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Contents

Guidelines and Style for IRRN Contributors

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

Style

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

Guidelines

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

Genetic evaluation and utilization

OVERALL PROGRESS

Identification of long-duration semidwarf rice cultivars for low-lying situations in different agroclimatic zones of West Bengal

P. Mukherjee and A. R. Debnath, Rice Research Station (RRS), Chinsurah, West Bengal, India

A multilocation investigation was conducted during the 1979 wet season to identify suitable rice cultivars for lowlands (20-50 cm water level) in specific agroclimatic zones in West Bengal. The entries were promising rice cultivars of diverse genetical constitution from coordinated trials, and mutant and hybrid derivatives developed at RRS, Chinsurah; the Central Rice Research Institute, Cuttack; other institutions of India and IRRI.

Sixteen promising long-duration (140 days or longer in the wet season) semidwarf rice cultivars were fitted in a randomized block design with 3 replications. Plot size (net) was 4.6 × 2.7 m, with a spacing of 20 × 15 cm. Fertilizer was applied at a rate of 80 N:40 P_2O_5:40 K_2O kg/ ha.

The table shows that at Chinsurah, grain yields ranged between 5 t/ha for CR1O11 and 2.4 t/ha for CNM539. CR1006 (4.8 t/ha) and Pankaj (check) (4.7 t/ha) ranked 2d and 3d.

At Bankura, the grain yield was poor because of drought. Nevertheless, IR34 and 1R4219-35-3-3 yielded nearly 3 t/ha and CR1002 and IET5638 yielded 2 t/ha. CO 40 was completely damaged.

The trial at Krishnanagar also suffered because of drought. Only IR4219-35-3-3 yielded 2.6 t/ ha, and Pankaj (check) yielded only 1.9 t/ ha.

On the basis of average grain yields at three sites, the cultivars IR4219-35-3-3, Pankaj, IR34, CR1002, and CR1006 are suitable for low-lying areas in different zones of West Bengal. ■

Mean yield of long-duration semidwarf rice culivars in low-lying areas during 1979 wet season at 3 sites in West Bengal, India.

Cultivar	Growth duration (days)	Grain yield (t/ha) Chinsurah	Rankura	Krishnanagar	Varietal mean
CR1002	142	4.4	2.0	1.4	2.6**
CR 1006	160	4.8*	0.8	1.7	2.6**
CR 1009	152	4.3	1.2	1.3	2.3
CRlOlO	156	4.5*	0.9	1.3	2.2
CR1O11	151	5.0*	0.7	1.3	2.3
IET5638	145	4.4	2.0	0	2.1
IET5656	155	4.2	1.9	0.7	2.3
CO 38	143	3.6	1.9	0.8	2.1
CO 40	170	4.0	0	0.5	1.5
CN 195	143	3.7	1.4	0.6	1.9
CN643	150	3.7	1.2	0.8	1.9
CN644	154	3.5	1.3	0.5	1.8
CNM539	145	2.4	1.1	0.8	1.4
IR34	140	3.6	2.9*	1.6	2.7**
IR4219-35-3-3	150	4.0	2.9*	2.6*	3.2**
Pankaj (check)	145	4.7*	1.8	1.9	2.8**
L.S.D. (0.05)		0.5	0.6	0.4	

*Indicates at par. **Indicates recommended.

Delay in flowering of some lines during rapid generation advance

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

In the rapid generation advance (RGA) method the plants are subjected to short days and high temperature so they can be harvested 60-90 days after sowing. But we have noted that the flowering of many plants in several crosses was delayed despite the short-day treatment. Some plants in crosses such as G. Benton 1101/IR42, DA29/IR42, and BR4/ Patnai 23 matured as late as 134 days after sowing.

A study of the parents showed that crosses involving two parents of long basic vegetative phase (BVP) (such as G. Benton 1101/IR42 and DA29/IR42) resulted in delayed flowering of many lines (see table). But in crosses where one or both parents have short BVP, such as Silewah/Hokkai 241, the resulting progeny are early flowering.

The delay in flowering of certain crosses is mostly the result of long BVP. Thus, a line with a BVP of 60 days will take longer than 100 days to mature. Such crosses tend to diminish the advantage of RGA because the possibility of 3 generations/year becomes difficult.

The BVP, if known, should be considered in determining what crosses to run through RGA. Crosses with long BVP that are insensitive to photoperiod could be planted in the field because the growth duration in the RGA is not considerably shortened and, in some cases, is actually delayed. ■

Basic vegetative phase (BVP) and growth duration of varieties involved in crosses. IRRI, 1981.

	BVP	Growth duration (days)
G. Benton 1101	60	F_2 = 122
IR42	49	F_3 = 99
DA29	41	F_2 = 113
IR42	49	F_3 = 134
BR4	40	F_2 = 115
Patnai 23	41	F_3 = 106
Silewah	45	F_2 = 82
Hokkai 241	13	F_3 = 67
		F_4 = 70
		F_5 = 75
Silewah	45	F_2 = 85
IR2793-80-1/ IR747B2-6-3	short	
Silewah	45	F_2 = 103
IR52	medium	

Performance of IR36 in Karnataka, India

B. S. Naidu, M. Mahadevappa, S. S. Inamdar, K. Maharudrappa, and Jayaram, University of Agricultural Sciences, Bangalore, Karnataka, India

In Karnataka, about 55% of the rice area is planted to 16 recommended high yielding varieties. Some more area could be brought under high yielding rices by filling the extension gap. But special varieties with multiple resistance, intermediate plant stature, and earliness are needed for the area still planted to native rices.

Recent research and minikit results have indicated that IR36 has potential to supplement the currently recommended early-maturing, high-yielding varieties. IR36 has four attractive features: long slender grain, tolerance for salinity, tolerance for iron deficiency, and early maturity. This combination of characteristics cannot be found in any variety on the current recommended list.

Performance of IR36 in Karnataka, South India, 1978-80.

Year	Season	Variety[a]	Sites[b] (no.)	Av yield (t/ha)	Increase (%) over cheek varieties
1978	Wet	IR36	5	5.1	
		Rasi		4.7	9
		IR20		4.6	11
		Ratna		4.2	21
1978	Upland trial	IR36	1	4.8	
		Rasi		4.4	9
1979	Wet	IR36	3	4.4	–
		Mandya Vani		3.9	13
		IR20		4.4	–
		Pushpa		4.0	10
1980	Wet	IR36	1	4.1	
		Madhu		3.8	8
		Pushpa		3.3	24

[a]Some check varieties were not included at all sites. [b]Mandya, Mangalore, Mugad, Dhadesugur, Hebbal, Nagenahalli, and Ankoal, Karnataka, India.

Performance tests conducted at different sites and across seasons in the rice experiment stations of Karnataka show the superiority of IR36 over Rasi, Ratna, Mandya Vani, Madhu, IR20, and Pushpa (see table).

IR36 also was evaluated for two seasons through minikit trials in farmers' fields and will be tested for a third season. It is hoped that IR36 will supplement other early varieties in the districts of Bangalore, Tumkur, Kolar, Chitradurga, Bellary, Raichur, Shimoga, and Dharwad. ■

GENETIC EVALUATION AND UTILIZATION

Grain quality

Aflatoxins in Sri Lankan rice

J. M. R. S. Bandara, plant pathologist; and H. A. Ratnasoma, Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Carcinogenic aflatoxins are produced by the fungi *Aspergillus flavus* and *A. parasiticus* that commonly grow on cereals and legumes in tropical climates. In Sri Lanka, rice is mainly consumed as raw *kekulu* processed (with or without bran) or parboiled rice (brown or polished). In parboiling, rough rice is soaked, steamed and sun-dried before milling. The chances of grains becoming moldy during this procedure are high. Various types of rice were examined for the relationship of processing method to aflatoxin contamination.

About 27% of the rough rice samples collected from Kandy were contami-

Occurrence of aflatoxin B_1 in Sri Lankan rice.

Rice	B_1 (ppm)	Rice class
BG90-2	0	rough
BG94-1	0	rough
BG400-1	trace +	rough
BG379-2	0	rough
BG34-8	0.056	rough
MI39-193-1	0	rough
MI639-124-23	0	rough
MI290-32	0	rough
BW265	0.024	rough
BW272-6B	0	rough
BW272-8	0	rough
Parboiled samba	0	polished
Parboiled	0.128	polished
Parboiled	0.234	brown rice

nated with aflatoxin B_1 (see table). The level (0.234 ppm) detected in parboiled (brown) rice collected from Peradeniya was much higher than the tolerable level (0.01 ppm) in developed countries. The natural contamination of rough rice BG34-8 and BW265 could indicate a higher susceptibility of new improved varieties to toxigenic strains of *Aspergillus.*

Twelve rice varieties tested for susceptibility at moisture content 30% were artificially inoculated with two toxigenic strains of *A. flavus* and *A. parasiticus.* All 12 were susceptible. They also produced very high levels of toxins (above 0.300 ppm) in 2 weeks of incubation at 25° C. ■

GENETICE EVALUATION & UTILIZATION

Disease resistance

Leaf scald disease of rice in Andhra Pradesh

K. Satyanarayana, scientist (S-1- Pathology), All India Coordinated Rice Improvement Project (AICRIP); and K. Janardhan Reddy, assistant research officer (Breeding), Regional Rice Research Station (RRRS), A. P. A. U., Nellore, Andhra Pradesh, India

During a disease monitoring tour to RRRS, Nellore, in February 1981, leaf scald disease caused by *Rhynchosporium oryzae* Hashioka and Yokogi was observed in many rice varieties on the farm. Disease-affected specimens were collected, the causal organism was isolated, and its pathogenicity was confirmed at AICRIP, Hyderabad. On the basis of all morphological characters, the fungus is identical to what Ou described in 1972.

The conidial suspension of the fungus was prepared from 7-day-old streaked culture on potato dexrose agar in petri dishes. Two susceptible varieties — TN1 and EUP-1582 — (known from the earlier work with the Ponnampet isolate of the pathogen) were grown in pots. When the plants were at panicle initiation stage, they were inoculated with the clip inoculation method and then kept in humid chambers for 72 hours. Five days after inoculation, 2- to 3-mm-long water-soaked lesions at the clipped ends of leaves were observed. The lesions gradually moved downwards and within 12 days covered 12-15 cm of the leaf blade, turning straw color with transverse banding. From the fresh advancing lesions, the fungus was reisolated and identified as *R. oryzae.* This is the first record of leaf scald occurrence in Andhra Pradesh.

Various experimental trials have shown the following varieties or cultures as susceptible to leaf scald disease at Nellore: NLR 11214, NLR 10859, NLR 18235, NLR 18161, NLR 17906, NLR 17039, NLR 16696, NLR-T 197, RNR 89128, RNR 36178, RNR 87877, K H 998, Rajendra, KLN H 361-1-1-6-2, KLN H 36, MTU 6099, MTU 5249, MTU 5283, MTU 5410-9, CR 181-62-15, CR 42-10-231, RP 1033-43-2, PS 1–44–624, IR20,1R34, BPT 1235, IET 6844, IET 7532, IET 6069, IET 6097, IET 6560, IET 7041, IET 6661, IET 6896, IET 7237, and IET 7042. ■

Disease reaction of advanced rice cultures

B. Balakrishnan, K. M. Rajan. G. Mathai, and N. Remabai, Rice Research Station (RRS), Moncompu, Kerala, India

In Kuttanad, the rice bowl of Kerala, 100% coverage of high yielding rice varieties has been achieved. Severe incidences of sheath blight disease caused by *Rhizoctonia solani,* sheath rot disease caused by *Acrocylindrium oryzae,* and bacterial blight caused by *Xanthomonas oryzae* occur in the area. To develop varieties that can tolerate those diseases, rice cultures developed at the RRS, Moncompu, were evaluated.

The cultures were screened repeatedly for 2 years in the field and in the greenhouse, and artificial inoculations by standard techniques were done. Disease intensity was scored by the IRRI Standard Evaluation System for Rice scales, 2 weeks before harvest. The mean disease scores recorded for each entry are in the table.

Disease reactions[a] of advanced rice cultures. Rice Research Station, Moncompu, Kerala, India.

Culture of Variety	Mean sheath blight score	Mean sheath rot score	Mean bacterial blight score
M11-57-5-1[b]	1.25	2.20	0.35
MI544-2	2.62	3.67	2.75
MI5-36-2[c]	0.00	2.95	5.15
MI537-2	2.00	1.85	2.10
M23-100-2-2	1.36	1.20	1.15
M23-16-1-1	1.35	1.05	1.35
M23-17-1-1	0.25	0.85	1.37
M23-69-1-1	0.60	0.45	1.35
M23-69-1-1-1	3.95	1.75	0.65
M23-74-1-2-1	2.07	2.57	1.97
M23-17-1-3	4.12	2.50	2.47
M23-69-1-2	2.35	2.42	1.80
M23-83-1-1	1.37	2.80	0.35
M22-65-2-4	2.02	4.25	1.62
M22-184-1-1	1.50	3.92	2.50
M14-59-2	1.42	3.35	2.47
M23-74-1-1	0.70	2.22	1.62
M24-211-1	0.67	3.17	1.85
M1537-1	1.15	3.00	1.45
M22-67-3-2	1.62	2.70	2.40
Jyothi (susceptible check)	4.12	2.70	4.52
TN1 (" ")	2.67	3.32	4.21

[a]Scored by the 1980 Standard Evaluation System for Rice scales of 0-9. [b]Released as Bhadra during 1978. [c]Released as MO 5 during 1980.

M15-36-2 (MO 5), M23-17-1-1, M23-69-1-1, M23-74-1-1, and M24-211-1 showed good tolerance for sheath blight (score < 1); M23-17-1-1 and M23-69-1-1 were found to tolerate sheath rot (score < 1); M11-57-5-1 (Bhadra), M23-69-1-1-1, and M23-83-1-1 tolerated bacterial blight (score < 1).

