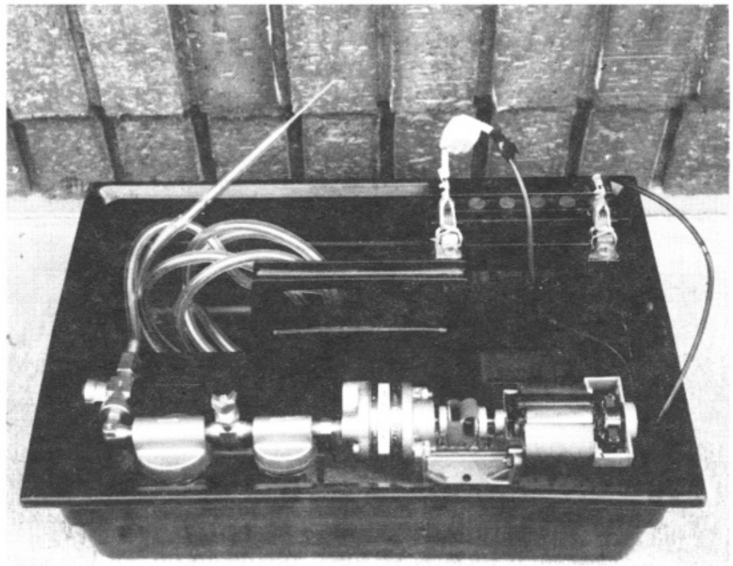
The assembled unit, including the



1. A new portable vacuum emasculator.

battery and carrying box, weighs 4.4 kg. It can be carried in any convenient small box. A plastic box (Photo 2) will permit the unit to float in the paddy water, although the position of the battery must be adjusted for proper balance. One operator can emasculate 12 panicles/hour with the unit, depending on the operator's skill and other variables.

The entire unit (including the box and a small battery charger) costs about US$l50. Prices may vary, depending on the local availability of the components. The pump, motor, filter, and trap are manufactured by Gast Manufacturing Corp., Benton Harbor, Michigan, US. Units may be purchased at cost through the Plant Breeding Department, IRRI. □



2. Portable vacuum emasculator in a plastic carrying case that allows the unit to float when operated in the field.

Scientific publication among rice breeders in Asia

Thomas R. Hargrove, associate editor, International Rice Research Institute

The scientific papers or articles that 38 rice breeders had published or had accepted for publication in 1974-75 were analyzed as part of a research project on rice breeding programs in 10 Asian nations: Bangladesh, India, Indonesia, Iran, Korea, Nepal, Pakistan, Philippines, Sri Lanka, and Thailand.

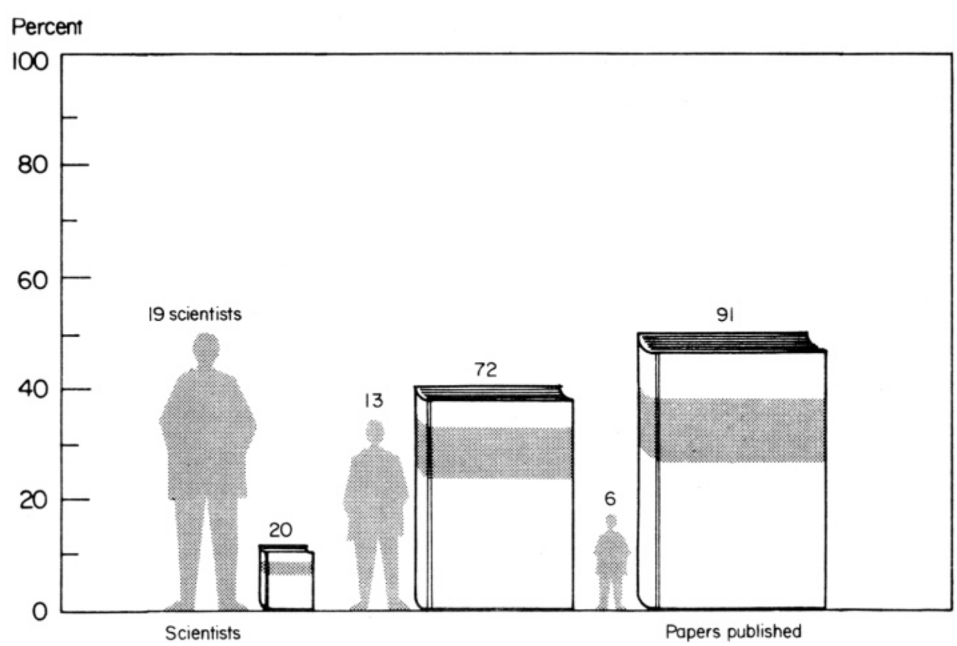
The 38 scientists had authored or coauthored 183 scientific papers during the 2 years — an average of 2.4 papers/ scientist per year. Fifty-three percent of the papers were published in journals within the scientist's own nation; 23% in institutional publications; 18% in journals in highly developed nations; and 6% in international publications such as the International Rice Commission Newsletter or the SABRAO Newsletter.

The distribution of publication productivity was later determined and compared with that predicted by Derek de Solla Price, who states that *half of the publications produced by a population of* n *scientists are authored by the most productive of about* $\sqrt{n}$ *of the population.* The inverse-square root law has held true since the early scientific journals of the 17th century, but most of the research has been conducted on chemists and physicists in the western nations.

Half of the publications were authored by only 6 of the breeders — roughly the square root of the sample of 38 breeders. And 50% of the breeders authored 11% of the total publications (see figure).

That suggests that the scientific norms of rice breeders are similar to those of other scientists, and that Asian scientists' norms are similar to those of peer scientists in America and Europe.

When social characteristics of the scientists were compared, it was found that all the high publishers and 30% of the low publishers held the Ph.D. On the average, the high publishers were about 3 years older than the low publishers and had about 3 more years of professional experience working with rice (see table).



A study of Asian rice breeders and the scientific publications that they authored or coauthored over a 2-year period (1974–75) showed that 50% of the scientists had written or helped write 11% of the total scientific articles published by the sample; 16% had published 50% of the articles. One hundred and eighty-three scientific articles and contributions to scientific books published by 38 rice breeders at 27 agricultural experiment stations and universities in 10 Asian nations.

A comparison of the educational and sociological backgrounds of 19 low-publishing and 6 high-publishing rice breeders in Asia. Taken from a sample of 38 rice breeders at 27 agricultural experiment stations and universities in 10 Asian nations, 1975.

Characteristic	Rice breeders	
	Low publishers (19)	High publishers (6)
Highest educational attainment		
B.S. (70)	35	0
M.S. (%)	35	0
Ph.D. (%)	30	100
Source of highest degree		
Local (%)	70	33
Other Asian countries (76)	5	17
Highly developed country (70)	25[a]	50
Av. age (yr)	40.5	43.8
Av. professional experience (yr)	12.2	15.5
Travel[b]		
Foreign travel (70)	79	83
Trips (av. no./scientist)	2.3	1.5
Preferences for scientific publication[c]		
National (%)	42	17
International (76)	10	0
Highly developed country (76)	32	83
No response (%)	16	0

[a] Of six low-publishing Ph.D.'s, four were educated in highly developed nations. One scientist whose highest educational attainment was an M.S. degree had received the degree in a highly developed nation.
[b] Scientists who had traveled abroad in the past 5 years.
[c] When asked to name the scientific journal or publication in which they would most like to publish an article about their research results, if they could be assured of publication anywhere in the world.

They averaged slightly fewer trips abroad.

The purpose of the research was to better understand how scientific information moves among Asian rice improvement programs. The author in no way implies that the rice breeders who published the most papers, or even papers in the most prestigious journals, are better or worse scientists than the others.

The research was partially funded by a grant from The Rockefeller Foundation. □

GENETIC EVALUATION & UTILIZATION

Disease resistance

Varietal resistance of rice to sheath blight

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

Rice varieties and cultures in Tamil Nadu were screened for resistance to sheath blight disease of rice caused by *Rhizoctonia solani.* During the maximum-tillering stage, 1,404 cultivars were inoculated with the *R. solani* pathogen by the straw bit method. Thirty-six rices were resistant and 68 moderately resistant.

The resistant rices were: ADT 22, ADT 5, CO20, Ponni, Ratna, Thillainayagam (S.AR) Cult. 55-100, V228, W449, Wase Aikoku, T1185, V42, Dular, Cult. 2100, Cult. 6547, Cult. 2210-2, Cult. 5143, Kam Ban Ngan, IR1544-340, DGWG, IR1156-501-P, Cult. 3879, Cult. 3896, Cult. 3875, Cult. 3885, Cult. 3948. Cult. 3965, Cult. 3964, Cult. 3868, Cult. 5996, Cult. 4295, Cult. 4078, Cult. 3904, Cult. 3900, Cult. 6001, and Cult. 3872.

The moderately resistant rices were: Cult. 3953, Cult. 3916, Cult. 3961, Cult. 3886, Cult. 5994, Cult. 6003, Cult. 3867, Cult. 6008, Cult. 3945, Cult. 3877, Cult. 3987, Cult. 4116, Cult. 13493, CR-1014, Jaya, Bala, IR5, CR-6, Cauvery, Bhavani, Pankaj, Jarnuna, IET-1991, CO2, C07, COI9, C022, GEB24, C027, C028, C023, C031, C032, C036, ADT13, ADT25, ASD4, ASD9, ASD13, ASD7, PTBl5, Tetep, Zenith, Dawn, 46-Palman, IR3273, IR1103-15-8-3, IR1614-389-3, IR579-126, IET2913, V-11/3, V-238, Cult. 2226, Cult. 1900, AC82, Thangasamba, T-336, MTU-5715, F13-22, V12, V121, T215, T1157, T347, Mottai Karu, AC-2959, Jagannath, and Malagkit Sungsong. □

Rice ragged stunt disease in India

R. Velusamy, M. Bulasubramanian, and P. V. Subba Rao, Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coirnbatore 3, India

Ragged stunt. a new virus disease of rice, was observed at the Paddy Breeding Station, Coimbatore, India, in February 1978.

Percentage of hills infected by ragged stunt virus disease. Tamil Nadu, India.

Variety	Infected hills[a] (%)
Cult. 644	89
IR30	83
Cult. 1722	83
Cult. 5202	14
IR28	73
Cult. 2361	13
Cult. 2684	69
Cauvery	64
IET2222	63
Cult. 13613	62
Cult. 658	52
IET1444	44
Cult. 1893	43
Vaigai	42
IR36	35

[a]Mean of 4 replications.

The diseased plants were stunted; leaves were ragged and smaller than normal ones; and flag leaves were deformed. Severely infected plants did not produce healthy grains and had incomplete panicle emergence. Yield losses ranged from 80 to 100%. Dr. E. A. Heinrichs of IRRI identified the disease in the field as caused by ragged stunt virus.

Ragged stunt incidence was further noted in 17 cultures grown in the field at that time. The percentage of ragged stunt-infected hills is presented in the table. □

Varietal resistance to neck blast in rice

B. N. Singh, junior rice breeder; R. A. Singh, plant pathologist; and B. D. Dubey, senior research assistant, G. B. Pant University of Agriculture and Technology, Pantnagar 263145, and Rice Research Station, Majhera, India

Blast *Pyricularia oryzae* is one of the most damaging rice diseases in the hills of Uttar Pradesh, India. During kharif 1977, two coordinated Uniform Variety Trials of rice were conducted at the Rice Research Station, Majhera, Nainital district. Severe neck blast incidence was scored on a scale of 1 to 9. Only 5 entries were resistant (see table). China 988 and China 1039, which have high cold tolerance, were highly susceptible to neck blast. The observations point out a major weakness in the composition of the hill trials. The entries should be thoroughly screened against diseases before promotion to advanced yield trials. This is particularly necessary in the Uttar Pradesh hills, where all representative races of the pathogen have been reported. □

Reaction of varieties to neck blast in the field. Uttar Pradesh, India.