M23-17-1-1 and M23-69-1-1 were found to possess tolerance for both sheath blight and sheath rot, diseases that are serious in the area. ■

Varietal response to bacterial blight and stem rot under artificial epiphytotic conditions

S. C. Ahuja, S. S. Malik, Uma S. Ahuja. C. V. S. Malik, Rice Research Station, HAU, Kaul 132021, India

Two experiments tested 56 varieties and lines at the Rice Research Station, Kaul, during May-October 1980. In the first experiment, the yields of 11 promising high yielding varieties and lines were compared with those of cultivars Jaya and Palman 579. The entries were planted in 15-m^2 plots in a randomized block design with 3 replications. Two rows of the susceptible check TN1 were planted between two consecutive plots. In the second experiment, 43 varieties and lines were planted in 3-m-long 2-row plots to identify a resistance source for bacterial blight (BB) and stem rot (SR).

BB inoculation was at maximum tillering. The upper 5-cm leaf-tip portions were cut with a sickle dipped in inoculum prepared by soaking pieces of infected leaves in water for 20 minutes. SR inoculation was done in the laboratory on excised internodes (with intact nodes at both ends) collected at flowering stage by the cut-stem wound method.

Observations on intensity of BB and SR were recorded after 14 and 10 days, respectively, in accordance with standard methods. Under BB stress, IET4141, IR36, and Prasad yielded 5.85, 5.59, and 5.54 t/ ha or 32% 26%, and 25% more than the check variety Jaya.

IET4141 and Prasad were resistant to SR, IR36 and HAU-6-163 were susceptible. IR36 and Prasad matured 11 days earlier than IET4141. Grain sterility ranged from 5.02 to 12.65 in resistant varieties and 13.54 to 51.89% in susceptible ones (Table 1).

In the second experiment, 16, 22, and 5 entries had resistant, susceptible, and intermediate reactions to SR, and 8, 12, and 14 entries had resistant, susceptible, and intermediate reactions to BB. Damodar and CR206-6176-260 were resistant to both diseases (Table 2). ■

Table 1. Performance of high yielding strains or varieties under high bacterial blight stress at Kaul, India.

Strain or variety	Pedigree	Reaction[a] to		Days to		Grain sterility (%)	Yield[b] (t/ha)
		Bacterial blight	Stem rot	50% flowering	Maturity		
RP633-519-3-8-1-1 (IET4141)	(IR8/BJ 1 43)//IR22	3	1	118	151	12.65	5.85 a
IR36	(IR1561-228)//(IR24/ON)///CR94-13	3	9	105	140	8.14	5.59 a
Prasad	(IR747 B_2-6/IR579-48)	3	1	106	140	5.02	5.54 ab
HAU 6-163	Jaya/Palman 246	9	9	106	141	30.63	4.96 abc
CR167-10 (IET4096)	Ratna/Early prolific	5	5	107	142	13.54	4.79 bc
Palman 579	IR8/Tadukan	5	1	105	140	14.86	4.49 c
HAU 1-38-1-1	Jaya/Jhona 349	9	9	105	140	38.19	4.43 cd
Jaya	TNI/T141	9	9	112	146	17.95	4.43 cd
PR 106	IR8//(F'eta S/Bellepatna)	9	1	112	146	15.08	4.30 cde
6473 (IET2729)	–	7	3	110	143	27.18	4.24 cde
6475 (IET2730)	–	5	1	110	143	21.71	4.15 cde
HAU 2-97-1	Jaya/Jhona 351	9	5	94	129	41.99	3.42 de
HAU 1-227-1	Jaya/Jhona 349	9	9	96	131	51.89	3.15 e

[a]Based on the Standard Evaluation System for Rice scales. [b]Means followed by a common letter are not significantly different at the 5% level.

The International Rice Research Newsletter (IRRN) invites all scientists to contribute concise summaries of significant rice research for publication. Contributions should be limited to one or two pages and no more than two short tables, figures, or photographs. Contributions are subject to editing and abridgement to meet space limitations. Authors will be identified by name, title, and research organization.

Table 2. Reaction of lines or varieties to stem rot and bacterial blight at Kaul, India.

Line or variety	Pedigree or origin	Reaction[a] to	
		Stem rot	Bacterial blight
Basmati 370	Pure line selection	1	7
Jhona 349	Pure line selection	3	9
IR8	(Peta/DGWG)	9	7
Jaya	(TNI/T141)	9	9
Pusa 2-21	(IR8/TKM6)	1	7
Sona	(GEE 24/TN1)	3	7
Improved Sona	–	1	5
Ratna	(TKM6/1R8)	5	7
Zenith	U.S.A.	9	7
Benibhog	–	7	7
Damodar	–	1	3
CO 13	–	9	3
HAU 1-6-1	(Jaya/Jhona 349)	5	7
HAU 1-38-1-1	(JayalJhona 349)	9	9
HAU 3-103-3	(IRB/Jhona 351)	9	5
HAU 5-162-3	(Palman 579/Basmati 370)	9	7

(continued on page 7)

Table 2 (continued)

Line or variety	Pedigree or origin	Reaction[a] to	
		Stem rot	Bacterial blight
HAU 6-163-2	(Jaya/Palman 246)	9	9
UPRM 202	(Basmati Mutant)	9	5
UPRM 500	Hansraj Mutant	9	5
PAU 1-608-A	(Basmati 370/IR8-36)	7	5
PAU 41-30-6-2-5	(Phulpattas 72/Mutant 65)	9	9
PAU 128-1191-PR 303	(IR305-3-17-1-3/IR661-1-140-3)	1	5
CRR 89-5-1-1 RPSC 14	(Ratna/Domsiah)	3	5
CRR 89-5-4-1 RPSC-51	(Ratna/Domsiah)	3	5
CRR 89-5-4-2 RPSC-52	(Ratna/Domsiah)	9	7
CR 167-10	(Ratna/Early Prolific)	5	3
CR 206-6176-260	(Vijaya/Domsiah)	1	3
CR 209-6253-262	(RatnalDomsiah)	5	3
FH 661		9	7
RP 967-4-1-2-4	(Improved Sabarmati/Sona)	9	3
ADT 32	(IR20/Pusa 33)	9	5
ADT 14166	(Pusa 140/Pusa 33)	3	9
ADT 14185	(Pusa 140/Ratna)	5	5
TRB 63	Basmati Mutant	9	5
SST_1 - 1898	Punjab	9	7
SST_1 - 1906	Punjab	3	7
SFC III	(IR8/NP 49)	9	1
R 575	Himachal Pradesh	1	7
O 12990-2/6-10-2	(IR8/Pankli 203)	1	7
IR4422-480-2	(IR2049-134-2/1R2061-125-31)	1	5
IR8073-231-3-3	(IR4-1l/IR2035-290-2-3)//1R2153-26-3	3	5
IR9752-303-3-1-3	(IR28/Kwang-Chang-Ai)//IR36	9	3
Nong Nghiep 75-5	(IRS/D 268)	9	5

[a]Based on the Standard Evaluation System for Rice Scales.

Pathogenic variability in *Xanthomonas oryzae*

S. T. Tembhurnikar, Plant Pathology Division, Central Rice Research Institute, Cuttack 753006, Orissa; and S. Y. Padmanabhan, Svagatham, 97 V. M. Street, Madras 600004, India

Thirty-six rice varieties were artificially infected in the field with 24 isolates of *Xanthomonas oryzae* (Uyeda et Ishiyama) Dowson in September 1973 and April 1974. The objective was to select suitable parents for determining genes for resistance and probable differentials for research on pathogenic specialization.

Twenty-six of the varieties were selected on the basis of their known reactions to 1 or 2 virulent isolates of *X. oryzae;* 16 were morphological markers of the 12 linkage groups in rice, included to identify characters associated with resistance.

The rices were artificially infected by the clipper method developed by Kauffman, using 2-day-old cultures suspended in sterile distilled water. The optical density was adjusted to 1.5 with Spectronic-20 at 620 nm. The spread of infection was measured (in centimeters) below the point of infection 15 days later.

The infection generally spread more in September than in April, with some notable exceptions. The response to seasonal factors in variety-isolate interactions was differential (see table).

Differential varieties should have short growth duration (120-130 days or less) and be insensitive to photoperiod. Short-duration varieties facilitate the multiplication and maintenance of pure seeds, the raising of seedlings to the flag-leaf stage for artificial infection, and other operations. Differential varieties should also show clear-cut resistant and susceptible reactions (the spread of infection in susceptible reaction should exceed 10 cm).

BJ1, Wase Aikoku 3, AC3550, and AC616 were completely resistant to 9 isolates, and, therefore, poor candidates as differentials, but good resistance donors. One or two of this group, however, could be included in the differential set to detect new virulent races in a region.

Differential reaction between isolate and rice varieties between September and April inoculations in Madras.

Variety	Isolates showing differential reaction
AC616	C
JBS376	C H201
AC806	C
AC5169	H J
Pirurutong	J H110 H146
Sigadis	H14 H1110 H66 H100
AC1063	D
ARC 142	H24
AC5607	H167 H200
T1242	H167 H100
MNP153	H167
SLO 16	H200
AC467	H200
Vijaya	H200 H201
JBS376	H34
M18	H201 H34
Early Prolific	H201
AC1224	H201
Lacrosse/Zenith-Nira	H110 H146 G
MNP153	H100
MNP152	G

PTB 10, Cauvery, IR8, and TN1, being susceptible to all isolates, are also poor differential candidates. TN1 might be included as a test variety in infection studies.

The following appear to be good candidates as differentials: AC616, AC5169, AC3551, AC1063, ARC11249, ARC142, AC5607, JBS376, Bluebelle, and Lacrosse/Zenith Nira. Only Sigadis had consistently low infection against all isolates in kharif and is, therefore, a good donor for resistance to Indian isolates.

The variability of the pathogen and its response to environmental fluctuation suggest the need for a rigid standardization of infection procedures. ■

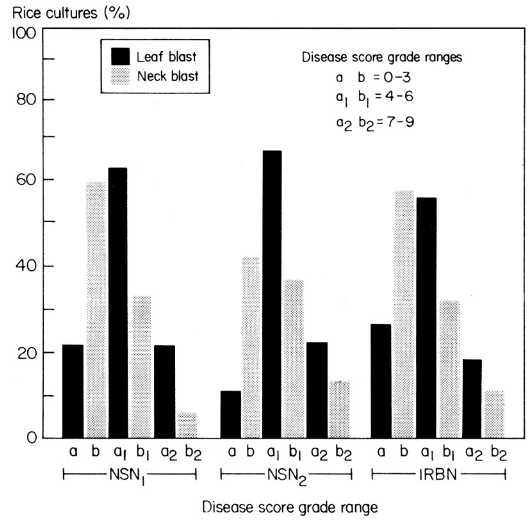
Relation between leaf blast and neck blast disease on paddy in trials during 1980 kharif in India

S. Sanne Gowda, pathologist; and K. T. Pandurange Gowda, research assistant, University of Agricultural Sciences, Regional Research Station, V. C. Farm, Mandya

This study sought to understand the relationship between leaf blast and neck blast on various cultures of paddy in national screening nurseries (NSN-1 and 2) and the International Rice Blast Nursery (IRBN) trials conducted in 1980 at V. C. Farm, Mandya. Information from the entries screened — 290 in NSN-l, 285 in NSN-2, and 264 in IRBN — showed the variable reaction of cultures to blast and disease incidence.

The data for disease incidence (see figure) indicate that the lowest number of cultures reacted to neck blast in NSN-1, with a disease score range of 7-9. In the NSN-2 trial, the highest number of cultures reacted to leaf blast, with a score range of 4-6. In all three trials, a high number of entries reacted to neck blast (0-3 score range). The leaf blast score was 4-6. In all trials, 31-36% of the cultures had neck blast in the score range of 4-6.

The variability in disease reaction and



Rice cultures showing variable reactions to leaf and neck blast. Karnataka, India, 1980.

number of cultures reacting to the two stages of blast may be due to the variable agroclimatic factors prevailing during the season, variable inoculum potentiality at the time of infection, and the resistant reaction of some cultures to the pathogen. ■

GENETIC EVALUATION AND UTILIZATION

Insect resistance

Rice varietal resistance to brown planthopper

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A total of 1,070 varieties (1,000 ARC, 20 IRRI, and 50 from other sources) were evaluated to identify better sources of brown planthopper (BPH) resistance as well as to study the mechanism of resistance in selected varieties. In a mass-screening replicated test, resistance (less than 1.5 score on a 0-5 scale) was shown by only 18 varieties: ARC5500, ARC5754, ARC5757, ARC5764, ARC5780, ARC5838, ARC5917, ARC5973, ARC5981, ARC5988, ARCl 2864, ARCl 3854, ARCl 3966, ARC14394, AR13507, ARC14539, ARC14766 A, and ARC14703. Moderate resistance (1.6 to 3.0) was observed in 73 varieties. ARC5780, ARC5973, and ARC12864 exhibited less damage and were comparable to the resistant check PTB 33.

A high degree of nonpreference and antibiosis mechanism was evident in ARC5780 and ARC5988. Varieties less preferred by BPH nymphs were also less suitable for adult oviposition, with the exception of ARCl 3854, ARC 14766 A, and ARC15507. On selected resistant varieties nymphal mortality was higher and nymphal development was longer by 3-7 days, than in the susceptible check TN1. Resistant varieties bore a higher number of probing marks made by insects during attempts to feed. Feeding on resistant varieties was 6.6 to 11.9 times less than on the susceptible check. Insects lost 9 to 40% of their body weight while feeding on resistant varieties, but gained 27% on a susceptible variety. Some varieties showing moderate damage reaction (ARC59 18, ARC10443, ARC13984, ARC14529, and ARC14864) also exhibited more feeding marks, greater amounts of honeydew excretion, and higher gain in body weight of the insects, confirming a moderate degree of resistance.