Reaction [a]	Entries (no.)	Designation
Resistant	5	K17-9-1-1, K30-82-B-1, K35-67-2-1-3-1, K42-115-1-2-1-2, R × T 42.
Moderately resistant	5	K21-9-10-1, K26-2-36, K28-1, K42-86-B-2-1, KH6159.
Susceptible to highly susceptible	23	K17-BK-1-3-1, K18-6-B-2-1-2, K28-KH74, K28-48-B-2, K31-163-3, K39-96-3-1-1-1-2, K41-146-1, K41-105-2, K42-15-1-1-3-3, K46-15-13-2-24-1-1, K46-15-B-2-1, K84, K102-51-10, K102-42-2-1, K143-17-3, K178, K229-59, KR17254, KH7164, China972, China 988, China 1039, IR579-ES-29.

[a]Score of 1–3 = resistant, 5 = moderately resistant, 7–9 = susceptible to highly susceptible.

Field reaction of upland rainfed paddy varieties to various diseases in Karnataka, India

S. Sanne Gowda, pathologist, All India Cooperative Rice Improvement Project, Regional Research Station, V. C. Farm, Mandya; T. H. Khan, research assistant, Agricultural Research Station, Ponnampet; and M. Jayarama Reddy, research assistant, Main Research Station, Hebbal University of Agricultural Sciences, Bangalore, Karnataka, India

The reactions of a few selected varieties to natural infection by various diseases were tested at selected locations during kharif 1977. The table shows the variability of the varieties' reactions to different diseases at different locations, under irrigated and rainfed conditions. □

Reactions of upland paddy varieties to various diseases in Karnataka, India.

Designation	Origin	Reaction to diseases [a] at Mandya		Hebbal				Ponnampet			
		LB	NB	LB	NB	BB	BLS	LB	NB	Rhy	Hel
M161	Sel. from Mugad (local)	–	S	–	–	M	–	–	–	M	M
M249	-do-	L	S	M	S	S	M	M	S	M	M
M141	-do-	–	–	M	–	S	M	M	–	–	M
M81	-do-	L	S	–	S	M	L	M	S	–	M
HY258-1	280-51-36/M141	–	M	L	S	M	–	S	S	M	M
HY449-17	M141/Y-4	–	S	L	S	S	L	S	–	–	M
HY26-10	M141/Y-4	L	M	–	S	M	M	S	–	–	M
HY256	A200/475-36	L	M	L	S	S	L	S	S	M	–
HY249-13-1	280-51-36/M-141	L	M	–	S	M	L	S	S	–	M
Waner 1	Sel. from Waner		M	M	S	M	M	M	S	S	S
K44-1	Sel. from Kagasal	–	L	–	M	M	L	S	S	–	–
D6-2-2	Sel. from Dodigya	L	–	–	–	S	L	M	M	M	M
Y4	Sel. from Yelikerisal	–	–	–	–	M	M	S	M	–	M
A200	Sel. from Antarsal	M	–	–	–	M	M	S	M	–	–
A67	-do-	–	–	–	–	M	M	M	M	–	M
A90	-do-	L	M	–	S	M	L	M	M	–	S

[a]LB = leaf blast, NB = neck blast, BB = bacterial blight, BLS = bacterial leaf strek, Rhy = Rhynchosporium, Hel = Helminthosporium, L = low disease rating, M = medium disease rating, S = severe disease rating.

Reaction of IET3626 (TNAU13613) to *Helminthosporium* in Tamil Nadu, India

N. Jaleel Ahmed and P. Chidambaram, All India Cooperative Rice Improvement Project (AICRIP), Aduthurai, Tamil Nadu, India

Helminthosporium is a major rice disease in Tamil Nadu, primarily in the second crop season (Oct.–Feb.). All existing varieties are affected. To identify a good donor parent for resistance to *Helminthosporium,* many hybrid derivatives have been screened at Aduthurai for several years. Among the cultures tested, only IET3626 (TNAU13613 – a mutant of TKM6) was rated as resistant to moderately resistant. It exhibited a similar reaction at other AICRIP centers (see table). □

Reaction of IET3626 (TNAU13613) *Helminthosporium* in tests at various centers in India AICRIP, Aduthurai, Tamil Nadu, India.

Center	Reaction [a]	
	1976	1977
Coochbehar	–	MR
Cuttack	MR	R
Faizabad	MR	MR
Ponnampet	–	MR
Coimbatore	R	–
Kalimpong I	MR	–
Kalimpong II	MR	–
Aduthurai	MR	R

[a] MR = moderately resistant, R = resistant.

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GENETIC EVALUATION & UTILIZATION

Insect resistance

Need for varieties resistant to the whitebacked planthopper in the Punjab

G. S. Sidhu, rice breeder, Punjab Agricultural University, Rice Research Station, Kapurthala, Punjab, India

The whitebacked planthopper (WBPH) *Sogatella furcifera* was not an important rice pest when farmers grew traditional tall varieties in the Punjab. But with the cultivation of semidwarf varieties, WBPH began to cause alarming damage. Rice was hopperburned by WBPH in the rice seasons of 1967, 1972, 1975, and 1978 (see photo). In 1978 WBPH severely damaged a number of promising breeding lines in replicated yield trials at the Rice Research Station, Kapurthala (see table).

All the varieties in the table were considered susceptible, but the degree of damage varied. WBPH began to damage rice in mid-August. First damaged were the more leafy varieties PR274, PR437, PR558, PR559, and PR562. The insects started to migrate to other varieties at the milk stage. At the end of September, 10% BHC dust was applied at 25 kg/ha to salvage seed. Thus, the varieties with little damage were those not exposed to the WBPH attack for sufficient time at the proper growth stage.

The susceptibility of varieties with low damage was confirmed by their reaction in different replications. For example,

Whitebacked planthopper damage to some promising rice breeding lines in 1978. Approximate pooled damage in 3 replications estimated by visual observations. Punjab, India.

Cultivar	Cross	Damage (%)
PR106	IR8//Peta 5/Belle Patna	35
PR445	Basmati 370/Hamsa	35
PR560	IR8/Basmati 370	35
PR561	Basmati 370/Hamsa	35
PR563	Basmati 370/Jaya	35
PR270	Basmati 370/Hamsa	50
PR440	Basmati 370/Hamsa	50
PR484	Mutant Basmati 370 (0.4% EMS)	50
PR564	PP72/Mutant 65	50
PR565	IR8/Basmati 370	50
IET5862	Improved Sabarmati/Sona	50
IET6250	Improved Sabarmati/Sona	50
IET6251	Improved Sabarmati/Sona	50
R 36-2486	–	50
PR151	Mutant Basmati 370 (40 Kr)	70
PR274	Basmati 370/Hamsa	70
PR437	Basmati 370/IR8	70
PR476	Mutant Basmati 370 (0.4% EMS)	70
PR503	Basmati 370/Hamsa	70
CRM 10-57-10-4	Irradiated Basmati 370	70
CRM 5667-1	Irradiated Basmati 370	70
CRM 5713-8	Irradiated Basmati 370	70
CRM 5713-13	Irradiated Basmati 370	70
IET 3618	Sabarmati/Ratna	70
IET 4110	Basmati 370/IR8-36	70
IET 5729	Mutant Basmati 370	70
IET 5861	Improved Sabarmati/Sona	70
SFC I	–	70
SFC III	–	70
Basmati 370	–	70
PR558	Basmati 370/Hamsa	95
PR559	Basmati 370/Hamsa	95
PR562	Basmati 370/Hamsa	95

PR106 had less than 20% damage in one replication but more than 60% of its plot was completely destroyed in another replication. The same was true for PR445, PR560, PR561, and PR563.

A survey conducted by the Indian Directorate of Quarantine, Plant Protection, and Storage also revealed hopperburn on IR8 on farmers' fields in the Punjab in 1978. An objective of our future rice breeding programs is to develop WBPH-resistant varieties. □

Hopperburn in PR558 rice, caused by WBPH in 1978 at the Rice Research Station, Kapurthala, India.

Evaluation of rice strains for resistance to gall midge and leaf roller

K. Saivaraj, N. Chandramohan, N. Govindan, and T. Kumaraswami, Tamil Nadu Agricultural University, Madurai, India

Rice entries received from the All India Coordinated Rice Improvement Project were screened for resistance to gall midge *Orseolia oryzae* and leaf roller *Cnaphalocrosis medinalis* in a field trial laid out in a randomized block design at Madurai Agricultural College Farm in 1977-78. Of the 265 entries evaluated, 20 had minimum incidence of gall midge and leaf roller (see table). IET 6181, 6286, 6293, and 6195, on which the incidence of both gall midge and leaf roller was much lower than that on the susceptible varieties, appear to have some resistance to both insects.□

Rice entries resistant to gall midge and leaf roller, mean of two replications in 3 periods, Madurai, India.

IET no.	Designation	Parents	Tillers (%) affected by gall midge	Leaves (%) affected by leaf roller
Resistant to bath gall midge and leaf roller				
6181	WGL20691	CR44/W12708	0.9	7.1
6286	CR 95-181-2	Leaung 152/IR8	0	9.3
6293	WGL 26445	–	0	8.8
6295	RNR 32341	–	0.4	7.9
Resistant to gall midge				
4600	RP 872-1-2	Cauvery/W12787	0	–
5700	IR2071-636-5-5	IR24/CR94-13	0.8	–
5703	HYN 17-5-4	Hoyoku/Zinya	0.5	–
5981	OR 100-7	Kumar/Bala	0.9	–
5116	RP894-5-1-5-4	CR44-35/W12708	0.5	–
5233	RP872-20-4-3-4	Cauvery/W12787	0.4	–
5711	RP974-173-4	Sona/RP9-4	0	–
6257	1140-47-2-46-19		0.3	–
2911	RPW 6-17	IR8/Siam 29	0.7	–
3347	ORS 46 1	Leaung 152//IR8*2	0	–
3354	RP350-57-1-1	820862/820916	0.2	–
3356	RP352-28-1-1-4	IR8/PTB18//Eswarakora/IR8	0	–
3362	RP9-10-3-2-1-1	IR8/W1251	0.7	–
6287	CR 95-26-1	Leaung 152/IR8	0.7	–
6292	WGL 26442	–	0.3	–
–	RPW 6-13	–	0.7	–
Susceptible check				
Jaya			17.2	60.1
Pankaj			12.0	–

Outbreak of rice thrips in Kuttanadu, Kerala, India

M. J. Thomas, S. S. Nair, and N. R. Nair, Rice Research Station, Moncompu, Kerala, India

The usual farming practice in Kuttanadu is to grow a single rice crop (locally called *punja*) from October to February. Farmers have recently attempted to grow a second rice crop from April to September, which is almost free of serious insect problems.

The rice thrip *Buliothrips biformis* has only recently become a serious punja-season pest, especially on the late crop. The transplanted crop suffered a serious thrip outbreak in May and June 1978. The main symptoms were leaf rolling and drying at the leaf tips. In severe infestations the plants were stunted and the lower leaves killed.

Observations of 15 varieties and lines

showed that some were seriously damaged. The percentage of infested leaves varied from 28.2 on the variety Jyothi to 51.5 on Thriveni. That suggests that the thrip shows some varietal preference or nonpreterence. The grass *Panicum repens,* which grows abundantly on field bunds, is an alternate host for the insect. □

GENETIC EVALUATION AND UTILIZATION

Drought resistance

Dry matter and nitrogen accumulation in two semidwarf indica rices in rainfed-upland conditions

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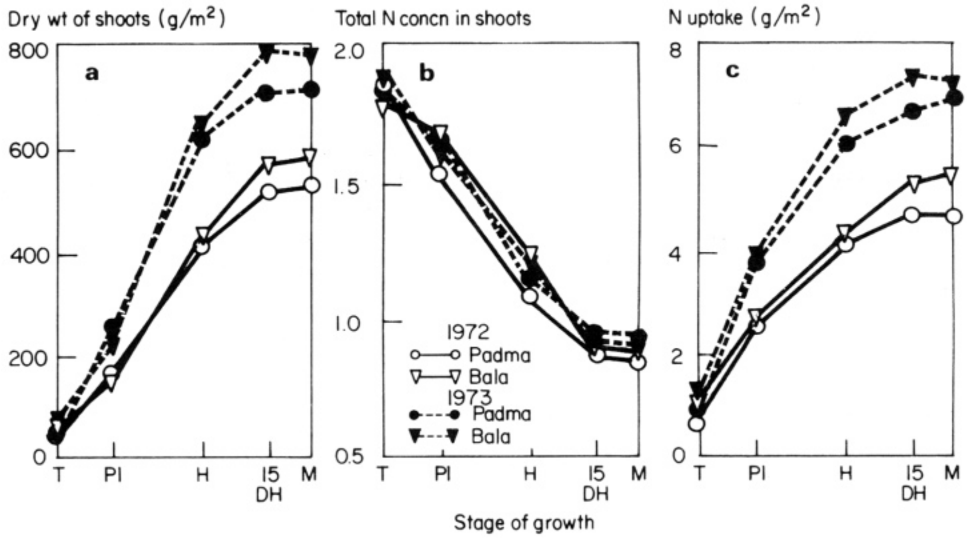
The accumulation of dry matter and nitrogen in two semidwarf indica rices, Padma and Bala, under rainfed-upland culture was studied in a field trial during the kharif (wet) season of 1972 and 1973 at the Crop Research Center of the G. B. Pant University of Agriculture and Technology, Pantnagar. Seeds were drilled in a dry seedbed at 60 kg/ha in rows 23 cm apart. Four nitrogen levels (30, 60, 90, and 120 kg/ha) and 5 application methods were used.