The susceptible reaction in mass-screening tests of resistant varieties (IR26, IR28, IR30,1R32, IR34, IR36, IR38, and 1R40) to different biotypes and of donors such as Mudgo and ASD7 has further confirmed the possibility of different biotypes in the Hyderabad, India, area. Statistical analysis of more than 1,000 varieties showed that lemma and palea color was not associated with BPH resistance. ■

Research on brown planthopper biotypes in China

Wu Jung-Tsung, Chang Liang-You, Qiu Xi-Quang, and Mo Meng-Ye, Plant Protection Department, South China Agricultural College, Kwangchow, (Canton), China

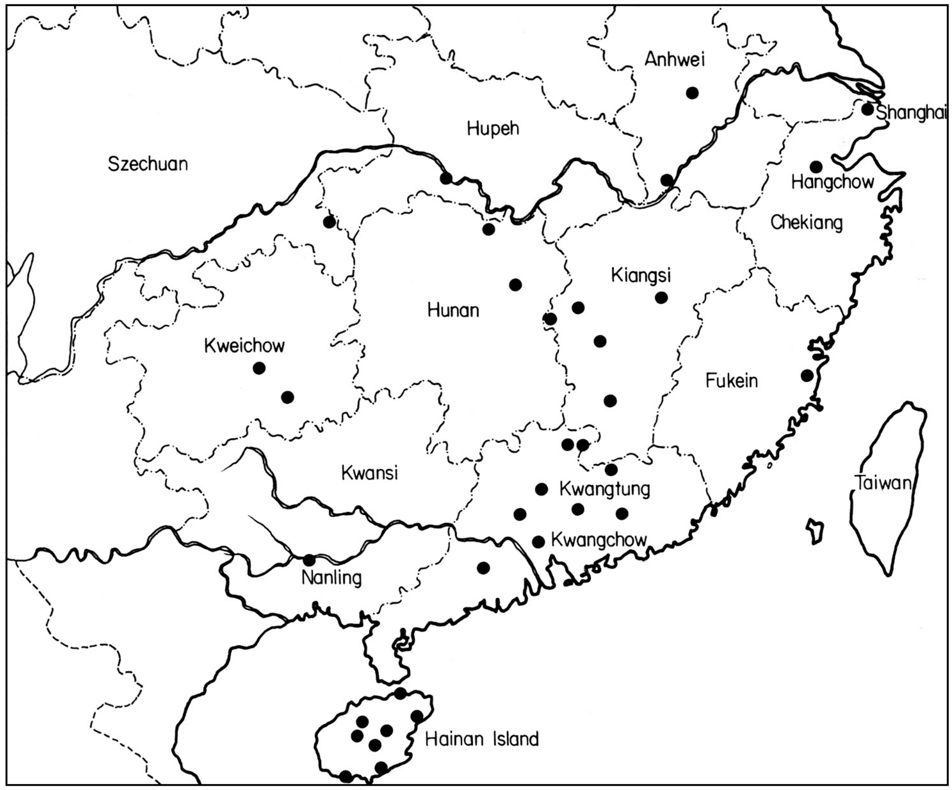
This study was part of the brown planthopper collaborative project sponsored by IRRI. To determine the brown planthopper (BPH) biotype that occurs in different regions of China, responses of different rice varieties to BPH, the survival rate of nymphs, population buildup, and honeydew excretion of the insect were measured.

Twelve rice varieties with resistance genes were tested (see table).

BPH types were collected from 35 counties and cities in China, including

Rice varieties and resistance genes tested for brown planthopper response in China.

Variety	Gene
Mudgo	*Bph 1*
IR26	*Bph 1*
IR42	*bph 2*
ASD7	*bph 2*
H105	*bph 2*
Rathu Heenati	*Bph 3*
Babawee	*bph 4*
PTB 21	2 unidentified
PTB 33	2 unidentified
Sinna Sivappu	2 unidentified
Sudu Hondarawala	2 unidentified
TN1	none



Distribution of brown planthopper biotypes in China.

10 provinces — Kwangtung, Kwansi, Fukien, Chekiang, Hupeh, Hunan, Kweichow, Szechuan, Anhwei, and Kiangsi (see figure). They infested TN1 seriously but were light on Mudgo, IR26, ASD7, Rathu Heenati, Babawee, PTB 21, PTB 33, Sudu Hondarawala, and Sinna Sivappu.

Survival of BPH nymphs on TN1 was significantly greater than on varieties with resistance genes. TN1 supported a larger population and allowed greater development of BPH.

The area of honeydew stained by ninhydrin on TN1 was greater than the area on resistant varieties. The heaviest honeydew was excreted by BPH fed on TN1. ■

The results indicate that BPH collected from the different regions of China are biotype 1. ■

GENETIC EVALUATION AND UTILIZATION

Adverse soils tolerance

Inheritance of tolerance for aluminum toxicity in Brazilian rice *Oryza sativa* L.

Verediano dos Anjos Cutrim, Tan V. Nguyen (presently at Rice Researchers. Inc., Glenn, Calif., USA), CNPAF/ EMBRAPA; José Carlos Silva and José Domingos Galvilo, Universidade de Vicosa, Brazil

Four Brazilian upland rice cultivars — Pratão, IAC 25, Perola, and Bico Ganga — and their F_1 and F_2 progenies from a diallel cross were evaluated for response to 0, 30, and 60 ppm Al in nutrient solutions. The characters studied were plant height, root length, and shoot and root dry weight of 25-day-old seedlings after 21 days of growth in the solutions.

Pratão and IAC 25 were more tolerant of aluminum toxicity than Pérola and Bico Ganga. At 0 ppm Al, Pratão had shorter stems (2%), shorter roots (10%), and less dry weight (49%) than Pérola, but at 60 ppm Al had longer stems (23%), longer roots (15%), and greater dry weight (195%).

Tolerance for aluminum toxicity was controlled by more than one pair of genes, with transgressive segregation and quantitative inheritance observed. Specific combining ability was more important than general combining ability, indicating a greater nonadditive genetic factor. Specific combining ability for all the characters studied at different aluminum concentrations was least in the Pérola-IAC combination. Genotypic correlations were greater than phenotypic correlations, indicating that genetic components had greater contribution than environmental components. ■

GENETIC EVALUATION AND UTILIZATION

Temperature tolerance

Sensitivity of some modern rice varieties to high temperature at anthesis in the western districts of Orissa, India

A. Roy, rice breeder: and N. Acharya, soil physicist, Regional Research Station (RRS), Chiplima, Sambalpur, Orissa, India

Anthesis or blooming is the only growth stage at which rice plants are sensitive to high temperatures. Spikelet sterility is mainly attributed to pollen desiccation. Jennings and others found some varieties, such as Hoveyzeh from south Iran, fertile at temperatures higher than 45° C when others are sterile.

Preliminary observations on the effect of maximum day temperature during

Effect of different maximum day temperatures at blooming on spikelet sterility of different varieties Orissa, India.

Variety	Date of 50% flowering	Max temp (°C)	Sterility (%)	Yield (t/ha)
Subhadra	10 Mar 1980	32.5	11.0	2.3
Bala	16 Mar 1980	39.0	39.4	2.1
Parijata	20 Mar 1980	39.5	9.4	3.8
Rajeswari	30 Mar 1980	33.5	19.9	4.1
Suphala	1 Apr 1980	38.0	28.5	3.6
Kumar	5 Apr 1980	37.5	62.4	2.9
Ratna	–do–	–do–	49.4	3.2
IR36	–do–	–do–	25.8	3.1
IR32	–do–	–do–	26.6	3.4
Annapurna	–do–	–do–	18.1	3.8
Rasi	–do–	–do–	37.3	3.2
Pusa 2-21	–do–	–do–	34.0	3.3
Jatjati	–do–	–do–	34.4	4.6
Jaya	25 Apr 1980	44.5	17.3	4.9
Hema	–do–	–do–	23.7	4.7

anthesis on spikelet sterility of 15 high yielding modern rice varieties at the RRS, Chiplima showed a wide spectrum of resistance to high temperatures at blooming (see table). Kumar suffered the most with a temperature of 37.4° C at anthesis; its sterility percentage was 62.4. Parijata suffered the least with a higher temperature of 39.5° C at anthesis; its sterility was only 9.4%. With a still higher temperature of 44.5° C — often the maximum temperature for this tract — the sterility percentage was only 17.3 in Jaya and 23.7 in Hema. ■

The International Rice Research Newsletter (IRRN) invites all scientists to contribute concise summaries of significant rice research for publication. Contributions should be limited to one or two pages and no more than two short tables, figures, or photographs. Contributions are subject to editing and abridgement to meet space limitations. Authors will be identified by name, title, and research organization.

Pest management and control DISEASES

Host range of *Pyricularia oryzae* and *Thanatephorus cucumeris* in the Vietnamese Mekong Delta

Pham van Kim, Lam Len, Vo thanh Hoang, Tran thi Thu Thuy, Ly hong Hoa and Nguyen ba Hoai, Plant Protection Department, University of Can Tho, Vietnam

After a 3-year survey of rice diseases in the Vietnamese Mekong delta, 9 hosts of *Pyricularia oryzae* and 27 hosts of *Thanatephorus cucumeris* were collected. These hosts were determined according to Koch's postulate.

Hosts of *P. oryzae* (a causal agent of rice blast disease) were *Brachiaria mutica, Digitaria* sp., *Echinochloa colonum, Echinochloa* sp., *Leptochloa chinensis, Leersia hexandra, Paspalum conjugatum, Polytrias amaura, and Sacciolepsis* sp.

Hosts of *T. cucumeris* (causal agent of sheath blight of rice) were *Glycine max, Zea mays, Sorghum vulgare, Saccharum officinarum, Alternanthera repens, Brachiaria mutica, Brachiaria distachya, Cynodon dactylon, Cyperus pilosus, Cyperus haspan, Eichhornia crassipes, Echinochloa colonum, E. crus-gulli, E. cruspavonis, Eleusine indica, Fugraea colhinchinensis, Fimbristylis miliacea, Heydystis brynii, Leptochloa chinesis, Leersia hexandra, Lindernia peduculanta, Monochoria hastata, Paspalum conjugatum, Sacciolepsis interrupta, Scirpus grossus, Scirpus articulatus,* and *Neyraudia reynaudiana.* ■

Correct schedule of cypermethrin spray for RTV control

S. Srinivasan, Paddy Experiment Station (PES), Aduthurai 612-101, Tamil Nadu, India

Trials at PES have shown that rice tungro virus (RTV) can be controlled by foliar spray with cypermethrin. It was also observed that spraying after the 15th DT (day after transplanting) alone was not as effective as spraying on the 15th DT. To determine the correct crop stage to spray and optimum number of cypermethrin spray for effective RTV control, a detailed study was conducted

Data on rice tungro virus incidence and grain yield. Tamil Nadu, India, 1980-81 thaladi. [a]

Treatment[b]	Rice tungro (%)		Stunted unproductive population (%)		Grain yield (t/ha)
	AV	TV	AV	TV	
Control	76.9	61.3	46.8	43.2	2.8
One spray: 7th DT	34.6	36.1	16.9	24.3	4.3
Two sprays: 7th and 14th DT	18.5	25.5	0.5	4.1	5.4
Three sprays: 7th, 14th, and 21 st DT	0.5	4.1	0.5	4.1	5.9
Four sprays: 7th, 14th, 21st, and 28th DT	0.5	4.1	0.5	4.1	6.0
C.D. (P = 0.05%)		8.4		6.2	0.369

[a] AV = actual percentage of RTV, assessed with disease counts taken from the field. TV = transformed value for the actual percentage of RTV incidence. [b] DT = day after transplanting.

during the 1980-81 thaladi season. The replicated trial, with five treatments, had IR20 as the test variety. Cypermethrin at 50 g a.i./ ha was sprayed at weekly intervals from planting. RTV incidence, unproductive stunted population recorded at the 9th stage of the crop, and grain yield are in the table.

Three sprays with cypermethrin at 50 g a.i./ha — on the 7th, 14th, and 21st DT — gave 100% control of the disease and the highest grain yield in the medium-duration variety IR20. ■

Development of bacterial blight of rice in oil cake-amended soils

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Nonedible oil cakes, generally used by Indian farmers as manure in rice cultivation, increase yields to a significant level.

A glasshouse study in 1980 kharif investigated the effect on bacterial blight of amending the soil with four nonedible oil cakes in three concentrations. Taichung Native 1 seedlings were transplanted into the amended soils in clay pots 15-20 days after treatment. When the seedlings were 50-60 days old, they were inoculated with a virulent strain of *Xanthomonas oryzae.* Lesions were measured 15 days after inoculation.

The plants grown in soil amended with nonedible oil cakes showed more disease than the control plants (see table). Plants grown in Karenja cake-amended soil showed more disease development, followed by plants grown in soils treated with undi, sal, and kusum cake. Disease development gradually increased with increase of oil cake concentration in the soil. ■

Effect of nonedible oil cake amendments on bacterial blight of rice. Hyderabad, India, 1980 kharif.

Treatment	Conen (wt/wt) (%)	Lesion length (cm)
Karenja cake *(Pongamia glabra)*	0.5	27.86
	1.0	29.17
	2.0	32.55
Kusum cake *(Schleichera trijuga)*	0.5	24.49
	1.0	26.06
	2.0	26.00
Sal cake *(Shorea robusta)*	0.5	25.20
	1.0	25.68
	2.0	27.62
Undi cake *(Calophyllum inophyllum)*	0.5	24.65
	1.0	28.54
	2.0	29.84
Untreated control	–	18.83

Pest management and control

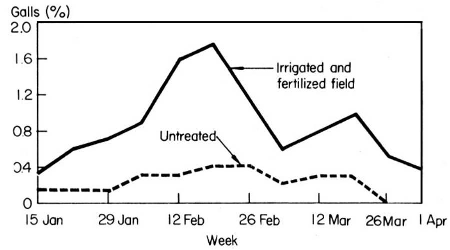
INSECTS

Potencial of rice stubble for gall midge multiplication

S. K. Shrivastava, M. P. Rice Research Institute, Raipur, M. P., India

The gall midge (*Orseolia oryzae*) has become an important pest with the introduction of fertilizer-responsive short-duration varieties. The stubble left after harvest of the monsoon crop and its profuse growth in moist areas serve as a suitable environment for rice gall midge in the off-season. Immediate destruction of stubble is needed to minimize the pest's regeneration.

A study of two similar fields used rice variety TN1. Each plot measured 30 × 25 m. One field was given more water and fertilized with 50-30-30 kg NPK/ ha. The second was left in a natural condition. Gall midge damage on tiller basis was recorded daily from 15 January to 1 April 1979.



Percent galls in TN1 rice variety stubble. Raipur, M. P., India.

Results (see figure) show that gall midge was perpetuated in both conditions. But the irrigated and fertilized stubble was more suitable for pest multiplication. Damage varied between 0.3 to 1.8% galls/m^2 in the irrigated and fertilized field and between 0.1 and 0.4% galls in the untreated field.

Even though unreplicated, this trial suggests that luxuriant stubble growth helps build gall midge populations. ■

Rice mealybug and its alternate host plants

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Rice mealybug *Brevennia rehi* (Lindinger) has become a pest of rice in some places in the terai belt. The insect is often seen in patches in Sarlahi, Bara, Parsa, Rautahat, and Dhanusha and causes severe damage in the infested area.

During February 1980, mealybugs were first observed in the infested rice plants of the previous year that were maintained in the glasshouse. The pest increased tremendously and destroyed all the materials in the glasshouse. In that severe infestation period the newly emerged nymphs were observed as fine dust particles scattered on the plants. That easy spreading capability of the tiny nymphs would have made it possible for them to spread easily in the field.

From the end of March to April, the bugs were few, but from May to July severe outbreaks were noticed in some fields. The trials with fertilizer, date of seeding, and *cropping system* were heavily infested. The severely intested varieties were Durga (IET2938) and Laxmi (IR206I-628-1-61-3). The mealybug infestation in the plots of the cropping systems trial ranged from 42.5% to 72.5% infested hills. Each plot had 1,250 hill. The outbreak may have been due to drought during May-July 1980.

Because of the insect's economic importance, an experiment determined possible alternate hosts by artificial inoculation. The common weeds of rice fields and sugarcane were planted in pots. Some nymphs of the rice mealybugs were inoculated into the leaf sheaths and kept for multiplication in the glasshouse. Sugarcane is attacked by the mealybug *Saccharicoccus sacchari,* but *Brevennia rehi* is the species that usually occurs in the rice fields. The nymphs inoculated into the sugarcane were observed only in the basal part during the early experimental period, but later the bugs were observed sucking and multiplying. The multiplication pattern shows that sugarcane is a more suitable host than is the rice plant itself. Overwintering nymphs and adults were also observed in the experiment, but the multiplication rate is slow during off-season in the alternate host plants in both field and glasshouse. The alternate host plants, their infested parts, and infestation periods are in the table. ■

Alternate hosts of rice mealybug. Nepal, 1980.

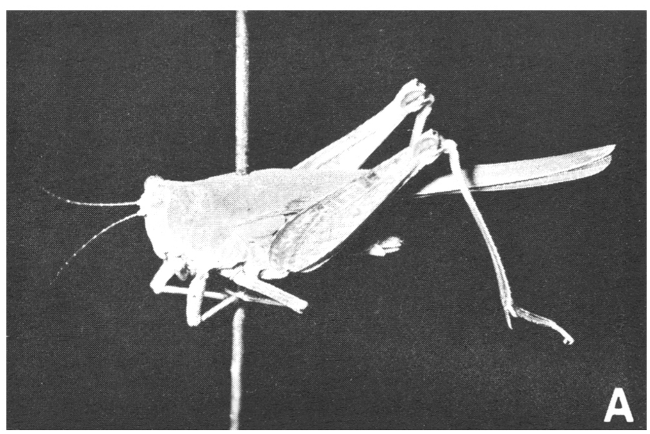
Host	Infested parts	
	Summer	Winter
Saccharum officinarum	Leaf sheath	Inside old leaf sheath
Echinochloa crus-galli		Inflorescence + leaf sheath
Echinochloa colonum		
Cyperus difformis	Floral parts + leaf sheath	Floral part
Cyperus rotundus		
Cyperus iria		
Cynodon dactylon	Leaf sheath	Leaf sheath
Phalans minor	Leaf sheath + panicle	Leaf sheath + panicle
Fimbristylis littoralis	Leaf sheath	Leaf sheath
Leptochloa chinensis		
Setania sp.	Inflorescence + leaf sheath	Inflorescence + leaf sheath
Eleusine sp.		
Some unidentified grasses	Leaf sheath	Leaf sheath

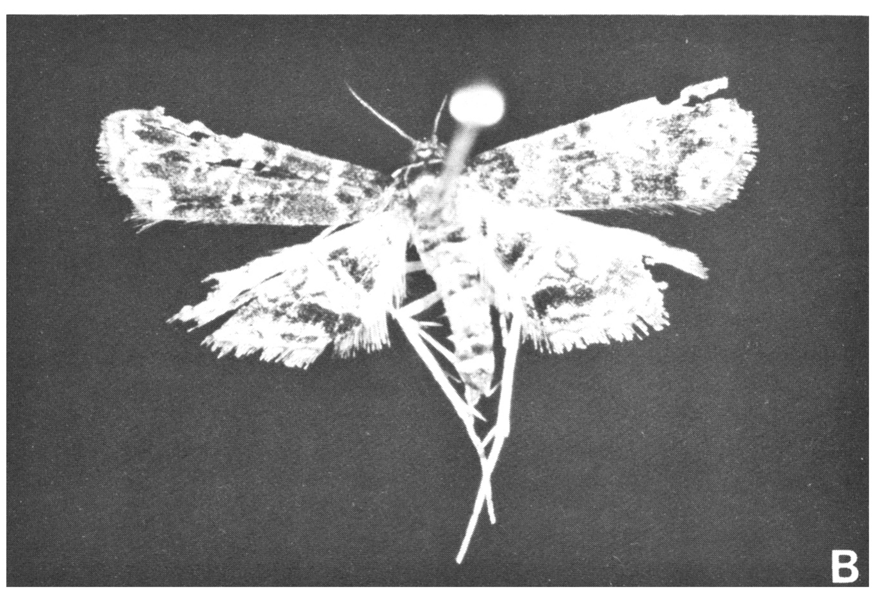
Insect pests on *Azolla pinnata* at Bangkhen, Thailand

J. Takara, Entomology Department, University of Hawaii, Honolulu, Hawaii, USA

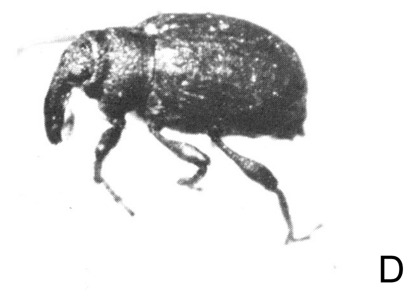
Insects were observed attacking *Azolla pinnata* R. Br. in ponds at Bangkhen, Thailand, during Sep-Nov 1977. Five species were collected: two Lepidoptera: Pyralidae — *Cryptoblabes* sp. near *gnidiella* Milliere (det. by M. Shaffer, British Museum, London, Eng.) and *Nymphula enixalis* (det. by E. G. Munroe, Agr. Canada Research Branch, Ottawa, Canada); Diptera: Chironomidae — *Polypedilum johannseni* Sublette and Sublette (det. by J. Sublette, Eastern New Mexico Univ., Portales, N. M., USA); Coleoptera: Curculionidae — *Bagous* sp. near *nodieri* Hustache (det. by E. C. Zimmerman, CSIRO, Canberra, Australia); Orthoptera: Tetrigidae — *Criotettix* sp. (det. by L. Pitkin, British Museum).

Feeding damage in some ponds was severe. *Criotettix* sp. (see photo) was the most destructive. It also consumed *Lemna minor* L. and *Pistia stratiotes* L. *Cryptoblabes* sp. was very important, despite heavy ant predation and parasitism by an unidentified braconid wasp.





Four pests of azolla from Bangkhen, Thailand. A. *Criotettix* sp. (2-cm body length), B. *Nymphula enixalis* (1.6-cm wing span).



C- *Cryptoblabes* sp. (1.2-cm wing span), D-*Bagous* sp. (2-mm body length).

N. enixalis caused significant damage. *P. johannseni* may be important because of its high numbers, but assessment was difficult since it appeared primarily detrivorous, feeding facultatively on azolla. *Bagous* sp. was a minor pest.

Weekly samples were taken from a 280-m^2 pond at the Kasetsart University campus October 1977. Pond coverage by azolla declined from 100% to 1 % during sampling. Samples were taken only from sections with dense, uniform plant growth. A 100-cm^2 net, with 11.3-cm mouth diameter, mounted on a bamboo pole, was slowly lifted from beneath the water surface to gather plants. Insects were separated by vigorous shaking in a 0.05% detergent solution. Because azolla coverage progressively declined, the number of netfuls taken each week was reduced to maintain an approximately 1–1,000 ratio between the plant area represented in the sample and the pond area covered by azolla.

Of the four species sampled, *P. johannseni* was most abundant and *Bagous* sp. the least (see table). *Criotettix* sp. was present on all dates, averaging 2-4/ 100 cm^2. It did not appear in the samples because it escaped capture. Although azolla decline generally correlated with insect density, the exact cause is unknown. ■

Relative abundance of 4 insect pests of *Azolla pinnata*, Bangkhen, Thailand, 11-27 October 1977.

Date	Samples (no.)	No./100 cm^2 [a]			
		Crymhlubes	*Nymphula*	*Polypedilum*	*Bagous*
11 Oct	27	0.41 ± 1.01	0.26 ± 0.53	36.78 ± 40.87	0
17 Oct	24	1.71 ± 3.62	0.38 ± 0.92	186.92 ± 153.07	0.25 ± 0.85
24 Oct	3	0.67 ± 1.15	0.33 ± 0.58	54.67 ± 29.57	0
27 Oct	1	0	0	37	0

[a] ± = standard deviation.

Biochemical basis of insecticide-induced brown planthopper resurgence

Hilda G. Buenaflor, R. C. Saxena. and E. A. Heinrichs, Entomology Department, International Rice Research Institute

Application of certain insecticides on brown planthopper (BPH)-susceptible rices is known to induce resurgence of BPH populations both in the greenhouse and in the field. This has been attributed primarily to increased BPH feeding and reproductive rates, reduced nymphal periods, enhanced adult life, and killing of predators. We investigated the biochemical changes that take place in the rice plant after insecticide applications because pest resurgence is believed to be at least partially a host plant-mediated phenomenon. We found that when plants of the BPH-susceptible Taichung Native 1 (TN1) were sprayed with decamethrin, a strong resurgence-causing insecticide, levels of free amino nitrogen in the leaf sheath were significantly higher than in TN1 plants sprayed with Perthane, a nonresurgence

Carbohydrate and nitrogen levels in leaf sheaths of insecticide-treated rice plants. IRRI, 1980. [a]

Variety	Treatment	Starch (%)	Soluble sugars (%)	Nitrogen (%)	Carbohydrate-nitrogen ratio	Free amino nitrogen (mg leucine/g sample)
TN1	Methyl parathion	5.97 a	1.67 a	1.77 ab	0.94	1.15 ab
	Decamethrin	6.65 a	1.02 a	1.88 a	0.54	1.34 a
	Perthane	4.70 a	1.44 a	1.57 b	0.92	0.76 b
	Water (control)	4.40 a	1.80 a	1.90 a	0.95	1.06 ab
IR36	Methyl parathion	7.02 a	1.85 a	1.63 b	1.13	0.75 b
	Decamethrin	7.32 a	1.06 a	1.55 b	0.68	0.98 ab
	Perthane	7.32 a	1.58 a	1.57 b	1.01	0.75 b
	Water (control)	8.81 a	1.47 a	1.58 b	0.93	0.92 ab

[a] Chemical analysis according to *Laboratory Manual for Physiological Studies of Rice* (Yoshida et al 1972) and *Cereal Chemistry Procedures* (Juliano 1974), IRRI. Means of 2 replications. Means within a column followed by a common letter are not significantly different at the 5% level.

insecticide (see table). The carbohydrate-nitrogen ratio in decamethrin-treated TNl plants was lower than in the control and in Perthane-treated plants, and may explain the enhanced feeding of BPH on decamethrin-treated plants. No marked changes in the levels of starch and soluble sugars were observed in the leaf sheath tissue of insecticide-treated plants.