Padma and Bala did not differ markedly in the accumulation of dry matter up to the heading stage (see fig, *a*). But interestingly, the rate of dry matter accumulation from heading to maturity was higher in Bala than in Padma. That indicates that Bala had better photosynthetic ability than Padma during the postheading period, which was probably the main reason for its higher dry matter accumulation and, consequently, higher grain yield at maturity (see table). Bala had higher concentrations of nitrogen than Padma at all growth stages except tillering in 1972 (fig, *b*). But in 1973 nitrogen concentration was higher in Bala only until heading; afterwards, that in Padma was higher. In both years, the nitrogen concentration in the plants of the two varieties decreased linearly from panicle initiation to 15 days after heading (DH), but in 1972 that in Padma decreased linearly from tillering to 15 DH.

Bala plants absorbed more nitrogen from the soil than Padma plants at all growth stages in both years (fig, *c*). The difference was greater during the postheading period. The nitrogen uptake in Bala grains at maturity was higher than that in Padma, but that in Padma's straw was higher (see table). Padma and Bala removed an average of 58 and 63 kg N/ha, respectively, at maturity. Bala translocated to its grains about 74% of the absorbed nitrogen; Padma translocated 69%. The data show that Bala performs better than Padma in rainfed-upland culture. □



Dry-matter yield (a), nitrogen concentration (b) and nitrogen uptake (c) at various stages of growth of two dwarf indica rices. T = tillering (40 DS), PI = panicle initiation (60 DS), H = heading (86 DS), 15 DH (days after heading, 101 DS), M = maturity (111 DS), DS = days after sowing.

Dry matter yield, nitrogen concentration, and nitrogen uptake at maturity in two semidwarf indica rices under rainfed-upland conditions. Pantnagar, India.

Particulars	Padma		Bala		S Em.±		CD 5%[b]	
	1972	1973	1972	1973	1972	1973	1972	1973
Grain yield[a] (t/ha)	2.91	4.07	3.22	4.50	0.106	0.068	ns	0.205
Straw yield[a] (t/ha)	2.44	3.36	2.68	3.39	0.072	0.067	0.219	ns
N in grain (%)	1.10	1.18	1.20	1.22	0.011	0.009	0.034	0.029
N in straw (70)	0.66	0.64	0.55	0.52	0.007	0.009	0.020	0.028
N uptake of grain (kg/ha)	32.08	47.99	39.01	55.12	1.46	0.91	4.42	2.75
N uptake of straw (kg/ha)	15.19	21.42	14.88	17.68	0.44	0.63	ns	1.91
Total N uptake (kg/ha)	41.27	69.41	53.89	72.80	1.75	1.75	5.31	ns

[a]A sum of grain and straw yields would represent total dry matter at maturity.
[b]ns = not significant.

Majhera 3, a drought-tolerant variety

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During kharif 1978, 3 upland trials consisting of 121 early maturing entries were direct-seeded at the Rice Research Station, Majhera. Intermittent drought periods of 8, 9, and 10 days, separated by 5- to 6-day intervals, occurred during the vegetative growth stage. At the reproductive and grain-filling stages, drought struck twice for periods of 14 and 6 days, separated by a 4-day interval.

At maturity only the variety Majhera 3, a selection from the local variety Jaulia, matured and had good seed setting. None of the other 120 varieties performed well, although a few had seed setting. Majhera 3 is a tall, nonlodging type in uplands. Its medium slender grain has straw-colored husk and a red pericarp. It is susceptible to both leaf and neck blast. Its drought tolerance should be tested in other agroclimatic regions. □

GENETIC EVALUATION & UTILIZATION

Adverse soils tolerance

Research on varietal tolerance for phosphorus-deficient rice soils

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Phosphorus (P) deficiency appears to be the most widespread of several soil mineral stresses that limit rice yields in many rice-growing countries. Recent screening has shown that some varieties are tolerant of P deficiency. Use of varietal tolerance to stabilize rice yields would be simpler and less expensive than P amendment, especially in soils with mild mineral deficiencies.

IRRI conducted a performance test on a P-deficient soil (available P, 2 ppm) in the 1978 dry season at Pangil, Laguna province, Philippines, to measure how much P deficiency reduces yields and to assess the potential of varietal tolerance. Twenty-four tolerant and susceptible genotypes of comparable growth duration were used in the test. Rices tolerant of P deficiency were chosen after careful review of screening results for several seasons. The susceptible rices chosen had all exhibited high yield potential in rice yield trials. Half of the experimental site, referred to as P_1, received a basal application of 25 kg P_2O_5/ha. The untreated half was P_0. Eighteen-day-old seedlings were transplanted on 3 February 1978 at 25- × 25-cm spacing at 60 hills/plot, in a randomized complete block design replicated S times on P_0 and P_1. A basal application of urea at 50 kg N/ha was made at final land preparation. Recommended management practices were followed until maturity. The entries were scored for injury due to P deficiency on 17 March and 8 May. Grain, yield and ancillary characters, such as number of panicles, straw weight, and P content of grain and straw were recorded.

Treatment differences in yield were significant at both P levels (see table). For P_1 the yields ranged from 2.6 to 4.3 t/ha (mean. 3.9 t/ha); for P_0, they ranged from 3.6 to 4.0 t/ha (mean, 3.3 t/ha). The yield was 15%) lower in P_0 than in P_1. The yield depression ranged from 4.3 to 26.7%) for individual varieties. But

Performance of 24 rices on a phosphorus (P)-deficient soil at Pangil, Laguna province, Philippines, 1978 dry season.

Designation	Grain yield[a] (g/plot) P_1	P_0	Yield difference[b] (%) (P_1-P_0)
IR8	791 cdefg	736 abcd	7.0
IR34	877 a	812 a	7.4*
IR40	786 cdefg	620 efghi	21.1*
IR1514A-E666	784 cdefg	585 ghij	25.4**
IRl623-93-2-2	759 defg	619 efghi	18.4**
IR2061-628-1-6-4-3	841 abcd	713 bcde	15.4**
IR2307-84-2-1	797 bcdefg	672 cdefg	15.7*
IR2797-105-2-2	875 ab	709 bcdef	19.0**
IR2797-105-2-2-3	795 cdefg	761 abc	4.3
IR2823-103-5-lA	848 abc	732 abcd	13.7**
IR2823-103-5-lB	849 abc	741 abcd	12.7**
IR2863-35-3-3	792 cdefg	688 ef	13.1**
IR3449-172-2	718 g	611 fghi	14.9*
IR4219-35-3	528 h	516 j	2.3
IR4422-51-6-3	784 cdefg	575 ghij	26.7**
IR4427-58-5-2A	808 abcdef	671 cdefgh	17.0*
IR4427-58-5-28	7 94 cdefg	670 cdefgh	15.6*
IR4427-315-2-3	764 defg	695 bcdef	9.0
IR4432-38-6-5-2	740 fg	644 defghi	13.0*
IR4707-123-3A	760 defg	571 ij	24.9**
IR4707-123-3B	756 efg	630 efghi	16.7*
IR4816-70-1	822 abcdef	685 ef	16.7*
IR5105-93-2-2	771 cdefg	669 cdefgh	13.2
BR51-91-6	8 34 abcde	790 ab	5.3

[a]P_1 received a basal application of 25 kg P_2O_5/ha. P_0 received no P. In a column, means followed by a common letter are not significantly different at the 5% level.
[b]*Significant at 5% level; **significant at 1% level.

the yield of six cultures — IR8, IR2797-105-2-2-3, IR4219-35-3, IR4427-315-2-3, BR51-91-6, and IR5105-93-2-2 — were not significantly lower in P_0 and P_1. BR51-91-6 performed best in both P_0 and P_1.

Other top yielders were IR34, IR2823-103-5-1A, and IR2823-103-5-1B, but yields between the two levels differed significantly. Panicle numbers were significantly lower in P_0 than in P_1 in IR20, IR2823-103-5-1A, and IR1514A-E666. Straw production was considerably lower in P_0 in four cultures: IR2061-628-1-6-4-3, IR2823-103-5-lA, IR1514A-E666, and lR2797-105-2-2.

Varietal differences were found in P content of grain and straw. But P content was not related to varietal reaction to P deficiency.

Field observations showed that early growth was suppressed considerably in P_0 because of P deficiency, and that genotypes varied in degree of suppression. But the visible differences lessened after the maximum tillering stage and were minumum by flowering. Furthermore, flowering was delayed from 2 to 9 days in many entries in P_0. The late-maturing cultures may recover better from initial depression (caused by P deficiency) than the early maturing ones.

Overall, IR34, BR51-91-6, and IR1505-93-2-2 could be regarded as tolerant. Six others, IR40, IR1514A-E666, IR2061-628-1-64-3, lR2823-103-5-1A, IR2797-105-2-2, and IR4707-123-3A could be considered sensitive.

The test is being repeated in the 1978 wet season. □

GENETIC EVALUATION & UTILIZATION

Temperature tolerance

Rice cold tolerance workshop in Korea

Scientists from six national programs and IRRI participated in a workshop on cold tolerance in rice in the Republic of Korea, 16-19 September 1978. The workshop was sponsored by the Korean Office of Rural Development (ORD) and the UNDP-funded International Rice Testing Program (IRTP), coordinated by IRRI. Before the workshop, some of the scientists participated in an IRTP cold tolerance monitoring tour in the Indian states of Kashmir and Himachal Pradesh, and in Nepal.

Rice in the temperate areas and in many high-elevation areas in the tropics suffers from cool temperature during the seeding stage or at flowering. Most rice farmers in the temperate regions grow japonica varieties, but tropical farmers prefer indicas. Indicas have higher yield potential but they are more susceptible to cool temperature. Cooperative efforts are needed to combine the cold tolerance of japonica varieties with the high yield potential of the indica varieties.

Korean scientists have crossed indica and japonica germplasm to develop high yielding rice varieties with japonica grain quality and some cold tolerance. They have developed techniques to systematically evaluate their breeding materials for cold tolerance and have successfully integrated research with extension and farmers' training programs to implement research results quickly. Consequently, Korean rice production has increased dramatically since 1970.

In 1977 national rice yields were the highest in the world — average of 4.94 t/ha of milled rice. Thus, it was fitting that Korea host the first International Rice Cold Tolerance Workshop.

The objective of the workshop and the IRTP monitoring tour was to review the current status of breeding for cold tolerance and to evaluate entries in the International Rice Cold Tolerance Nursery (IRCTN). ORD Director General In Hwan Kim challenged the group to develop better varieties with cold tolerance, blast resistance, and acceptable grain quality. He said that although Korean production had increased substantially, the process of varietal improvement is continuous and never ending. Speakers from the various countries outlined their cold temperature problems and current research programs.

Participants made the following recommendations to improve collaboration work and speed the development of cold-tolerant varieties;

1. The rice growing environment of cool areas should be characterized.
2. Screening methodologies should be improved and expanded.
3. The rapid generation advance (RGA) method should be used to rapidly develop more diverse germplasm.
4. The IRCTN should be reorganized to maximize the utilization of nursery entries.
5. Young scientists from the cool regions should participate as a group in the GEU training program so they can become acquainted with new cold-tolerance screening methodology and share professional experiences. □

Pest management and control

DISEASES

Bacterial blight found in Africa

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Bacterial blight (BB) of rice, caused by *Xanthomonas oryzae,* is endemic to Asia and is the most important and damaging bacterial disease of rice. In 1973, BB was reported in northern tropical Australia — the first report from outside Asia. In 1975, it was discovered on and around some rice experiment stations in Colombia and Panama. Although no reports of BB from Africa or Malagasy had been confirmed, there have been private unconfirmed reports of symptoms resembling those of BB in earlier Taiwanese rice projects in several West African countries on the variety TN1, which was introduced in the 1960s. The senior author searched for the disease in many African countries during the last 4 years but did not detect its presence, even in older rice-growing areas.