Biochemical changes after insecticide treatment in plants of the BPH-resistant IR36 were not as vivid as those in the TN1 plants. ■

The black beetle as a pest of rice in Haryana, India

K. S. Kushwaha, assistant entomologist, Haryana Agricultural University, Rice Research Station, Kaul (Kurukshetra) Haryana, India

The grub stages of scarabaeid beetles have reportedly caused serious damage to a number of kharif crops other than paddy in different states of India. In the course of a 4-year field survey (1977-78 to 1980-81), the author observed the black beetle *Heteronychus lioderes* Redt. (Coleoptera: Scarabaeidae: Dynastinae) damaging both nursery and transplanted paddy crop from June to August. The fields had clay soil and were classed as irrigated fields. In these fields paddy-wheat crop rotation is followed. Earlier, some workers had observed this pest damaging nurseries in North India and Burma. In Haryana the pest was found damaging nurseries and transplanted rice for the first time.

The beetle cuts the stem from the base below the soil, leaving behind a thin layer of stem. The plant dries up within a few days. At the start, the central leaf of the plant droops, a symptom that may be confused with stem borer damage. After feeding on one plant the pest migrates to others on the same hill and thus kills the entire hill. As many as three beetles per hill were found. It was observed that in plants close to field boundaries, the damage was greater than elsewhere. However, the level of attack was low and no economic damage to the crop was observed.

The Commonwealth Institute of Entomology identified the insects. ■

Nomenclatural changes for some rice insect pests

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

Cnaphalocrocis medinalis (Guenee), rice leaf folder

Confusion exists among rice entomologists as to the correct spelling of the genus *Cnaphalocrocis* Lederer. In almost all literature pertaining to this pest the genus has been incorrectly spelled *Cnaphalocrosis;* the correct spelling is *Cnaphalocrocis* (Hampson 1896, Fauna of British India, Moths; Vane-Wright 1980, British Museum, personal communication).

Cofana spectra (Distant), white rice leafhopper

A series of nomenclatural changes has occurred with the white rice leafhopper belonging to the genus *Tettigella.* The species spectra, formerly under *Tettigella,* was transferred to *Cicadella* Latreille, because *Tettigella* erected by China and Fennah was a junior objective synonym of *Cicadella* (China and Fennah 1945, Ann. Mag. Nat. Hist. [11] 22:711). But in 1966, the International Commission on Zoological Nomenclature suppressed *Cicadella* under the plenary powers citing the Laws of Priority and Homonymy (China and Doyle 1966, Official Index of Rejected and Invalid Generic Names in Zoology, 2nd installment: names 1170-1743, Opinion 647:171).

In a recent review of the leafhopper genus *Cofana* Melichar, *Cicadella, Tettigella,* and *Tettigoniella* became synonyms of *Cofana* (Young 1979, Proc. Entomol. Soc. Wash. 81[1]: 1-21). Therefore, *Cofana spectra* (Distant) is the correct name.

Cofana yasumatsui Young, small white rice leafhopper

In the review of *Kolla* Distant (1971, Trans, Shikoku Entomol. Soc. 11 [I]:18), Ishihara erected *Yasumatsuus* to accommodate *mimicus* and used *Kolla mimica* Distant as the type species. Thus, *Yusumatsuus mimitus* (Distant) became the valid name. But in the recent review of *Cofana* Melichar, *Yusumatsuus lshihara* became a synonym of *Cofana.* The correct name is *Cofana yasumatsui* Young.

To differentiate by common name the two species of white rice leafhoppers. we propose small white rice leafhopper for *Cofana yasumatsui* (length of male 6.4-7.5 mm, female 7.2-8.0 mm) and white rice leafhopper for *Cofana spectra* (length of male 8.0-8.6 mm, female 8.5-9.8 mm).

Tryporyza vs *Scirpophaga,* white and yellow rice stem borers

The use of scientific names for white and yellow rice stem borers has been inconsistent despite several taxonomic studies (I. F. B. Common, 1960, Aust. J. Zool., Melbourne 8[2]:307-347; A. Kapur, 1964, Taxonomy of Rice Stem Borers, p. 3-43, in The Major Insect Pests of the Rice Plant; A. D. Pawar, 1975, The Rice Entomology Newsletter 2:8). Personal communication with Dr. A. Lewvanich (Entomology and Zoology Division, Department of Agriculture, Bangkhen, Bangkok 9, Thailand) stressed that the generic characters used by Dr. Common for *Tryporyza* were too narrowly defined to be of generic value. Dr. Leuvanich pointed out that Dr. Common failed to examine other *Scirpophaga* species occurring outside Australia. Therefore many overlapping characters exist that are impossible to restrict only to *Tryporyza.* We therefore recommend the use of *Scirpophaga innotata* (Walker) for white rice borer and *Scirpophaga incertulas* (Walker) for yellow rice borer. ■

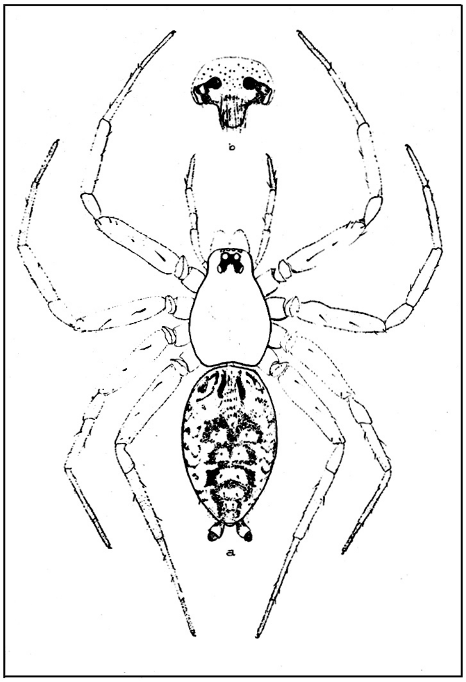
Hippasa holmerae Thorell (Araneae: Lycosidae): a new predator of rice leafhoppers and planthoppers

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

Hippasa holmerae Thorell, a lycosid spider, inhabits dryland areas such as earthen embankments of irrigation canals or reservoirs near paddy fields in the Philippines. It seeks shelter in soil crevices and actively moves over the water surface in search of prey on rice plants. When caged on rice plants infested with brown and whitebacked planthoppers or green leafhoppers, the spider readily preys on those species. It also was observed to prey on two species of legume insect pests: *Amrasca biguttula* (Shiraki) and *Ophiomyia phaseoli* (Tyron).

The adult spider can readily be distinguished from other paddy field lycosids by the slightly procurved anterior and strongly recurved posterior eyes; the presence of three promarginal and retromarginal teeth on the chelicerae; brown legs and cephalothorax: slant posterior region of the carapace; longitudinal black band on the midsternum; brown cardiac area on the dorsum of the dark brown abdomen; and large posterior spinnerets, which are twice the length of those in the anterior position (see figure).

Hippasa holmerae is a new item for the Philippines and Asian checklist of spiders inhabiting rice fields. ■



Hippasa holmerae Thorell, female dorsal view (a) and epigynum (b).

Parasa bicolor (Walk), a new pest of rice in Manipur

S. Amu Singh, pest surveillance officer, Agriculture Department, Mantripukhri, Imphal, Manipur, India 795002

During the 1980 kharif, *Parasa bicolor* (Lepidoptera: Limacodidae) was widespread in hundreds of acres of rice in the east district of Ukhrul state, where shifting/terrace rice cultivation is practiced. An average of 35% damage to the standing rice crops was caused by the insect in Kamjong areas of the district. But in some pockets of Phungyar subdivision, the loss of the standing crops was above 90%.

Larvae, active in the morning, consume leaves from the tips toward the base. Several popular local varieties of rice — Sangsun, Tarangphou, Meiringnu, Bumpani, Angangphou, Changbi, and Singuingou — are susceptible to the insect.

So far, the insect has not been found on either high-yielding varieties or local varieties grown in the valley rice belt of the central district of the State. However, when the insects were released in the laboratory, the entire foliage of a 9-11 tiller-hill of IR24 was eaten by 3-4 caterpillars within 48 hours. In the laboratory, the insects fed on seedlings as well as young transplanted plants. In the fields, the plants in the maximum tillering to early flowering stages were more susceptible to the pest.

The insect has been identified as *Parasa bicolor* (Walk) by Dr. Y. S. Rao of the Central Rice Research Institute, Cuttack, India. This report constitutes the first one on the occurrence of this pest on rice in Manipur. ■

Effects of method of nitrogen application on the incidence of rice leaffolder

R. Saroja, Syed Nazeer Peeran, and N. Raju, Paddy Experiment Station (PES), Tirur, Chingleput District, Tamil Nadu, India

Studies on the effect of nitrogen levels on the occurrence of leaffolder on rice have reveaIed that pest infestation increased with increasing nitrogen level. An experiment conducted at PES, Tirur, in the 1979-80 samba (Jul-Aug to Nov-Dec) showed that a significant increase in percentage of leaffolder damage to leaves was achieved only by a very high level of nitrogen — 200 kg N/ha. The N was applied basally (1/2 the amount) and topdressed in 2 doses, 25 and 45 days after transplanting (DT).

Effect of nitrogen levels and method of application on leaffolder damage to rice at 60 DT[a], 1979-80 samba, Tamil Nadu, India.

Application method	Leaves damaged by leaffolder (%)		
	75 kg N/ha	150 kg N/ha	Mean[b]
All N applied basally	11.7	30.4	21.1 c
1/2 N basal + 1/2 N topdressed	7.3	20.4	13.9 b
All N applied by applicator at 15 DT	9.0	12.1	10.6 b
All N applied by paper balls at 15 DT	8.9	11.5	10.2 b
1/2 N by applicator at 15 DT + 1/2 N topdressed at 35 DT	11.1	10.8	10.9 b
1/2 N by paper balls at 15 DT + 1/2 N topdressed at 35 DT	13.2	14.7	14.0 b
No nitrogen	5.3	4.8	5.1 a

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

The effect on leaffolder damage of different methods of applying nitrogen was investigated further in a split-plot design with two nitrogen levels (main treatment) and seven methods of application (subtreatments). In some treatments N as urea was applied to the root zone with an applicator or by hand in paper balls. Fenitrothion (0.05%) was sprayed at 40 DT, and fenthion (0.05%) at 55 DT. Leaffolder infestation was assessed by recording the percentage of damaged leaves at 60 DT when the pest occurrence was highest.

Applying all the N basally tended to increase the leaffolder damage level above that with use of other methods (see table). But at a moderate N level, the application method appeared to have little effect on leaffolder damage. ■

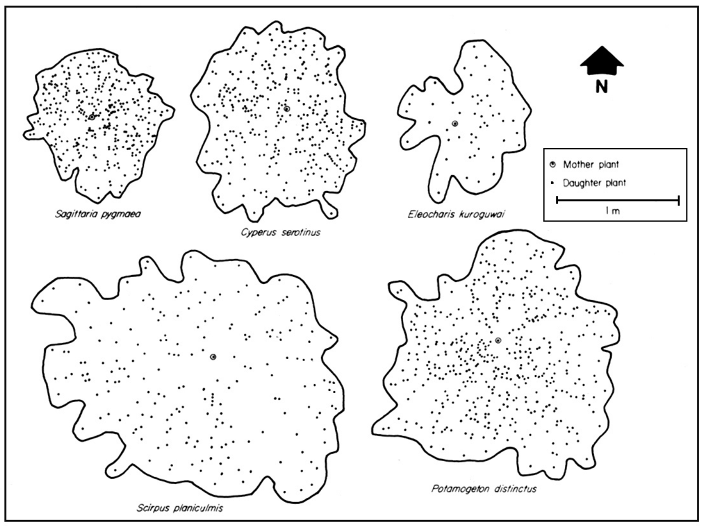
Pest management and control WEEDS

Propagation of perennial paddy weeds in unplanted paddy fields

Jiro Harada, Hokuriku National Agricultural Experiment Station, Joetsu, Niigata 943-01, Japan

Recent agricultural policy on surplus rice in Japan increased the unplanted paddy fields all over the country. Perennial paddy weeds proliferated in such fields and their propagules were spread by plowing and puddling. This seems to be one reason for the recent rapid increase of perennial paddy weeds.

To determine the propagation ability of a single plant in unplanted paddy fields, an experiment used five serious perennial paddy weeds: *Sagittaria pygmaea* Miq. (Sp), *Cyperus serotinus* Rottb. (Cs), *Eleocharis kuroguwai* Ohwi (Ek), *Scirpus planiculmis* Fr. Schm. (Spl), and *Potamogeton distinctus* A. Benn. (Pd). The field was plowed and puddled after a uniform application of 50 kg N/ ha, 100 kg P_2O_5/ha, and 100 kg K_2O/ha. One plant of each weed was transplanted in the center of a 9-m^2 plot separately on 10 June 1981. Hand weeding was carried out to avoid the effect of other weeds. The number of plants, the occupied land area, and the plant density were examined on 5 August and the propagules formed were examined on 12 November.



Distribution map of perennial paddy weeds propagated from a single plant. Niigata, Japan, 1980.

Propagation from a single plant of perennial paddy weeds in an unplanted paddy field. Niigata, Japan, 1980.

Weed species	Plants[a] (no.)	Occupied land area[a] (m^2)	Density[a] (plants/m^2)	Propagules[b] No.	Propagules[b] Fresh wt (g)
Sagittaria pygmaea	313	0.939	333.3	822	41.1
Cyperus serotinus	321	1.551	210.8	794	190.0
Eleocharis kuroguwai	51	0.793	71.9	51	68.2
Scirpus planiculmis	214	3.494	61.2	1,244	1295.9
Potamogeton distinctus	457	2.615	174.8	118	24.7

[a]Examined on 5 August 1980. [b]Examined on 12 November 1980.

The results are shown in the figure and the table. Considerable propagules were formed even in the least propagated weed. The results suggest that a few weeds remaining in the unplanted part of a paddy field is a big source of propagules for the following year. ■

Efficiency of fluchloralin, butachlor, nitrofen, and hand weeding for rice weed control

S. K. Mukhopadhyay and A. Mondal, College of Agriculture (P.S.S.), Visva-Bharati University, India

A field experiment at the Agricultural College Farm (Palli Siksha Sadana), Sriniketan, Visva-Bharati, West Bengal during 1979 kharif studied the comparative efficiency of some granular herbicides and hand weeding for controlling weeds in the semihumid lateritic tract of the state. There were 12 weed species: 3 were grasses, 3 were sedges, and 6 were broadleaved of which *Echinochloa crus-galli, E. colona,* and *Ludwigia perennis* were predominant in the experimental field. The granular herbicides fluchloralin at 2.0 kg a.i. / ha 7 days after transplanting (DT), nitrofen 1.5 kg and 2.0 kg a.i./ha 6 DT, and butachlor at 2.0 kg a.i./ ha 6 DT reduced the weed population but showed no injurious effect on the crop (see table). Nitrofen and butachlor gave very promising results in

Effects of granular herbicides and hand weeding on weed wt and rice yield. West Bengal, India.

Treatment [a]	Dry wt of weeds at 60 DT (g/m^2)	Yield of rice grain (t/ha)
Fluchloralin 1.5 kg 1 DBT	19.05	2.9
Fluchloralin 2.0 kg 1 DBT	16.81	3.0
Fluchloralin 1.5 kg 1 DT	13.46	2.8
Fluchloralin 2.0 kg 1 DT	11.34	2.7
Fluchloralin 1.5 kg 7 DT	10.04	3.2
Fluchloralin 2.0 kg 7 DT	6.48	3.7
Butachlor 1.5 kg 6 DT	5.74	3.5
Butachlor 2.0 kg 6 DT	3.92	3.6
Nitrofen 1.5 kg 6 DT	3.93	3.4
Nitrofen 2.0 kg 6 DT	2.23	3.8
Hand weeding, 25 & 50 DT	3.82	3.5
Unweeded control	52.95	2.3
S.Em ±	2.71	.06
C.D. at 5% level	8.40	1.90

[a]DBT = days before transplanting, DT = days after transplanting. All herbicide doses are in active ingredient per hectare.

controlling all categories of weeds. Fluchloralin 2.0 kg a.i./ha at 7 DT showed very effective reduction of broadleaved and grass weeds. The dry weight of weeds at 60 DT was very much reduced after the application of nitr6gen at 6 DT, butachlor at 6 DT, and fluchloralin at 7 DT compared to the other treatments. Nitrofen granules at 2 kg ai/ha applied 6 DT gave the highest yield of rice grain, closely followed by fluchloralin 2.0 kg a.i./ha at 7 DT, butachlor (G) 2.0 kg a.i./ha at 6 DT, and 2 hand weedings. As high as 37.69% loss in grain yield was observed with no weeding compared with the best treatment (nitrofen 2.0 kg a.i./ha 6 DT). ■

Weed control in deepwater rice in Bangladesh

M. Zahidul Hoque (present address: Multiple Cropping Department, IRRI), head; Nur-E-Elahi, senior scientific officer; and Mainur Rahman Siddiqui, scientific officer, Division of Rice Cropping Systems, Bangladesh Rice Research Institute (BRRI), Joydebpur, Dacca, Bangladesh

In Bangladesh, deepwater rice is also known as broadcast aman (b. aman) rice because the seeds are sown by broadcasting in March-April with the first monsoon showers. As in any direct-seeded rice, weeds are a serious problem in the deepwater rice crop. Farmers in Bangladesh with about 2 million ha (about 20% of the total rice area) of deepwater rice use raking, laddering, and hand weeding to control weeds in the b. aman rice fields. Sometimes the farmers allow the weeds to grow to a certain height and then use them as fodder, which commands a good market price in the deepwater rice belt.

In 1980, farmers' weed control practices at the BRRI deepwater rice-based cropping systems research site at Daudkandi were monitored. The results showed that, on the average, 1, 2, and 3 hand weedings were done by 22.5, 67.5, and 10% of the farmers (see table). The average time for hand weedings was 33 days after seeding (DS) for the first hand weeding, 51 DS for the second, and 75 DS for the third.

Triple hand weedings were used on two popular varieties Kartiksail and Sada Pankaish, the third weeding applied between 73 and 89 DS. Double hand weeding as practised in Ejuli Khama and Dulai Aman was completed between 44 and 54 DS. A small number of farmers grew varieties Bhatial Bajal and An Raj and applied only one hand weeding either at a very delayed (58 DS) or a very early (11 DS) date, but within 29 April and 7 May, the time of first flush of weeds after the initial monsoon rains (see table). More detailed weed studies at the site are planned. ■

Frequency and timing of farmers' hand weeding in the 1980 deepwater rice crop at the BRRI cropping systems research site, Daudkandi, Comilla district, Bangladesh.[a]

Deepwater rice variety	Samples (no.)	Av seeding date	Farmers (%) applying			Time of HW (DS)			Maturity (DS)
			1 HW	2 HW	3 HW	1st HW	2d HW	3d HW	
Kartiksail	18	9 Apr	11	72	17	27	49	13	215
Sada Pankaish	8	11 Apr	24	63	13	30	55	89	221
Ejuli Khama	8	15 Apr	12	88	–	21	44	–	206
Dulai Aman	3	2 Apr	33	67	–	35	54	–	230
Bhatial Bajal	2	30 Mar	100	–	–	58	–	–	230
Ari Raj	1	26 Apr	100	–	–	11	–	–	201
Av		10 Apr	22.5	67.5	10	33	51	75	216

[a]HW = hand weeding, DS = days after seeding.

The International Rice Research Newsletter (IRRN) invites all scientists to contribute concise summaries of significant rice research for publication. Contributions should be limited to one or two pages and no more than two short tables, figures, or photographs. Contributions are subject to editing and abridgement to meet space limitations. Authors will be identified by name, title, and research organization.

Soil and crop management

Response of deepwater rice to nitrogen fertilizer in fluxial ecology in Nigeria

N. A. Gill, National Cereals Research Institute, Rice Research Station (RRS), Birnin-Kebbi, Sokoto State, Nigeria

A 2-year trial (1978-79) at the RRS at Birnin-Kebbi studied the effect of time of nitrogen application on the yield of deepwater rice in the naturally inundated ecology in northern Nigeria where rice is traditionally grown on a vast hectarage.

Nitrogen at 67 kg/ha was applied as a single dose and in various split doses at sowing (worked into soil) 15 days and 30 days after sowing (basal dressing on wet soil) (see table). At the time of sowing 37 kg P_2O_5/ha was incorporated into the soil as, a blanket application. The source of nitrogen and P_2O_5 were calcium ammonium nitrate and single superphosphate. The plots had 30-cm-high bunds.

A long-duration (180 days), tall, photoperiod-sensitive rice variety FARO-14, well adapted to deep flood ecology, was dibbled at 30- × 30-cm spacing in mid-June and harvested in mid-December. During August to October the water depth in the experimental field ranged between 60 and 133 cm.

Effect of time of nitrogen application on grain yield of deepwater rice variety FARO-14. Birnin - Kebbi, Nigeria, 1978-79.

Treatment no.	Time and split dose of 67 kg N/h[a] AS	15 DS	30 DS	Grain yield[b] (t/ha) 1978	1979	Mean
1	67	0	0	4.33	5.34 abcd	4.84 ab
2	0	67	0	3.97	4.96 cd	4.47 bc
3	0	0	67	4.31	5.31 abcd	4.82 ab
4	22.3	22.3	22.4	3.88	4.94 cd	4.41 bc
5	33.5	33.5	0	4.06	5.39 abcd	4.73 ab
6	33.5	0	33.5	4.13	5.59 abed	4.86 ab
7	16.7	33.5	16.8	3.93	5.07 bcd	4.51 bc
8	33.5	16.7	16.8	4.82	5.76 abc	5.29 a
9	15.7	16.8	33.5	4.24	5.33 abcd	4.79 ab
10	0	33.3	33.5	4.43	5.29 abcd	4.87 ab
11	44.6	22.4	0	4.27	5.48 abcd	4.88 ab
12	22.4	44.6	0	3.98	4.83 abcd	4.41 bc
13	0	44.6	22.4	3.74	5.81 ab	4.77 ab
14	0	22.4	44.6	4.38	6.05 a	5.22 a
15		Control[c]		3.72	3.97 e	3.85 d
		Year mean		4.15	5.57*	
		CV (%)		12.11	9.90	10.80

[a]AS = at sowing, DS = days after sowing. [b]Means followed by the same letter are not significantly different at the 5% level. LSD for years 0.75 t/ha at 5% level. Plot size was 13.94 m^2. [c]Control = no nitrogen. applied.

The results of the study indicate that application of 67 kg N/ha increased the paddy yields highly significantly compared with the control. The time of application and split combinations did not show a consistent pattern of response. However, the effect of arrangements of time and splitting as in treatments 8 and 14 appears to be comparatively consistent and useful. ■

Iron coating on rice roots

F. T. Turner and C. C. Chen, Texas Agricultural Experiment Station, Beaumont, Texas; and J. B. Dixon, Soil and Crop Sciences Department, Texas A&M University, College Station, Texas, USA

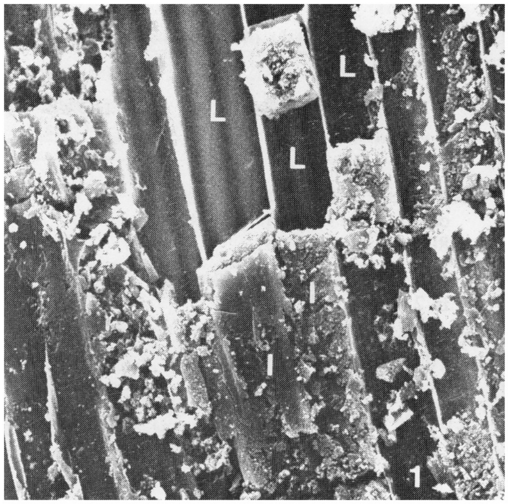
Oxidation and precipitation of ferrous iron in soil result in an iron coating on rice roots. The quantitative determination of the iron coating by dithionite-citrate-bicarbonate extraction revealed that cultivar, plant growth stage, and soil type influenced the quantity of iron compound on the roots. When grown on three east Texas soils (two Alfisols and a Vertisol) the cultivar Brazos had the highest iron coating accumulation (14% of the dry root weight) and highest grain yield compared with cultivars Lebonnet, Labelle, and Bluebelle. When grown on another Vertisol, Brazos ranked second to Labelle in amount of coating and grain yield.

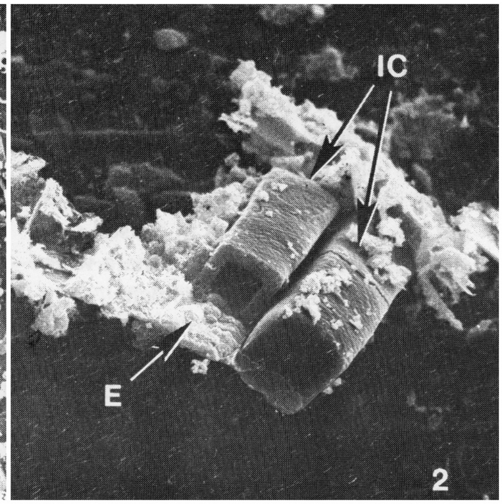
The high levels of iron coating associated with Brazos are believed to be related to the high amount of O_2 that its roots release in vitro.

The accumulation of iron (as FeOOH) was less than 2% of dry root weight for all cultivars within 7 days after soil flooding (plants about 35 days from emergence) and increased to an average cultivar maximum of 10% at plant maturity. Tanaka and others have reported that root-panicle ratio of rice in pots ranged from 20% to 100%. Assuming that rice plants produce 5,000 kg dry roots/ ha, that iron coating is 10% of the dry root weight, and that 1/2 of the oxygen in FeOOH is from the atmosphere, it was estimated that 6,300 liters of O_2 (31,500 liters of air)/ha would diffuse down the rice plant stem to precipitate Fe on the root.

The FeOOH was purified from extraneous materials such as quartz and layer silicate in the root coating by ultrasonication followed by high gradient magnetic separation. X-ray diffraction analysis of the final mixture (50% FeOOH) identified goethite (**α-FeOOH)** and lepidocrocite (**γ-FeOOH)** as the predominant minerals comprising the root-coating material.

Scanning electron microscope examination shows that a mature rice root has an abundance of open lumens resulting from decomposition of epidermal cells and the outermost cell walls. In general, iron coatings appear as porous or dense materials filling the lumens (Photo 1). In a rare case, FeOOH precipitated into lumens with all the cell walls intact and formed an iron cast the shape of the original epidermal cell (Photo 2). The hollow interior on the left cast with a broken end indicates that precipitation begins on the cell walls. No visible coating showed on younger secondary roots and sections of roots near the tips. ■





1. Representative view of iron coating on rice root. L: lumen, I: iron coating.

2. Special case of iron coating formation. IC: iron casts of epidermal cells, E: broken end of a cast.

Performance of new rice entries at different planting dates and nitrogen rates

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The timely planting of rice is important in testing the yield level of any rice variety because it enables the plant to utilize more efficiently the environment in which it is grown. In general early planting (first week of June) of medium-duration varieties results in higher yield. In case of short-duration varieties, planting time does not greatly affect the grain yield of rice. A field experiment at the Crop Research Centre of G. B. Pant University of Agriculture & Technology, Pantnagar, during 1977 kharif tested the performance of newly developed rice varieties.

Effect of planting dates on grain yield of rice varieties grown under different levels of nitrogen. Pantnagar, India, 1977 kharif.