In the 1978 growing season, symptoms resembling BB were noted at a rice experiment station at Kogoni, Mali. The authors visited the station in mid-November, at the end of the growing season, and found typical BB symptoms in one block of the variety Gambiaka kokum. Even kresek was found in some plants. Gambiaka kokum is a local tall indica that was grown in large blocks, along with other varieties, for seed distribution. □

Observations on rice diseases and insects in Madhya Radesh, India

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Certain observations have been made on rice diseases at Raipur, India.

Rice blast *(Pyricularia oryzae)* is the most important disease in Raipur and Bilaspur divisions, the main rice-growing areas of M.P. Neck blast is usually more important and damaging than leaf blast.

Bacterial blight *(Xanthomonas oryzae)* is the next most important disease of cultivated rice. It was first noticed in the area in 1965. In 1970 kharif, blight was observed on *Oryza rufipogon,* a wild rice growing in tanks at Raipur. Brown spot *(Helminthosporium oryzae),* still a minor disease in the area, was also seen on *Oryza rufipogon.*

Bacterial leaf streak *(Xanthomonas translucens* f. sp. *oryzicola)* was first noticed on a few lines of the cross 34/32 at the rice research farm in 1967. It occurred in epidemic form on IR8 in 1968 kharif. It has also been seen on another wild rice, *Oryza perennis.*

Sheath blight *(Corticium sasakii)* is minor but spreading in the area. During varietal screening, its basidial state was observed in densely growing paddy that was affected by sheath blight.

Stack burn *(Trichoconis padwickii)* is a minor disease, observed only on leaves of semidwarf varieties. In 1972 kharif the following varieties grown in disease screening trials were affected with traces of stack burn while other varieties were free: BCp sp. 1, CR120-181, CR120-182, C24550 (GEB/IR8), C1244(RDR7/TNl), MR89, MR106 (TN1/TKM6), OR10-257 (T90/IR8), R1912 (CO29/IR8), R1922 (CO29/IR8), RP4-12 (T90/IR8), RP4-12 (T90/IR8), RP20-9 (GEB24/Sigadis//IR8), RP175-1, Saturn 587-4 (short culm), Sambalpur E. No. 166, W1251, and No. 6948.0

Udbatta disease *(Ephelis oryzae)* was observed only in Sarguja district, Bilaspur division, on a local variety in 1969 kharif, and later at Dhamatari block, Raipur district, in 1973 kharif.

Sogatella furcifera is an important rice insect pest in Raipur and Bilaspur regions. About 5% of its adults were found dead with expanded wings on rice plants. Isolations from the dead insects yielded a fungus identified as Fusarium sp. Pathogenicity was proved. This may be the first record of this fungus on *S. furcifera* in India. □

Potential of weeds to spread rice tungro in West Bengal, India

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Many graminaceous and cyperaceous weeds can act as symptomless carriers of rice tungro virus disease. An experiment was conducted to determine the potential of weeds to spread tungro in the plant virus experimental rice field at Kalyani, where tungro occurs throughout the year. Virus incidence was surveyed in 1976–77 and 1977–78. The predominant cyperaceous and graminaceous weeds (see table) were brought to the glasshouse and tested for the presence of tungro by indexing the disease incidence on Taichung Native 1 (TN1) seedlings. Virus-free weeds were then inoculated with viruliferous *Nephotettix virescens* and tested for virus at 1-month intervals. The percentage of transmission to TN1 seedlings was recorded weekly. Only *Echinochloa colonum* and *Paspalum notavum* transmitted the virus. *E. colonum* infected 16% of the plants, *P. notavum* 20%.

To study the actual potential of the infected weeds to transmit the virus in the field, *E. colonum* plants were grown in pots and inoculafed with tungro in

Composition of graminaceous and cyperaceous weed flora during a 2-year period at the plant virus experimental field, Kalyani, West Bengal, India.

Weed	Av no./m^2		Relative occurrence (%)	
	1976–77	1977–78	1976–77	1977–78
Echinocloa colonum (Graminae)	182	300	5 3.8	43.8
Cyperus rotundus (Cyperaceae)	55	174	16.2	25.4
Cynodon dactylon (Graminae)	71	122	21.1	17.8
Paspalum notavum (Graminae)	30	58	8.8	8.5

kharif. The pots were used as virus sources in the field 35 to 40 days after inoculation. Twenty-five-day-old seedlings of TN1, Jaya, and Ratna were transplanted in replicated 1-m^2 plots prepared in random block design. One pot of inoculated *E. colonum* was placed at the center of each plot. Each plot was then covered with nylon netting on wooden frames. Freshly emerged leafhoppers were released into each covered plot. The plants in each plot were observed until the booting stage. Ratna plants had 1.57% infection; Jaya, 6.4%; and TN1 . 7.5%.

From this experiment it is apparent that the predominant graminaceous and cyperaceous weeds at the Kalyani virus experimental field do not contain any virus in natural conditions.

Weeds collected at Kalyani and other locations were inoculated with the virus. Only *E. colonum* and *P. notavum* were able to maintain the virus for 3 months.

In the field study with the inoculated *E. colonum* as the source plant, the virus was transmitted to all three test varieties (Ratna, Jaya, and TN1). Thus it is apparent that infected weeds such as *E. colonum* can act as the tungro virus source in the field. But no virus was detected in the weeds in natural conditions. Therefore, weeds may not play an important role in the field transmission of tungro. □

Occurrence of *Phaeotrichoconis crotalariae* on rice in Karnataka, India

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Many prerelease and released paddy cultures suffered from grain discoloration in 1977 kharif and 1978 summer in experimental plots at the Regional Research Station, VC Farm, Mandya, Karnataka. Derivatives of Basumathi and Sabarmati were particularly affected. When the discolored kernels were surface sterilized and incubated in moist chambers at room temperature (25-27°C), abundant spores of *Phaetrichoconis crotalariae,* as well as the commonly known fungi involved in discoloration, were encountered. The fungus was easily isolated by the single-spore technique and pure-cultured on potato-dextrose agar. In the initial stages, the mycelial growth was whitish, but at maturity became dark grey. Conidia were produced after 4 days; sclerotia developed after 8 to 10 days. Descriptions of the fungus are similar to those provided by Subramanyam in 1956 and Vaidehi in 1971. Vaidehi had isolated this fungus from TN1 rice kernels collected in 1967 in Andhra Pradesh, but the same fungus now occurs regularly and abundantly on many rice varieties in Karnataka. This is the only information reported on its widespread occurrence on different rice varieties in Karnataka.

A rice disease observed by the late Bill Golden in Nepal

K. C. Ling, plant pathologist, International Rice Research Institute

After reading the article "Symptoms resembling those of rice dwarf disease in the Kathmandu Valley, Nepal" in the IRRN 3(6):13-14, 1978, I found a color slide that was given to me by the late William (Bill) G. Golden, Jr., former IRRI rice production specialist and formerly with IRRI outreach programs in Sri Lanka and Bangladesh. The slide, taken by Bill in Kathmandu, Nepal, on 3 October 1966, shows A. N. Bhattarai

A photograph from a color slide taken by the late William G. Golden, Jr., in Kathmandu, Nepal, in 1966 showing A. N. Bhattarai holding a rice hill with symptoms similar to those of rice dwarf disease described in Japan.

holding a rice hill with symptoms similar to those of rice dwarf disease described in Japan: 1) stunting of plants, 2) profuse tillering, and 3) appearance of yellowish white specks forming interrupted streaks on leaf blades. The streaks are parallel to the midribs.

I recall having told Bill that the symptoms were similar to those of rice dwarf disease but that we needed transmission results, virus properties, etc. to make that conclusion. Therefore, the information was not published. □

Effect of transplanting time on the spread of tungro in boro

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An experiment at the plant virus experimental field studied the effect of transplanting time on the spread of tungro virus disease in rice during the 1977–78 boro. The Indian Council of Agricultural Research, New Delhi, funded the research

TN1 seedlings at 25 days of age were transplanted at 5-day intervals in replicated plots, 3 m^2 each. Each plot was provided with uniform inoculum for tungro virus (1 infected plant/plot). The number of plants with tungro symptoms at the booting stage was recorded.

Transplanting time appears to have pronounced effects on the spread of tungro (see table). The disease spread among seedlings that were transplanted in December, but not among those transplanted in January. The percentage of infection was high in seedlings transplanted in mid-December, then gradually declined toward the end of the month. Thus, early transplanting in boro may encourage tungro, maybe because tungro vectors are present in the field only until late December and are absent during January. □

Effect of transplanting time of TN1 seedlings on the spread of rice tungro virus disease during the boro season (Dec.–Mar.)and the corresponding vector population in the field. West Bengal, India.

Transplanting date	Vector population/sweep[a]												Plants infected with tungro (%)
	20 Dec 1977	25 Dec	2 Jan 1978	9 Jan	15 Jan	22 Jan	29 Jan	7 Feb	15 Feb	30 Feb	7 Mar	16 Mar	
15 Dec 1977	5	4	1	0	0	0	0	0	0	1	3	3	80
20 Dec	4	3	1	0	0	0	0	0	0	1	2	0	60
25 Dec		2	1	0	0	0	0	0	0	0	2	3	30
30 Dec			1	0	0	0	0	0	0	1	0	2	5
4 Jan 1978				0	0	0	0	0	0	1	1	0	0
9 Jan				0	0	0	0	0	0	1	2	2	0
14 Jan					0	0	0	0	0	2	0	1	0

[a]3-m^2 plots.

Effects of foliar spray of micronutrients on rice sheath blight disease

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Plants of the susceptible rice variety ADT31 at the maximum-tillering stage were inoculated with the Rhizoctonia *solani* pathogen, which causes sheath blight disease. The field trial had a randomized block design with four replications during the 1975 kuruvai (June–Sept.) and the 1975–76 thaladi (Oct.–Jan.). Two foliar sprays of the micronutrients borax, ammonium molybdate, zinc sulfate, magnesium sulfate, calcium sulfate, copper sulfate, and ferrous sulfate were applied twice at 0.059% level at 10-day intervals. Disease intensity was then assessed. All the micronut rients reduced the disease and increased the grain yield in both seasons. The effects were mal·ked with borax, zinc sulfate. copper sulfate, and ferrous sulfate. □

Effects of fungicidal spray on the population of *R. solani* and on rhizospheric microflora of rice

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ADT31, which is susceptible to the sheath blight disease caused by *Rhizoctonia solani,* was raised in pots and inoculated with the pathogen. The seedlings were sprayed with a 0.025% solution of the fungicides Brassicol, wettable ceresan, Thiabendazole, Benlate, Vitavax, Bavistin. Kitazin, Demosan, Daconil, and Hinosan at 20,25, and 30 days after sowing. The populations of fungi, bacteria, actinomycetes, and *R. solani* in rhizospheric and nonrhizospheric soils were estimated 48 hours later. Fungicidal spray drastically reduced the rhizospheric population of *R. solani.* Foliar sprays of Kitazin, Hinosan, Benlate, Vitavax, and Bavistin reduced the pathogen in the rhizosphere more than the other fungicides did. The fungicidal sprays stimulated the bacterial and actinomycetalpopulationsconsiderably, but inhibited the fungal populations.

Influence of fungicides on the production of pectinolytic enzymes of *R. solani*

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Sheath blight disease caused by *Rhizoctonia solani* is serious in many rice-growing areas of Tamil Nadu. The introduction of high yielding and fertilizer-responsive rice strains has intensified its occurrence and severity.

The influence of certain fungicides on enzyme inhibition was studied. Incorporation of Kitazin, Hinosan. Benlate, Bavistin, Daconil, Vitavax. Thiabendazole, and wettable ceresan in Czapek's Pectin medium markedly inhibited the pathogen's growth. Kitazin inhibited the production of pectinolytic enzymes PC, PGTE. and PTE significantly. Inhibition of PTE production was maximurn with Hinosan, and next highest with Bavistin. Both fungicides also inhibited PG and PGTE production considerably. □

Pest management and control

INSECTS

Laboratory evaluation of insecticides as foliar spray for control of the rice leaf folder

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The rice leaf folder *Cnaphalocrosis medinalis* is found throughout .Asia but is most abundant in the tropics. Its importance has increased in recent years, possibly because of changes in cultural practices associated with improved rice technology. Because no variety with resistance to the leaf folder is available, insecticides are the only immediately practical and effective means of control.

Although most tropical Asian countries recommend chemical control of leaf folders, few recommendations are based on experimental data because of problems in conducting reliable field trials. A technique for mass rearing of leaf folder larvae was recently developed at IRRI. It will enable scientists to evaluate insecticides in the laboratory.

Taichung Native 1 seedlings of 25 to 30 days of age were infested with freshly hatched leaf folder larvae. When all the leaves had folded (about 2 weeks after infestation), the potted plants were sprayed with various test insecticides at 0.04% concentration. Two days later, the folded leaves were opened. The living and dead larvae were counted and the percentage of mortality was determined.

Most of the insecticides controlled the leaf folder adequately (see table). Among them were several new compounds — not yet commercially available — that were also found effective against the brown planthopper (BPH) in previous studies. Perthane, a selective compound that was highly effective against the BPH in previous tests, did not control the leaf folder. It also had little effect on stem borers in previous studies. □

Activity of insecticides applied as a 0.04% foliar spray on potted Taichung Native 1 plants infested with freshly hatched larvae of leaf folder *Cnaphalocrosis medinalis.* IRRI greenhouse, 1978.

Insecticide	formulation	Mean mortality (%) [a]
FMC 27289	48 EC	100 a
Permethrin	10 EC	100 a
Monocrotophos	16.8 EC	100 a
Cypermethrin	40 BC	98 ab
Miral	50 EC	98 ab
Chlorfenvinphos	20 EC	98 ab
Methyl parathion	50 EC	93 abc
BPMC	31.5 EC	90 bc
Carbofuran	12 F	90 bc
Endosulfan	35 EC	85 bc
FMC 35001	48 EC	83 bc
Azinphos ethyl	40 EC	83 bc
A47171	24 EC	75 bc
Propoxur	20 EC	73 c
Metalkamate	30 EC	33 d
MIPC	50 WP	23 de
Vamidothion	40 EC	13 de
Perthane	45 EC	5 e

[a] With 10 larvae/replicate; average of 4 replications. Values adjusted using Abbott's formula. Means in the same column followed by the same letter do not differ at the 5% level of significance.

Identification of insecticides that induce BPH resurgence when applied as granules to rice

S. Chelliah, postdoctoral fellow, and E. A. Heinrichs, entomologist, International Rice Research institute

Resurgence of brown planthopper (BPH) populations after a brief period of reduction following rice crop protection with certain insecticides has been reported repeatedly at IRRI. Paddy-water application of gamma-BHC, diazinon, Sevidol, and Miral has caused BPH resurgence at IRRI. In India, granular formulations of phorate, diazinon, quinalphos, and mephosfolan had varying levels of effectiveness in the period after initial application, then induced BPH buildups at later growth stages.

In controlled studies at IRRI, the reproductive rate of BPH was higher when the insects were confined on plants treated with diazinon and cartap granules (see table). Plants protected with the two insecticides were also hopperburned earlier than the other treatments, after loss of insecticidal efficacy. Evidently, the increase in reproductive rate may be the primary factor causing BPH resurgence. The reduced BPH reproduction in plants treated with FMC3 1768 is also significant when selecting the hest insecticides for BPH control.

BPH reproduction was higher in plants that received 0.5 kg a.i./ha of five of the granules tested than in plants treated with 1.0 kg a.i./ha (Cartap was an exception). That indicates impending BPH resurgence when low dosages of granular insecticides are applied to the rice crop (regardless of whether the low doses were due to economic limitations, defective distribution, or dilution by rains shortly after application).☐

Reproduction of and damage by brown planthopper as influenced by type and rate of granular insecticides applied to potted rice plants.[a]

Treatment[b]	Insecticide rate (kg a.i./ha)	Nymphs[c] (no.)	No. of days for complete hopperburning[d]
Diazinon	1.0	305.3 b	16.0 bc
Diazinon	0.5	379.3 a	14.0 abc
Cartap	1.0	388.7 a	13.7 ab
Cartap	0.5	249.0 bcd	11.0 a
Aldicarb	1.0	202.7 de	17.7 cd
Aldicarb	0.5	316.7 ab	15.3 bc
Dacamox	1.0	247.0 bcd	24.7 fg
Dacamox	0.5	277.7 bc	23.3 efg
Carbofuran	1.0	189.7 d	26.7 g
Carbofuran	0.5	213.7 cd	24.7 fg
FMC 31768	1.0	137.7 e	25.0 fg
FMC 31768	0.5	187.3 d	22.7 ef
Control	–	234.7 cd	20.7 de

[a] In a column, means followed by a common letter are not significantly different at the 5% level.
[b] Granules were incorporated into the soil twice when the plants were 35 and 47 days old.
[c] From eggs laid by 2 females/7 days, 30 days after second application of granules.
[d] Damage by nymphs that emerged from eggs laid by 2 females. Days from the emergence of first group of nymphs.

Identification of insecticides that induce brown planthopper resurgence when applied as foliar spray

S. Chelliah, postdoctoral fellow, and E. A. Heinrichs, entomologist, International Rice Research Institute

Field and insectary experiments at IRRI have consistently shown that foliar spraying of rice with insecticides such as methyl parathion, decamethrin, and diazinon induces brown planthopper (BPH) resurgence after the insecticide's toxicity is lost. Detailed studies of BPH resurgence by the authors revealed that the reproductive rate of BPH on plants protected with different insecticides would be an appropriate criterion in evaluating an insecticide's resurgence potential. Following this technique, 23 common emulsifiable concentrates of insecticides were evaluated under controlled conditions.

Among the four classes of insecticides tested, organophosphates and synthetic pyrethroids generally tended to cause resurgence, while carbamates and organochlorines were fairly safe (see table). But there were exceptions in both groups. Screening studies suggested that A 47171, FMC 35001, vamidothion, BPMC, and Perthane reduced the BPH reproductive rate significantly. Perthane, BPMC, and A 47171 have been identified as effective for BPH control in both laboratory and field experiments at IRRI. The fact that they do not cause resurgence may make them more important for BPH control. On the other hand, this evaluation also suggested that the use of methyl parathion, fenitrothion, decamethrin, diazinon, and fenthion should be avoided in BPH-infested areas because they stimulate BPH reproduction.☐

Reproductive rate of brown planthopper as influenced by various insecticides applied as foliar spray on rice. IRRI, 1978.

Treatment[a]	Formulation EC (%)	Class[b]	Reproductive rate[c] (no. of nymphs)
A47171	24	OP	107.0 a
FMC 35001	48	C	115.3 a
Vamidothion	40	OP	116.7 a
BPMC	50	C	120.0 a
Perthane	45	OC	124.7 a
Carbophenothion	40	OP	135.0 ab
FMC 27289	48	C	155.7 abc
FMC 31768	23	C	161.0 abc
Endosulfan	35	OC	182.3 abcd
Control (water spray)	–	–	207.3 bcde
Acephate	40	OP	210.7 bcde
Phosphamidon	50	OP	211.3 bcde
Methomyl	19.3	C	214.0 cde
Azinphos ethyl	40	OP	236.7 def
AC 64475	25	OP	252.3 defg
Dacamox	23	OP	253.3 efg
Cypermethrin	40	P	255.7 efgh
Triazophos	40	OP	262.7 efghi
Monocrotophos	16.8	OP	269.0 efghi
Methyl parathion	50	OP	297.0 fghij
Fenitrothion	20	OP	322.0 ghij
Decamethrin	2.5	P	334.7 hij
Diazinon	20	OP	336.0 ij
Fenthion	50	OP	353.0 j

[a] Insecticides applied as a foliar spray 3 times on plants at 20-, 30-, and 40-days after sowing at 0.04% concentration except cypermethrin and decamethrin, which were sprayed at 0.00270 concentration.
[b] C = carbamate, OC = organochlorine, OP = organophosphate, P = pyrethroid.
[c] From eggs laid by 2 females/7 days. The females were released 30 days after the third spraying. Means followed by a common letter are not significantly different at 5% level.

Population dynamics of green leafhopper with respect to time and space

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The behavior of rice green leafhopper populations with respect to time and space was studied by catching and counting leafhoppers with light traps at different locations in 1976–77 and 1977–78. The Indian Council of Agricultural Research (ICAR), New Delhi, provided financial support for the work.

The light traps were fitted with 100-watt electric bulbs and installed near the plant virus experimental field at Kalyani, at the model farm of the W. Bengal Directorate of Agriculture at Habra, and at the Central Soil Salinity Research Institute, ICAR, at Canning. The lights were turned on each evening and off the next morning. The relative occurrence of *Nephotettix virescens* and *N. nigropictus,* and the male-to-female ratio of each were recorded. A calendar of the characteristics of the populations was prepared (see table).

The distribution patterns of the green leafhoppers were similar in different years and sites, but more critical analysis showed that they differed in a few characters (see table). □

Calendar of the population distribution of the green leafhopper in three locations in West Bengal, India, in a 2-year period.

Observation	Kalyani		Habra		Canning	
	1976–77	1977–78	1976–77	1977–78	1976–77	1977–78
First appearance	1st wk, Apr.	1st wk, Apr.		2d wk, Apr.		April
Disappearance	1st wk, Dec.	2d wk, Dec.	3d wk, Feb.	2d wk, Dec.	2d wk, Feb.	2d wk, Feb.
Appearance of high population	3d wk, Sept. to 3d wk, Nov. 3d wk, May to 3d wk, June	3d wk, Sept. to 4th wk, Oct.	Oct. to Nov.	2d wk, Sept. to 2d, wk, Oct.	1st wk, Oct. to 2d wk, Oct. 4th wk, Nov. to 2d wk, Jan.	Apr. to 2d wk, May Oct. to 1st wk, Jan.
Peak populations	4th wk, Sept. 3d wk, June 2d wk, Nov.	4th wk, Sept.	1st wk, Nov.	3d wk, Sept.	2d wk, Oct. 1st wk, Jan.	1st wk, Oct. 2d wk, Dec.

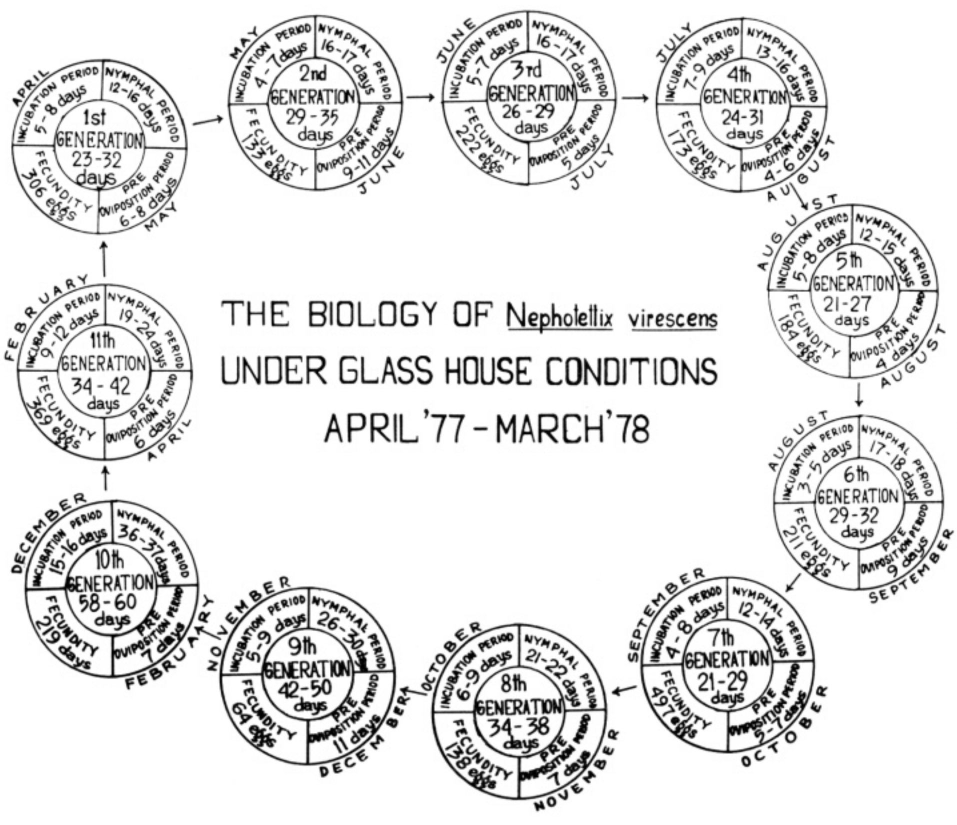
Biology of the green leafhopper *Nephotettix virescens*

Chakravarti, Sunanda, A. B. Ghosh, and S. Mukhopadhyay, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal, India

The biology of the green leafhopper *N. virescens* was studied from April 1977 to March 1978 in a glasshouse. Male and female adults were collected from rearing chambers and released in cages of TN1 seedlings. Eggs were collected from the seedlings and again placed on caged 25-day-old TN1 seedlings. The seedlings were observed and the moultings recorded every 24 hours.