Variety	Grain yield (t/ ha)					
	1 June		16 June		1 July	
	60 kg N/ ha	120 kg N/ ha	60 kg N/ ha	120 kg N/ ha	60 kg N/ ha	120 kg N/ ha
Jaya	6.1	6.7	6.2	6.9	5.5	6.5
UPR103 D-6-1	5.5	6.5	5.3	5.6	4.4	4.8
UPR171-12	5.3	6.5	5.2	6.4	5.4	5.8
UPR73-23	6.0	6.7	6.0	6.3	5.5	5.9
IET2815	5.9	6.8	6.1	6.7	5.1	6.4
Ratna	5.9	6.7	6.1	6.2	6.5	5.5
Saket 4	6.1	6.7	6.4	6.3	5.3	6.0
UPR4-D-1-1	6.3	6.3	5.4	5.6	5.2	5.6
UPR82-1-7	5.6	6.3	6.1	6.2	5.7	5.9
IR36	6.2	7.0	5.6	6.4	5.3	6.0

	S.Em.±	C.D. at 5%	C.V. (%)
Date × nitrogen × variety	0.23	0.64	7
Nitrogen × variety	0.13	0.37	

Jaya gave maximum yield when planted on 16 June; UPR103-D-61, UPRI 71-12, UPR73-23, UPR4-D-1-1, and IR36 gave higher yields when planted on 1 June, irrespective of nitrogen dose. Ratna, Saket 4, IET2815, UPR82-1-7 yielded more when planted 16 June with 60 kg N/ ha than when planted 1 July with 120 kg N/ha (see table). ■

Neem cake-blended urea for increased nitrogen use efficiency in transplanted rice

B. Rabindra, junior soil scientist, All India Coordinated Rice Improvement Program; and H. K. Rajappa, research assistant, University of Agricultural Sciences, Regional Research Station, Mandya, Karnataka, India

When nitrogen fertilizers are added to soil, their efficiency is reduced considerably — sometimes to the extent of 50% or less — because of leaching, denitrification, volatilization, and surface runoff. There is a need for some simple and cheap device to reduce these losses. One device found effective under the different soil conditions prevailing in Karnataka is blending ordinary urea with nonedible neem cake available locally. Neem (*Azadirachta indica*) trees grow abundantly in India.

The technique consists of mixing well-powdered, country-pressed neem cake with ordinary urea (30% by wt). Adherence of neem cake powder to urea granules is very important in the blending process. To ensure that, the powder and granules are mixed well 1 or 2 days ahead of application. The mixture is incorporated uniformly in equal doses at the time of planting and tilling.

Better adherence of neem cake to urea granules is obtained by using a coal tar (used for road surfacing) and kerosene oil mixture in 1:2 proportions while blending, especially when deoiled neem cake is used. When that mixture is used, the neem cake–urea blend may be applied in a single dose, also saving the cost of topdressing. This is more practical in situations where effective topdressing is not easily done, as in coastal districts of North and South Canara where water management is a problem.

Neem cake obtained from a country press generally contains an average 2% nitrogen, 14% crude fat, 1.2% total calcium oxide, and 0.21% total P_2O_5. The effectiveness of neem cake results from an alkaloid content, such as "Nimbidin," which helps to regulate mineralization and minimize nitrogen losses.

Experiments on the efficacy of neem cake-blended urea in transplanted rice were conducted over four seasons at Mandya centre (see table). The soil type of the experimental site was red sandy loam (Alfisols) with pH 6.8, less than 0.2 mmho total soluble salts/cm, 0.6% organic carbon, 19.2 kg available phosphorus/ha, and 268.3 kg potassium/ha. All recommended practices were followed. The results indicate that blending urea with neem cake saved nitrogen fertilizer to the extent of 20% and increased yield up to 15%.

Grain yield and uptake of nitrogen and phosphorus in grain using neem cake-blended urea.

Treatment	Grain yield (t/ha)	Yield response (kg grain/kg N)	Nitrogen content in grain (%)	Phosphorus content in grain (%)
Neem cake-blended urea using coal tar and kerosene oil, at 80 kg N/ha, all basal	5.2	32	1.4	0.8
Neem cake-blended urea alone, in 2 splits, at 80 kg N/ha	4.7	26	1.3	0.8
Ordinary urea in splits (3) at 100 kg N/ha, recommended practice	4.2	12	1.1	0.7
Control – no nitrogen	2.6	–	0.7	0.5
F Test	**			
C.D. (0.05)	0.4			
C.V. (%)	8.9			

The additional cost for preparing neem cake-blended urea was about US$5/ ha for ingredients and labor. ■

Role of higher nitrogen rate, sulfur, and zinc application in bridging the yield gap of farmer's boro rice in Bangladesh

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Boro rice (transplanted Dec-Jan, harvested Apr-May) usually gives the highest yield per hectare of all the types of rice grown in Bangladesh. The crop is irrigated and farmers generally apply to it a higher intensity management, including fertilizer, than that for aus, transplanted aman, and deepwater rice.

In many cases, however, farmers do not apply adequate amounts of fertilizer to the boro crop. This ultimately reduces yields. Furthermore, in many boro rice-growing areas, soil problems are increasingly evident, particularly because of the continuous wet conditions of the soil in the irrigation projects.

At the BRRI cropping systems research site at Salna, sulfur (S) and zinc (Zn) deficiencies recently were detected. A complete factorial trial with three replications was conducted in 1979-80 in a farmer's field to determine the effect of a higher rate of N, and application of S and Zn, on the grain yield of BR3 variety. Ammonium sulfate was the source of S, and the treatment consisted of dipping seedling roots in 2% ZnO suspension in water before transplanting.

Effect of higher rate of N, S, and Zn application on the yield of BR3 boro rice, 1979-80 boro season, Salna village, Dacca, Bangladesh.

Fertilizer rate						
Kg N/ha	Kg S/ha	Zn (%) used in ZnO suspension in water for root dipping	Yield[a] (t/ha)	Panicles (no./hill)[a]	Plant ht(cm) at harvest[a]	Straw yield[b] (t/ha)
40	None	None	3.80 e	8.9 d	73 b	5.1 c
40	None	1.6	3.87 e	8.9 d	73 b	5.4 bc
40	11.3	None	4.35 d	9.3 cd	78 a	5.9 abc
40	11.3	1.6	4.43 cd	9.7 bcd	76 a	5.6 bc
80	None	None	4.54 bcd	10.4 bc	77 a	5.9 abc
80	None	1.6	4.85 abc	11.1 b	78 a	6.5 abc
80	11.3	None	4.92 ab	12.5 a	79 a	6.8 a
80	11.3	1.6	5.09 a	13.2 a	80 a	6.9 a

[a] In the column, values having a common letter do not differ significantly at the 1% level of significance. [b] In the column, values having a common letter do not differ significantly at the 5% level of significance.

The results indicate that a rate of 80 kg N/ha gave a significantly higher grain yield than the farmer's rate of 40 kg N/ha (see table). At the farmer's N level, the Zn treatment did not significantly influence grain yield, but S application increased it. At both levels of N, application of S with or without Zn gave statistically similar grain yields. But in all cases the Zn treatment gave some quantitative increase in grain yield. The yield gap was 1.3 t/ ha, and the contributions of higher N, S, and Zn in bridging the gap were 0.70 (53%), 0.45 (34%), and 0.18 (1 3%) t/ ha.

The number of panicles per hill, plant height, and straw yield also were influenced significantly by the treatments (see table). Results of the present experiment indicate that a higher rate of N and application of S are important for obtaining the potential yield of boro rice at this site. ■

Mung straw management and nitrogen economy in rice culture

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Fertilizer use in multiple cropping systems requires a new strategy that will consider the lag in fertilizer production and consumption. Technology that helps maintain soil productivity in the intensive cropping system with moderate levels of fertilizer application must be evolved. In northwest India, the predominant crop rotation of rice - wheat is fertilizer-intensive. The new technology has made it possible to include summer mung (*Vigna radiata*), a leguminous crop, as a catch crop in this cropping system. The wheat crop sown in early November and harvested in mid-April leaves sufficient time for sowing of summer mung, which matures in the third week of June. A study was undertaken to see the effect of plowing in of mung straw — after the pods have been picked — on nitrogen economy and yield of rice. The mung straw incorporated 1 day before rice is transplanted weighed 4.7 t/ha and added 100 kg N/ ha. The soil of the experimental field was a Typic Ustochrept (sandy loam, pH 8.2, organic carbon content 0.17%) and contained 62, 3, and 72 kg available N, P, and K/ ha. The DTPA-extractable zinc, copper, iron, and manganese content of the air-dried soil was 1.5, 1.5, 13.2, and 3.0 ppm, respectively.

The plowing-in of mung straw, along with application of 60 kg N/ ha, gave as much rice yield (6.9 t/ ha) as that obtained with the application of 120 kg N/ha alone (see table). Incorporation of mung straw also caused a significant increase of organic carbon, and available nitrogen, copper, iron, and manganese contents. The study suggested that in soils of low organic matter content, plowing in of mung straw saved 60 kg N/ha in rice and also favored the natural supply of nutrients. ■

Effect of incorporation of mung straw on rice yield and soil properties, Ludhiana, India.

Straw and fertilizer (kg NP/ha) treatments		Grain yield (t/ha)	Organic carbon (%)	Available nutrients (kg/ha)			DTPA-extractable cations (ppm)			
Nitrogen	Phosphorus			Nitrogen	Phosphorus	Potassium	Zinc	Copper	Iron	Manganese
Straw removed										
60	0	5.1	0.19	69	4.5	72	0.71	0.64	15.4	3.1
60	30	5.0	0.21	69	9.6	73	0.94	0.71	19.3	4.3
120	0	6.9	0.21	69	4.7	78	0.87	0.75	17.6	4.0
120	30	7.2	0.22	72	10.6	86	0.94	0.68	17.6	3.0
Mean		6.1	0.21	70	7.5	77	0.87	0.70	17.5	3.6
Straw plowed in										
60	0	6.9	0.23	84	4.8	78	1.08	0.83	27.5	12.4
60	30	7.5	0.24	84	14.0	79	0.87	0.95	27.7	12.0
120	0	8.6	0.24	81	6.4	86	0.88	0.99	36.8	13.6
120	30	8.7	0.24	81	10.6	77	0.85	0.82	33.1	11.9
Mean		7.9	0.24	82	8.95	80	0.92	0.90	31.3	12.5
C.D. 5%										
Fertilizer		0.53	0.03	NS	NS	NS	NS	0.11	8.7	4.1
Straw		0.43	0.02	7	NS	NS	NS	0.04	7.1	6.9

Management trial for increasing nitrogen use efficiency of wetland rice

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Nitrogen use efficiency by wetland rice was studied during the 1978 and the 1979 dry seasons at Aduthurai. Soil type was clay loam, which had low available nitrogen, medium available phosphorus, and high available potash. Soil pH was 7.5. Nitrogen was applied at the rate of 60 kg/ha. Treatments were all basal vs split application of commercial urea, compared with deep placement of nitrogen as urea supergranules manufactured by IFFCO in India, urea enriched with neem cake and farmyard manure, and granulated compost. The treatments had four replications set in a randomized block design.

Granulated compost recorded the maximum yield in both seasons (see table). It was similar to commercial urea applied in two split doses (planting + panicle initiation or planting + tillering or tillering + panicle initiation), and neem cake-blended urea. ■

Effect of different methods of N application on rice yield at Aduthurai, India.

N source	N application (kg/ha)			Grain yield (t/ha)	
	Planting	Tillering	Panicle initiation	1978	1979
None	0	0	0	4.02	4.46
Commercial urea	60	0	0	4.63	4.84
Commercial urea	30	0	30	5.08	5.20
Commercial urea	30	30	0	5.00	5.12
Commercial urea	0	30	30	5.18	5.23
Neem cake-blended urea	60	0	0	5.05	5.16
Urea enriched with farmyard manure	60	0	0	4.40	4.58
1-g urea supergranules	60	0	0	4.73	4.67
2-g urea supergranules	60	0	0	4.40	4.58
Granulated compost	60	0	0	5.29	5.36
CD (0.05)				.51	.44

Fertilizer phosphorus requirement of rice and wheat grown on sodic soils

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Sodic soils, formed under the influence of sodium carbonate, are widespread on the Indo-gangetic plains of India. Sodic soils are nonproductive because of the high levels of exchangeable sodium, which causes the poor soil physical properties and high pH. Efforts are made to bring sodic soils under cultivation by the use of amendments and the adoption of appropriate agronomic practices. Because rice has high tolerance for excess sodium and has reclamative effect, it is recommended for cultivation on sodic soils during the initial years of reclamation.

Our knowledge of the dynamics of phosphorus (P), a major plant nutrient, during reclamation is limited; therefore this study was initiated to examine the P status of sodic soils and to identify the P fertilizer needs of rice and wheat grown on such soils.

A survey of the P status of barren sodic soils from many sites showed high amounts (15 to 68 ppm) of Olsen's extractable-P in the surface layer (0-1 5 cm), which decreased with depth and were highly correlated with the soils' electrical conductivity (EC).