During the report period, *N. virescens* completed 11 generations. The figure shows the time required to complete each generation.

Hatching occurred within 5 to 9 days of incubation in the 1st, 2d, 3d, 4th, 5th, 7th, 8th, and 9th generations. The incubation period was only 3 to 5 days in the 6th generation, but was 9 to 12 days in the 11th.



The biology of *Nephotettix virescens* in the glass house, April 1977–March 1978.

The total nymphal periods for each generation differed greatly (12–14 to 36–37 days); however, the oviposition period did not (4–6 to 9–11 days). The fecundity per female of each generation also differed to a large extent (64 to 306 days). The total life-span of each egg-laying female of the different generations ranged from 17–23 to 49–56 days. □

Damage to rice grains by stem borer attack

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The proportionate distribution of larvae of the five types of stem borers that attack rice in this area is: *Tryporyza incertulas,* 61.2%; *Chilo partellus,* 37.3%; *Sesamia inferens,* 1%; and *Chilotraea auricilia* and *C. infuseatellus,* 0.5%. This study was conducted to determine the extent to which early instars of borers damage the rice grains at the flowering stage.

Grains were counted from randomly collected earheads. The significance of varieties in the incidence of borer attack was determined by the chi square (χ^2) test.

The overall damage rates to the aman, aus, and boro rice crops were 18.0, 4.0, 5.7%, respectively (data compiled from Table 1). Furthermore, the incidence of chaffiness due both to direct borer attack on grains and indirect attacks (on stems) was found to depend on the varieties of aman rice (Table 2). For both direct and indirect attacks, the calculated χ^2 value was much higher than the table value of χ^2 at the 1% level of significance.

The University Grants Commission, New Delhi, India, provided financial assistance for the project. □

Table 1. Extent of grain damage by stem borers in three kinds of rice. Kaiyani University, West Bengal, India.

Season	Randomly examined earheads (no.)	Grains (no.)	Borer-damaged grains	
			No.	%
		Completely chaffy earheads [a]		
Aman	949	4,538	1,111	24.5
Aus	694	2,889	70	2.4
Boro	570	1,731	90	5.1
		Partially chaffy earheads [b]		
Aman	106	7,641	1,082	14.2
Aus	62	7,285	342	4.7
Boro	53	2,034	126	6.2

[a] Because of simultaneous attack of grains and stems.
[b] Because grains were attacked.

Table 2. Percentage distribution of different categories of damaged grain in varieties of aman rice. Kalyani University, West Bengal, India.

Varieties	Direct effect (%)		Indirect effect (%)	
	Partial chaffy earheads	Complete chaffy earheads	Partial chaffy earheads	Complete chaffy earheads
Badsabhog	43.3	56.7	0.5	99.5
Tilakkachari	79.0	21.0	32.1	67.3
Kalma 222	33.3	66.7	44.8	55.2
Patnai 23	55.7	44.3	21.2	78.8
Bhasamanik	15.4	84.6	2.4	97.6
Observed χ^2 value (d.f. 4)	161.62		596.11	

Occurrence and control of the whitebacked planthopper in the Punjab of Pakistan

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The whitebacked planthopper (WBPH) *Sogatella furcifera* has long been known to occur in the Punjab as a sporadic and minor rice pest. But the WBPH struck in epidemic proportions in 1978 because the monsoon season was prolonged with intermittent rain and farmers used nitrogen heavily. Three districts that comprise 60% of the rice area in the Punjab — Sialkot, Gujranwala, and Sheikhupura — were badly affected. Although WBPH were present in varying populations in those areas, typical hopperburn symptoms were not always noticeable.

All varieties except IR6 (which headed in the last week of August) were attacked. (Punjab farmers seldom apply insecticide to 1R6 because they plant it earlier in the season to protect it from a serious attack of the stem borer (the major insect pest)). WBPH affected about 15% of the area, reducing yields by 4 to 5% and, sometimes, by 40 to 50%. In applied research trials conducted by the Agricultural Research Council, the plots treated with Furadan G completely escaped WBPH attack — one dose incorporated into soil before transplanting protected IR6 throughout the season. In another preliminary trial, application of Mipcin 50% W.P. spray at 1.0 kg a.i./ha and of Sevin 10% dust at 2.0 kg a.i./ha in the maturing crop effectively controlled the pest. □

Potential of rice stubble in spreading tungro in West Bengal, India

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An experiment was conducted to determine the potential of rice stubble for spreading tungro virus disease in rice fields. Taichung Native 1 (TN1) seedlings were grown under heavy tungro inoculum pressure, which infected the plants markedly. After harvest clumps of stubble of the infected plants were carefully uprooted. Some intact clumps were placed in pots. The others were chopped, mixed with soil, and placed in pots. The intact stubbles were then tested at 15-day intervals for the presence of the virus.

Test seedlings of TN1 were transplanted into the pots containing the soil-stubble mixture under insect-proof conditions and then tested 10 days later. Freshly emerged *Nephotettix virescens* collected from the rearing chambers were released and kept on the seedlings for several days. The seedlings were then observed for 20 days.

A field experiment was conducted to study the efficiency of stubble as the virus source in the field. Twenty-five-day-old seedlings of TN1, Jaya, and Ratna were transplanted in 1-m^2 replicated plots in a randomized block design. One pot of infected stubble was placed at the center of each plot. Each plot was covered with nylon netting on wooden frames, and freshly emerged leafhoppers were released on it. The plants were observed until the booting stage, and the numbers with disease symptoms were recorded (Table 1).

The study confirmed that infected stubble can act as a virus source in the field (Table 2). Stubble can maintain the virus for 75 days in boro. But the efficiency of stubble transmission from boro stubble was lower than that from kharif stubble. The extent of transmission in both cases declined with increasing stubble age.

The Indian Council of Agricultural Research provided financial assistance for this work. □

Table 1. Transmission of rice tungro virus from Taichung Native 1 (TN1) stubble of different ages. West Bengal, India.

Stubble age at acquisition feeding time (days from harvest)	Time of transmission	Transmission in seedlings (%)
	Boro season 1977[a]	
15	1st wk, May	20.0
30	3d wk, May	13.3
4s	1st wk, June	13.3
60	3d wk, June	6.6
7s	1st wk, July	6.6
90	3d wk, July	0
105	1st wk, Aug.	0
120	36 wk, Aug.	0
	Kharif crop 1978[b]	
15	1st wk, Jan.	33.3
30	3d wk, Jan.	26.6
4s	1st wk, Feb.	20.0
60	3d wk, Feb.	13.3
75	1st wk, March	6.6
90	3d wk, March	0
105	1st wk, April	0
120	3d wk, April	0

[a]Virus source: infected boro crop harvested in April 1977.
[b]Virus source: infected aman crop harvested in Dec. 1977.

Table 2. Potential of 60-dayold rice stubble to act as the source of tungro virus in the field. 1978 kharif, West Bengal, India.

Variety	Infection (%)
Ratna	2.1
Jaya	4.0
TN1	11.5

Soil and crop management

Seed treatment to overcome zinc deficiency in direct-seeded rice

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Zinc deficiency in seedling rice is common in Louisiana. When recognized, it is usually corrected with a foliar application of Zn-EDTA. But in small seedlings, stands can be reduced severely before farmers recognize the problem and apply zinc.

Seed treatment with Zn-EDTA was evaluated as a means of preventing zinc deficiency in seedling rice. Field experiments were conducted for 4 years on a Crowley si1t loam soil, a Typic Haplaqualf. Soil pH was 7.6 and 0.1 N HC1 extractable soil zinc was 0.5 ppm. The zinc was added to the seed by diluting a commercial 6% Zn-EDTA solution with water, adding the diluted mixture to the seed, and tumbling to ensure thorough mixing. The rates of zinc varied each year — 0.03, 0.05, 0.06, and 0.11 kg Zn/ha were added in 1973 through 1976. The rice was drill sown at 100 kg/ha. Adequate nitrogen, phosphorus, and potassium were applied. The plots were mechanically harvested.

Effect of Zn-EDTA seed treatment on the yield of Vista rice, Crowley, Louisiana, USA.

	Yield (t/ha)				
	1973	1974	1975	1976	Mean
Treatment					
No zinc	2.3	2.5	2.3	3.3	2.6
Zinc coated	3.0	4.1	3.3	3.9	3.6
Difference	0.7	1.6	1.0	0.6	1.0
LSD 0.05	0.4	0.7	0.4	0.7	0.3

Yields were corrected to 12% grain moisture.

Coating rice seeds with relatively small amounts of zinc resulted in increased grain yields each year. The mean increase over the 4 years was 1 t/ha, ranging from 0.6 to 1.6 t/ha (see table). Although yield increases were significant. zinc deficiency symptoms were observed in all plots each year. But the symptoms were less severe and occurfed later with zinc seed treatment. The symptoms of zinc deficiency indicate that the seed treatment, although beneficial, did not supply all the zinc that the plants needed in the Crowley soil. Other zinc sources are being evaluated, along with higher rates of zinc seed coatings, to overcome the deficiency. ☐

Response of direct-seeded rice to zinc application in Sudan Gezira

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Direct-seeded rice in the Sudan Gezira often shows symptoms of zinc deficiency, particularly in early growth stages. Although most symptoms usually disappear soon after continuous flooding begins (5–6 weeks after seeding), the effect of flooding on available zinc in the soil has not been determined. Therefore, to determine the importance of zinc application to rice production (IR298-12-1-1-1) in the Gezira, an experiment with 5 levels of zinc (0, 2, 4, 6, and 8 kg Zn/ha) was established in 1977 at the Gezira Research Farm. The design was randomized complete block with six replications. At seeding, the zinc, as zinc sulfate, was incorporated into the soil (heavy clay with av. pH of 8.5). The effects of zinc level on plant height, straw yield, and major grain yield components were determined.

The experiment showed that Gezira soils are slightly deficient in available zinc (see table). Grain and straw yields increased progressively with level of applied zinc ($P = 0.05$). The application of 8 kg Zn/ha increased grain yield by 12% and straw yield by 142. The increase in grain yield suggests the positive effect on dry matter production of applied zinc, which increased straw yield and grain specific weight. Zinc level had no significant effect on plant height, number of grains per panicle, or number of tillers. ☐

Effects of zinc level on plant height, grain yield, straw yield, and major components of grain yield of IR298-12-1-1-1 planted at Gezira Research Station, Sudan.

Zinc level (kg Zn/ha)	Plant ht (cm)	Grain yield (kg/ha)	Straw yield (kg/ha)	Panicles (no./m^2)	Grains (no./panicle)	1,000-grain wt (g)
0	83	4,143	6,688	398	75	20.1
2	85	4,333	7,076	387	17	20.2
4	84	4,250	6,688	396	15	20.3
6	85	4,514	7,076	417	77	20.3
8	87	4,662	7,628	398	76	20.3
S.E.	1.17	144	188	13.5	3.2	0.02

Production of blue-green algae in the field

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Blue-green algae harness solar energy to fix nitrogen. The rice plants use the nitrogen released by the blue-green algae. Thus, a rice field is an efficient nonsymbiotic nitrogen-fixing ecosystem. In submerged rice soils, biological nitrogen fixation is essentially an algal process that contributes 20 to 30 kg N/ha

Mass-scale multiplication of blue-green algae was attempted in a rice field. Soil was well prepared and levelled. The plots (10 × 2 m) were laid out. Superphosphate, lime, carbofuran, and starter culture were applied at three levels (see table).

The water level in the plots was maintained at 10 cm. Superphosphate and lime were added and mixed well with the water. The plots were inoculated with the starter culture (*Aulosira, Anabaena, Aphancthece, Nostoc*). Finally, carbofuran was applied to control soil insects. The plots were not disturbed. When daily evaporation was high, the plots were irrigated intermittently. The algae grew lapidly. In about 10 days algae formed a thick mat floating on the water surface. Fifteen days after inoculation the plots were allowed to dry

Mass production of blue-green algae in the field, Tamil Nadu, India.

Treatment	Soil-based blue-green algal yield (kg)				Mean algal yield (kg)
	Rep. 1	Rep. 2	Rep. 3	Rep. 4	
Superphosphate : 500 g Lime : 50 g Carbofuran : 100 g Starter culture : 500 g	18.7	19.4	21.2	15.2	18.6
Superphosphate : 1000 g Lime : 100 g Carbofuran : 150 g Starter culture : 1000 g	20.6	18.9	22.1	24.5	21.5
Superphosphate : 1500 g Lime : 150 g Carbofuran : 200 g Starter culture : 1500 g	24.2	25.3	24.6	22.6	24.1

in the sun. The algal flakes from the surface of the plots were collected or scraped and stored. The mean yield of algal flakes per plot was 18—24kg (see table). Differences in the algal yield with various treatment levels were small.

Studies on the cultivation of azolla in rice fields

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New technical measures combined with *paired narrow rows* were introduced in China in 1973 to encourage year-round cultivation of azolla with rice in paddy fields. By the paired narrow rows technique, azolla propagation could be prolonged without interfering with rice growth, ensuring azolla yields several times higher than those in ordinary rice culture.

The rice seedlings are transplanted in double rows. Pairs of rows are spaced 53 to 66 cm apart, with a 13.2-cm spacing between the 2 narrow rows, and a 6.6-cm spacing between hills. Azolla is then grown in the broad space between pairs of double rows. The closer distance between wider rows (about 50 cm) is suitable for dwarf varieties.

In 1977, this technique was tested at various brigades in Pucheng, Fukien. The average yield of the rice was 6.52 t/ha per crop and the average yield of fresh azolla was 54.5 t/ha per rice crop. The distributions of rice and azolla yield are shown in the table.

Yield distribution of rice and azolla in a field where azolla was grown year round. Pucheng, Fukien, China.

Yields (t/ha)	Distribution (%)
Rice	
9.0– 10.0	3.3
10.0– 12.0	25.1
12.0– 13.5	37.4
15.0	34.0
Azolla	
30.0– 31.5	2.3
37.5–112.5	15.9
112.5–150	18.8
150	23.0

In experiments using only harvested azolla as fertilizer in the field (with no added N fertilizer) 9.9 t of rice/ha was harvested from 2 crops grown at 2 sites.

Seventy-five tons of fresh azolla per hectare can supply enough nitrogen for rice yields of 7.5 t/ha.

Successful use of the technique depends on 1) proper spacing of the pairs of lows, 2) proper and sufficient nutrients for both rice and azolla, 3) good water management, and 4) pest control. □

Efficacy of some fungicides against *Trichoconis padwickii*

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The fungus Trichoconis padwickii has caused seedling blight, leaf spot, and grain discoloration in many released and pre-release rice varieties in several parts of Mandya, Mysore, and Mercara districts, Karnataka, since 1976 kharif. To develop a spray schedule, the efficacy of certain fungicides in suppressing spore gemination and mycelial growth of the incitant fungus was studied *in vitro.* Eight popular fungicides were tested and found to be effective in the following order: Bavistin, Benlate, Ditlzane-M-45, Blitax-50, Difolatan, Hinosan-50, Brassicol, and F. M. Spray.

The systemic fungicide Bavistin was apparently superior to others at all concentrations. At 0.1% strength, Bavistin completely inhibited spore germination and mycelial growth; Benlate, Dithane M-45, and Blitax-50 gave complete control at 0.2%, strength. Hinosan-50 was not superior at 0.05% strength (the dosage usually recommended tor blast control) but gave 96–97%, inhibition at 0.2% strength. Difolatan, Brassicol, and F. M. Spray at 0.2% strength gave 93–97, 90–94%, and 81–93%) inhibition, respectively (see table). □

Efficacy of fungicides in inhibiting the spore germination and mycelial growth of *T. pacwickii.* Kartanaka, India.

Fungicide [a]	Spore						Mycelial growth					
	Germination (%)			Inhibition (%)			Colony diameter (cm)			Inhibition (%)		
	0.05%	0.1%	0.2%	0.05%	0.1%	0.2%	0.05%	0.1%	0.2%	0.05%	0.1%	0.2%
Bavistin 50 W.P.	2.6	0.0	0.0	96.0	100.0	100.0	0.2	0.0	0.0	95	100	100
Benlate, 50 W.P	3.3	0.3	0.0	95.3	99.5	100.0	0.2	0.1	0.0	94	97	100
Dithane M-45	4.6	2.0	0.3	93.0	98.0	99.5	0.2	0.1	0.0	93	97	100
Blitax-50	8.6	3.6	0.6	88.0	95.0	98.5	0.4	0.2	0.0	88	95	100
Hinosan-50	14.0	6.3	2.3	80.0	91.0	97.0	0.9	0.3	0.1	75	91	96
Difolatan	14.3	7.0	2.0	79.5	90.0	97.0	2.2	0.9	0.3	55	82	93
Brassicol	28.6	12.6	4.3	59.0	82.0	94.0	1.6	0.6	0.2	36	73	90
F.M. Spray	29.6	15.3	4.6	57.7	78.0	93.4	2.5	1.1	0.7	28	70	81

[a] Control: spore germination recorded at 15 hours (70%) and colony diameter after 10 days of incubation (3.5 cm).

The rice root nematode in lowland paddies in Kerala, India

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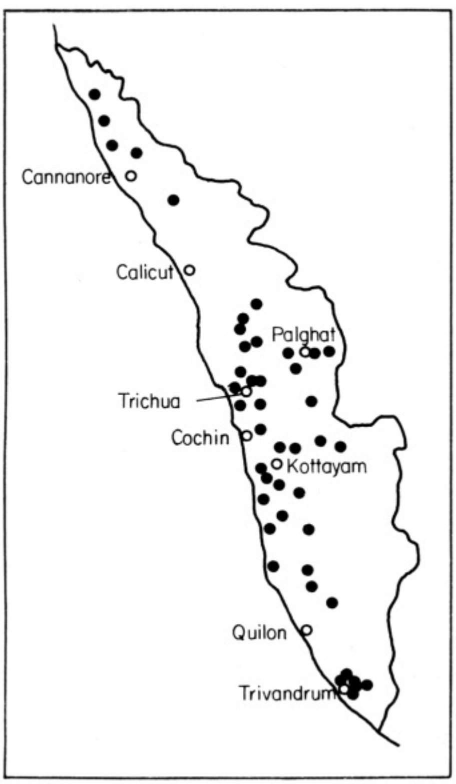
A survey of nametode parasites in the lowland rice areas of Kerala showed the rice root nematode *Hirschmanniella oryzae* in all regions (see map). All 104 soil samples collected at 43 sites were infested; so were the roots of rice planted in the soils. The number of nematodes ranged from 5 to 509/250 ml of soil and was as high as 450/sample of plant roots. Nematode infestation was found in lateritic loam, clayey loam, sandy, and pokkali (saline) soil types. The rice varieties Aswathi, Bharathi, Jaya, Mahoori, Triveni, and Annapoorna were infected. The nematode also infested the lowland weeds *Monochoria vaginalis, Fimbristylis miliasia, Cyperus iria, C. elusinoides,* and *Vallisneria piralis.*



The distribution of the rice root nematode in rice regions of Kerala, India.

Yield loss due to infection by rice root nematode in Triveni. Kerala, India.

Treatment [a]	Nematode population (no.) At planting, in 250 ml soil	At harvest In 250 ml soil	At harvest In 5 g roots	Grain yield (kg/plot)	Yield loss (%)
Natural field population	11	245	69	1.54	4.3
100 g infected rice roots added/plot	14	180	143	1.23	19.2
200 g infected rice roots added/plot	33	836	143	1.32	13.8
DBCP at 30 liters/ha	0	0	0	1.53	
E.D. (p=0.05)				0.20	

[a] Mean of 6 replicates.

Studies of yield losses in 4-m^2 field microplots revealed significant reductions in final grain weight with increases in nematode population in soil and plant roots at harvest (see table). ☐

Preliminary results of fertilization of upland rice in the *Llanos Orientales* of Colombia

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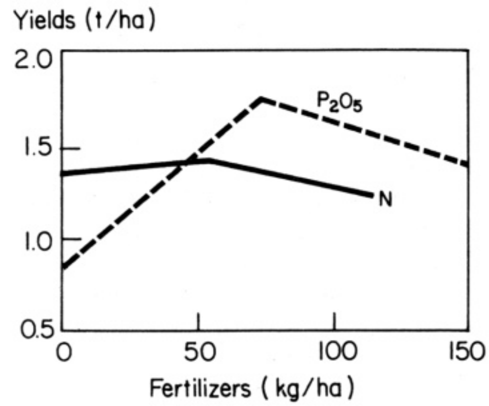
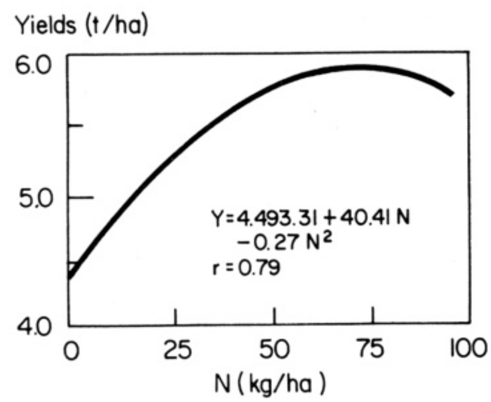
Preliminary trials were conducted to investigate the response to N. P. and K applications of upland rice in two soils ot the *Llanos Orientales* of Colombia. Two experiments were on savanna soils (Oxisols). which are extremely acid (pH 3.9). and have low fertility and are high in exchangeable aluminum. Three experiments were on river-bottom soils (Entisols) without aluminum, with a medium-high fertility level and pH higher than 5.5.

The yields on the savanna soils were low because of low soil fertility and high aluminum toxicity, and because the rice variely planted (IR8) is susceptible to such adverse soil conditions. Yields were more than doubled by the application of 75 kg P_2O_5/ha, but no response was obtained from nitrogen (Fig. 1).



1. Response of upland rice (variety IR8) to N and P_2O_5 in Oxisols of the *Llanos Orientales,* Colombia. Mean of two locations.

Statistical analysis of data from the river bottom experiments showed optimum yields of about 6 t/ha from application of 70 kg/ha of nitrogen on variety Cica 8 (Fig. 2).



2. Calculated yields of upland rice (variety CICA 8) with different N levels.

No response to P or K was observed in these experiments because the soil content was adequate, especially for K (P Bray II = 15.7 ppm; K = 0.72 meq/100 g soil).

The best method of applying nitrogen was 3 equal split applications at 30, 50, and 70 days after germination.

Sowing upland rice in savanna soils is not recommended because the varieties lack tolerance for excessive exchangeable aluminum, the most limiting factor in those soils. □

Effect of time of burying of Dhaincha *Sesbania aculeata* on nitrogen economy in paddy

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The crop recovers only about 15 to 40% of applied nitrogen in submerged paddy soils. The recent increase in paddy cultivation in nontraditional, light-textured soils in northeastern India has further aggravated the problem. It is important to develop a technology to increase the efficiency of nitrogen utilization and to conserve the nitrogen harnessed through green manure.

An experiment to test the relationship of Dhaincha *(Sesbania)* green manure to nitrogen economy was initiated at the PAU farm, Ludhiana, in 1977 kharif.

Effect on paddy yield of different times of burying Dhaincha.[a] Punjab Agricultural University, Ludhiana, India.

Days buried before puddling	Grain yield (t/ha)				
	No N	60 kg N/ha	90 kg N/ha	120 kg N/ha	Av.
Fallow	2.4	4.7	5.2	5.5	4.5
20	4.2	5.8	5.7	5.5	5.3
10	5.0	5.5	5.4	5.6	5.4
0	5.7	5.6	5.6	6.2	5.1
Av.	4.1	5.4	5.5	5.7	

[a] C.D. at 5% for N level: 5.7; C.D. for dates: 5.7; C.D. for dates × N level: 6.1

PAU presently recommends the burying of green manure about 2 weeks before transplanting paddy — which means that Dhaincha should be sown by the second or third week of April, when farmers are busy with the rabi harvest and postharvest operations. Because farmers are reluctant to include green manure in their cropping pattern, an experiment to determine the optimum time to bury Dhaincha without adversely affecting paddy yield was designed. (Dhaincha buried immediately before transplanting was thought to adversely affect crop growth because of nitrogen immobilization, low Eh value, and formation of organic acid on higher partial CO_2 pressure.) But it was more beneficial to bury Dhaincha at puddling than at 20 or 10 days before puddling (see table). Interestingly, it saved 120 kg N/ha. The recommended method saved only 60 kg N/ha. The new technique makes conservation of 100% more nitrogen possible, and gives farmers 15 more days to plan their Dhaincha sowing during the busy season.

The experiment was repeated in 1978 at the PAU farm and in farmers' fields in Ludhiana district. Effects on crop growth seem similar. Investigations will be reported. □

Effects of leaf area index and spacing on the productivity of Pankaj

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The longduration variety Pankaj (a selection of IR5) was transplanted at the Agricultural Research Institute, Patna, in the 1977 kharif using a strip-plot design with three replications. Two rates of nitrogen — N_1 (50 kg N/ha) and N_2, (100 kg N/ha) — and five spacings – S_1 (10 × 10 cm), S_2 (15 × 15 cm), S_3 (20 × 20 cm), S_4 (25 × 25 cm), and S_5 (30 × 30 cm) — were used. Basal treatments of superphosphate and muriate were used for all plots at 60 kg P_2O_5/ha and 40 kg K_2O/ha. The leaf area index (LAI) was recorded at five stages: maximum tillering, panicle initiation, ear emergence, dough, and ripening. The final yield was recorded.

Grain yield in relation to leaf area index and plant spacing at the Agricultural Research Institute, Patna, India.

Treatment[a]	Leaf area index					Yield (t/ha)
	Maximum tillering	Panicle initiation	Ear emergence	Dough	Ripening	
N_1S_1	3.0	4.2	9.4	9.2	7.8	5.9
N_2S_1	3.5	1.3	9.7	8.9	8.2	5.6
N_1S_2	3.9	3.7	11.1	6.0	7.1	6.3
N_2S_2	4.3	3.4	7.4	9.0	5.2	6.3
N_1S_3	1.4	2.4	5.7	6.7	4.1	5.8
N_2S_3	1.0	3.3	5.6	5.5	3.4	6.6
N_1S_4	1.8	3.7	4.7	5.3	3.9	5.8
N_2S_4	1.8	3.2	4.9	5.2	3.9	6.1
N_1S_5	0.7	2.1	3.5	4.9	2.6	4.1
N_2S_5	1.0	2.2	3.2	4.9	2.5	4.9

[a] N_1 = 50 kg N/ha, N, = 100 kg N/ha, S_1 = 10 × 10 cm, S_2, = 15 × 15 cm, S_3, = 20 × 20 cm, S_4, = 25 × 25 cm, S_5, = 30 × 30 cm.

The results show that the LAI at ear emergence and at the dough stage was related to yield. The LAI was visibly higher in the close spacing than in the wide spacing.

Pankaj yielded higher at 15- × 15-cm spacing with 50 kg N/ha and at 20 × 20 cm with 100 kg N/ha. Spacings greater than 25 cm between plants adversely affected yields. There was no yield response to the second 50 kg N/ha. □

Environment and its influene

Observations on rice grown in submerged vs saturated hydroecosystems in Gangetic alluvia soils

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Some scientists believe that submergence of the field during the life span of the rice crop is essential to maximize reproductive as well as vegetative yields. Others have reported, however, that submergence is not essential to high yields. They believe that during the growing season, soil saturation at field capacity is also conducive to high rice production with little yield sacrifice under certain agroecologic conditions (a high water table and low evaporative demand). A field trial was conducted in the 1977 summer monsoon season in Gangetic alluvial soils (medium-textured) of the BHU research farm, Varanasi. The indica semidwarf Cauvery was grown in: 1) fields that were submerged at a depth of 3–5 cm, and 2) soil that was saturated at field capacity (0–0.1 atmospheric tension).

The rice plants in the submerged fields tillered heavily, had more foliage, and were taller than those grown in saturated soil. The leaves were shiny green, their functional area and functional duration were high. The plants headed and flowered 3 to 5 days earlier. The relative growth rate and dry-matter production were also superior. The roots proliferated in the undergrown soil profiles both vertically (26 cm) and horizontally (12 cm). The feeding roots were numerous and the root surface area was nearly double that of rice grown in saturated soil.

On the other hand, poor root proliferation of plants in saturated soil must have been due to the high mechanical impedance in such soil. The rice plants in saturated soil faced severe competition from mesophytic and semiaquatic weed flora such as *Cyperus rotundus, Cyperus diffrmis, Eclipta prostrata,* and *Cynodon dactylon.* In both submerged and saturated soils, the white, hollow roots of *Panicum repens* reached a distance of 30 cm in the soil within 2 weeks and the roots of *E. prostrata* occupied the entire feeding zone of the rice roots. *C dactylon* was almost completely suppressed in the flooded soil, but neither *Panicum* sp. nor *Commelina benghalensis* was affected by moisture regimes.

Algal films were absent in the saturate saturated soil, but algal flora flourished in flooded rice beginning at 4 days after transplanting. Nitrogen fertilization rapidly increased algal growth. As the crop canopy covered the field, the algal blooms gradually disappeared (because of lack of light for photosynthesis). The algal films played a role other than nitrogen fixation – they suppressed the growth of aquatic weed flora by curtailing light penetration through the water surface. Another interesting phenomenon in the submerged-water regime was the low rice plant damage from mole crickets, cutworms, and rodents.

The plants grown in the saturated field showed wilting symptoms because cell turgidity decreased at midday on bright, sunny days. Grain yields were almost one third less under saturated conditions. Therefore, saturation at field capacity cannot substitute for flooding to maximize rice yields. □

Too late for

Pest management and control

DISEASES

Production of the perfect stage of the leaf scald fungus in culture

Pat Crill, F. L. Nuque, T. V. de Dios, S. P. Ebron, Plant Pathology Department, International Rice Research Institute

In 1978 S. H. Ou and associates reported the natural occurrence of the perfect stage of the leaf scald fungus *Rhynchosporium oryzae* on rice in the Philippines, Colombia, and Costa Rica.

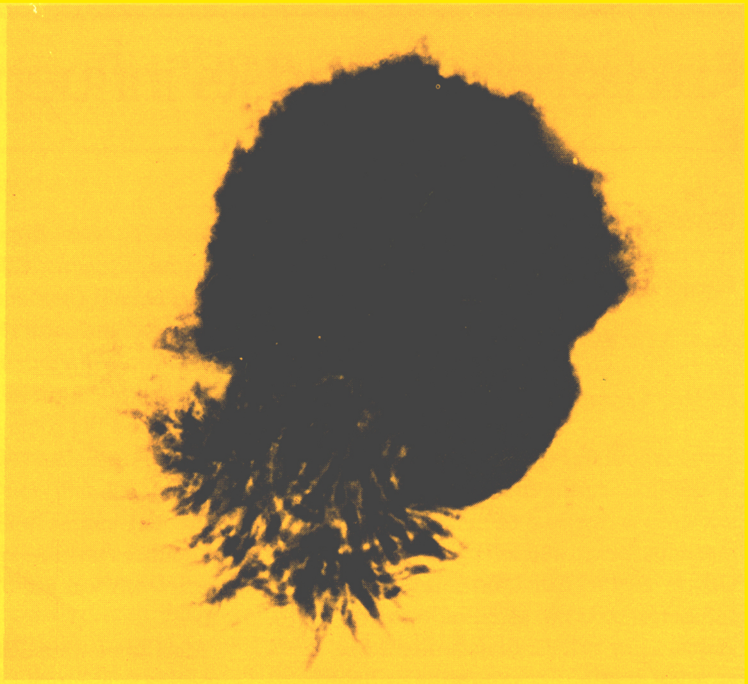
They compared descriptions of the fungi as reported by several authors, and concluded that the proper name of the perfect stage of the fungal causal agent of leaf scald was *Metasphaeria albescens* (von Thuemen) Wei.

Production of the perfect stage of most ascomycetes is a sexual recombination process that results in the formation of haploid, uninucleate ascospores. Because *M. albescens* is an ascomycete, the same general reproductive features should apply so the individual ascospores can be genetically studied for pathogenicity and other race and cultural characteristics.

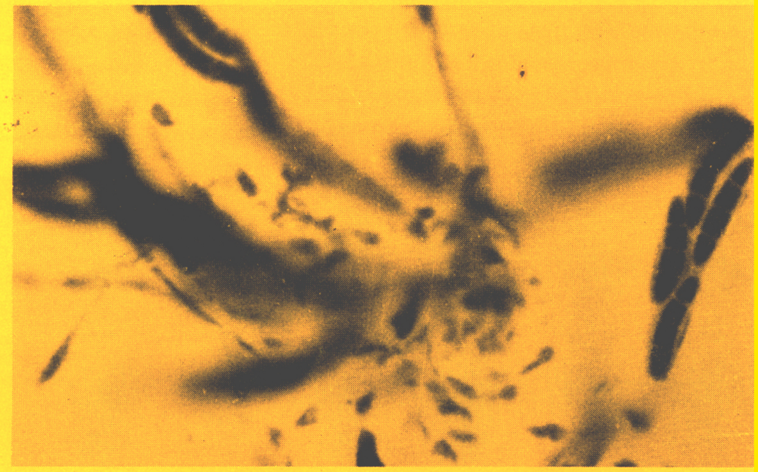
Rice leaves that exhibited typical leaf scald symptoms were collected at IRRI in August 1978. The leaves, which contained perithecia, were placed on the top cover of moist petri dishes. Ascospores were allowed to drop onto water agar (1.4%). Thirty-nine individual ascospores were transferred to agar slants. The single ascospore cultures were used as parents in various combinations. Ninety-six crosses or matings were attempted. Mycelial fragments and conidia were transferred from the monoascosporic cultures to nutrient solution and cultured at 25°C in the dark in 250-ml Erlenmeyer flasks. The flasks were removed from the incubator and shaken for 1 hour each day. After 10 days, 0.25 ml of the conidial and mycelial mixture was pipetted to petri dishes containing Sach's media in 1.7% agar into which sterilized leaf sheath pieces of IR442 were imbedded. The spore-mycelial mixture of the parents was placed equidistant on opposite sides of the leaf sheath pieces. These mating plates were placed at 25°C with 8 hours of light and 16 hours of darkness. Selected mating plates were observed daily for perithecial formation.

Perithecia were formed as early as 7 days and as late as 14 days after the mating plates were prepared. Fifty-eight of the 96 attempted crosses resulted in the formation of perithecia. Perithecia averaged 180 μ (range 130–250 μ) in diameter. The asci varied from 34 to 80 μ X 7–11 μ (av 57 X 9 μ) and ascospores varied from 14 to 23 μ X 3–6 μ (av 19 X 5 μ) in size. These measurements were within the limits described by Ou in 1978. Perithecia were dark brown to black (Photo 1) and ascospores were colorless. Mature ascospores commonly had 3 septa (Photo 2).

Although the data suggested the presence of mating types, it was inadequate to establish if the fungus was homothallic or heterothallic. Studies are in progress to determine this and other characters using serially isolated ascospores. □



1. A mature perithecium of *Metasphaeria albescens* with asci protruding. IRRI, 1978.



2. A mature ascus of *M. albescens.* Ascospores are stained with aniline blue. IRRI, 1978.

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