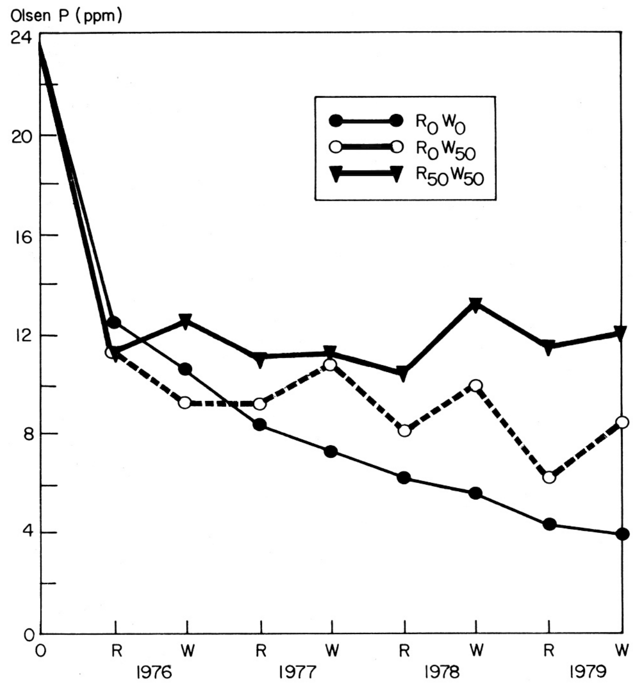
To define the optimum P fertilizer needs of rice and wheat grown in rotation, a replicated field experiment involving P application to neither crop, to rice, to wheat, and to both crops was initiated in 1976 on a barren, previously uncultivated sodic soil (pH = 10.3; EC = 4.6 mmho/cm, and Olsen P = 23 ppm). A rapid initial decrease in extractable-P after gypsum application and rice growth was due to the leaching of P to lower layers and also to its immobilization to less-soluble Ca-P compounds (see table and figure).

For rice and wheat grown in newly reclaimed sodic soils, application of P fertilizer can be withheld for the first 3-4 years. ■

Effect of phosphorus application on the yield of rice and wheat grown in sodic soil. Karnal, India.

Treatment[a]	Yield (t/ha) Rice 1976	Rice 1977	Rice 1978	Rice 1979	Wheat 1976	Wheat 1977	Wheat 1978	Wheat 1979
R_0W_0	5.0	6.2	5.4	5.4	2.2	0.9	2.9	3.0
R_0W_{50}	5.1	6.0	5.2	5.9	3.1	1.1	2.7	3.2
$R_{50}W_{50}$	4.8	6.0	5.4	6.0	3.6	0.9	3.0	3.4
C.D. at P = 0.05	ns	ns	ns	ns	ns	ns	ns	ns

[a] R = rice, W = wheat. Subscripts refer to P applications in kg/ ha.



Effect of P application on the P status of an alkali soil under rice - wheat crop rotation. R = rice, W = wheat.

Effect of azolla manuring without incorporation

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Earlier trials conducted at PES revealed the possibility of saving 25 kg N/ ha when a layer of azolla is incorporated into the soil before planting. The second crop raised in double-cropped wetlands can best use azolla. But because the farmer plants the second crop shortly after harvest of the first, the growing and incorporation of azolla before planting are not possible. Therefore, growing azolla after planting was tried. Because the farmers do not practice line planting, incorporation of azolla is difficult. Therefore, azolla as dual crop was tried without incorporation.

In a trial conducted during the thaladi season of 1979, azolla was introduced as seed material at 3 t/ ha a week after planting. Different levels of nitrogen — 0, 25, 50, 75, and 100 kg/ ha — were tried with and without azolla but with

Grain yield of ADT31 in plots with and without azolla. Tamil Nadu, India.

Treatment (kg/ ha)	Grain yield (t/ha)
N 0	3.0
N 0 + azolla	3.2
N 25	3.5
N 25 + azolla	3.6
N 50	3.9
N 50 + azolla	4.0
N 75	4.4
N 75 + azolla	4.5
N 100	4.8
N 100 + azolla	5.0
C.D. (P = 0.05%)	0.4

the same level — 50 kg/ha — of P_2O_5 and K_2O. The test variety was ADT3. The azolla covered the plots on the 13th day after introduction and was left without being incorporated till harvest. The wet weight of azolla was recorded 20 days after planting. The values ranged from 0.98 to 1.27 kg/m^2 (mean of 10 values was 1.09 kg/m^2).

The maximum yield increase by growing azolla as a dual crop without incorporation was 0.2 t/ha; for N application at 25 kg/ha, the yield increase ranged between 0.4 and 0.5 t/ha (see table). It was earlier observed at this station that when azolla at 3 t/ha was introduced as seed material a week after planting and incorporated on the 13th day — when it has completely covered the area — it gave a yield comparable to that from 25 kg inorganic nitrogen/ha [IRRN 5(3) (Jun 1980): 21]. Therefore, growing azolla without incorporating it did not add any appreciable N input to the crop. ■

Environment and its influence

Effectiveness of supplied nitrogen at the primordial panicle stage on rice plant characteristics and yields

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Ting and associates pointed out in 1959 that formed spikelets and rachis branches of rice usually degenerate during cultivation. Degeneration in the field can be 25.8% for spikelets, 3.8% for the primary branches, and 42.7% for the secondary branches. Matsushima reports that 40-50% of the spikelets degenerate and pointed out in 1957 and 1970 that the reduction division stage, which occurs about 11-13 days before flowering, is most sensitive to degeneration.

We investigated the application of nitrogen to indica rice varieties at the primordial panicle stage to develop improved cultural practices that would increase yields.

The application of nitrogen at the differentiation stage of primary branching increased the number of effective panicles, the number of filled grains per panicle, and the grain yield of the early-season variety Zhen-ZhuZ-Ai more than its application at the formation stage of pistils and stamens, at the formation stage of the pollen mother cell (PMC), or at heading (Table 1). Although nitrogen application at the differentiation stage or at the formation stage of pistils and stamens increases the number of panicles and grains, application at the formation stage of PMC or at the heading stage can increase the number of grains per panicle and grain weight. So, if nitrogen is applied only once, early application is better.

Field experiments in 1975-1976 with the early-season varieties Nanking-11 and Zhai-Ye-Qing showed that nitrogen applied at the differentiation stage of the first branch primordial (i.e., neck-node initiation) stage and of the primary primordial branch gave 150-225 kg higher grain yield/ha than heavy nitrogen application at the vegetative stage. With the late-season varieties Bao-Tai-Ai and Bao-Gou grain-yield increases were sometimes 166-787.5 kg/ha.

But nitrogen application only increases yields under the following conditions. 1) Short-statured, nonlodging plants with erect leaves are used. 2) Leaves turn yellowish green at the end of the tillering stage, indicating that carbohydrate metabolism has gained over nitrogen metabolism. The carbohydrates stored in the leaf sheath and stem contribute to panicle growth during the primordial panicle stage, thus filling

Table 1. Effect of nitrogen application at different panicle stages on grain yield using the early-season variety Zhen-Zhu-Ai. Guanezhou. China.

Stage when nitrogen was applied	Effective panicles (no./40 plant hills)	Panicles (no./hill)	Filled grains No./panicle	Filled grains %	1,000-gram wt (g)	Dry grain yield of 40 plant hills (kg)
Differentiation of primary-branch primordia	494	12.3	118.9	95.5	25.1	0.800
Formation of pistils and stamens	482	12.1	104.6	94.7	25.1	0.775
Formation of pollen mother cell	418	10.4	105.4	93.6	25.8	0.775
Heading	379	9.5	109.8	94.8	25.5	0.700
No treatment	367	9.2	103.5	92.4	25.4	0.700

Table 2. Distribution of ^{14}C and ^{12}P among the different parts of primordial panicle.

Plant parts	^{32}P (cpm/ g dry wt) Control[a]	^{32}P Treated[b]	^{14}C (cpm/g dry wt) Control[a]	^{14}C Treated[b]
Differentiation stage				
First bract primordia				
Upper	2,880	2,020	–	–
Middle	2,800	2,890	–	–
Lower	2,560	1,980	–	–
Secondary branch primordia				
Upper	2,040	2,080	–	–
Middle	1,940	2,730	–	–
Lower	1,850	2,720	–	–
Formation stage				
Stamens and pistils				
Upper	3,810	4,450	1,045	1,120
Middle	3,920	5,280	740	1,080
Lower	3,880	4,140	720	1,060

[a] No nitrogen. [b] 750 kg urea solution (1%)/ha, at the differentiation stage of primordial panicle.

grains better. 3) The amount of nitrogen applied is not excessive. Too much nitrogen leads to excessive vegetative growth, droopy leaves, lodging, increased disease and insect damage, and reduced availability of carbohydrates for grain-filling.

The number of secondary branches and spikelets increased by 11.5-19.0% when nitrogen was applied at the primordial panicle stage. Thus proper nitrogen application may increase the number of filled grains per panicle. It increased dry panicle weight by 13.0-18.0%.

Use of nitrogen increased the respiratory intensity of primordial panicles by 0.004-0.040 mg CG /g panicle per hour, perhaps because treated plants grow stronger than untreated plants.

The total nitrogen content in the leaf blade was increased by 0.27-1.0% with nitrogen application. That increased photosynthetic activity and photosynthetic products, resulting in more normal branches and spikelets and thus higher grain yield.

The contents of starch and sugars accumulated in the leaf sheath and stem of the treated plant were higher (about 14.1% and 17.4%, respectively) than in the control plants. Such assimilated carbohydrates contribute to the primordial panicle and thus increase grain yields.

Experiments using ^{14}C and ^{32}P show that the assimilation of ^{14}C and ^{32}P distributed among the middle and the lower parts of the developed panicle spikelets increased yields (Table 2). ■

Increased productivity in rice through inhibition of photorespiration

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Rice, a photorespiring plant (C3-type), loses much of its yield through photorespiration. Treatments with some inhibitors of photorespiration may increase the yield of this crop. In an experiment to test this hypothesis, neutralized aqueous solutions (10^{-3}M) of three photorespiratory inhibitors — isonicotinic acid hydrazide (INH), sodium bicarbonate ($NaHCO_3$), and L-glutamic acid —were foliarly sprayed on the rice variety NC1281 at preflowering and postflowering stages and yield parameters were recorded. The yield parameters included fertility percentage, sterility percentage, grain weight per plant, thousand-grain weight, and grain-straw ratio.

Photorespiratory inhibitors applied at either the preflowering or postflowering stage markedly improved yield parameters and yield per plant (see table). The postflowering treatments showed better effects on yield parameters than the preflowering treatments and increased yield per plant considerably over the control. Among the inhibitors used, INH (inhibitor of glycolate pathway) was the most effective; it was followed by $NaHCO_3$ (inhibitor of RuBP carboxylase-oxygenase). L-glutamic acid (inhibitor of glycolate pathway), when applied at preflowering stage, slightly inhibited yield, but when applied at postflowering stage, significantly increased yield and other yield parameters. The increase in yield could be ascribed to increased ripened grains and lower sterility. Thousand-grain weight of treated plants did not, however, vary distinctly from the control. The grain-straw ratio was positively correlated with grain weight per plant. Thus, some suitable photorespiratory inhibitors applied at a particular developmental stage of the plant could increase rice yield significantly. ■

Effects of photorespiratory inhibitors on some yield parameters and yield of rice (NC1281), West Bengal, India.

Treatment (10^{-3} M)	Ripened grains (%)	Sterile grains (%)	Grain wt [a] (g/plant)	1,000-grain wt (g)	Grain-straw ratio
Preflowering stage (145 days afzer sowing)					
Control	86.27	13.73	16.20	26.49	0.345
INH	86.54	13.46	20.50 (+ 26.5)	26.52	0.357
$NaHCO_3$	87.22	12.78	17.30 (+ 6.8)	26.53	0.389
L-glutamic acid	85.38	14.62	16.00 (- 1.2)	26.45	0.340
Postflowering stage (157 days afzer sowing)					
INH	88.29	11.71	22.10 (+ 36.4)	26.55	0.452
$NaHCO_3$	87.32	12.68	21.00 (+ 29.6)	26.45	0.378
L-glutamic acid	86.43	13.57	20.00 (+ 23.4)	26.44	0.299

[a] Figures within parentheses indicate percentage increases (+) or decreases (-) in yield in relation to the control.

A simple method for studying temperature and relative humidity within the rice plant canopy

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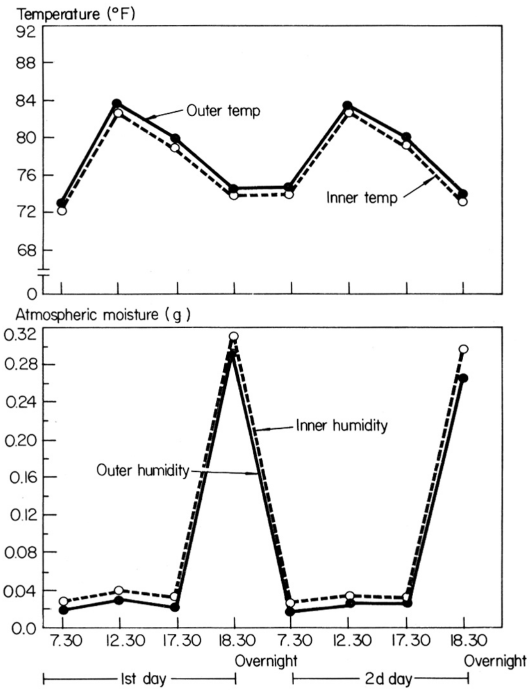
The conventional hygrothermograph measures the temperature-humidity levels in a given field, but not the actual microclimate between the tillers and areas where propagules of disease or insect pest organisms begin to develop. Equipment to measure such *microenvironmental* climates exists, but is difficult to procure and unsafe in most Asian fields.

We have tested a simple system to measure the atmospheric moisture and temperature between tillers of rice clumps with several replications. A weighing bottle with 1 ml of concentrated H_2SO_4 (AR) is weighed with its cap on, then is fixed to the tiller site by means of a tape and pole. The cap is then removed. A thermometer is fixed similarly. Any number of such bottles and thermometers can be kept at vantage points to get an average estimate of the humidity and temperature at a given area. The bottles are stoppered and reweighed after specific time periods. The difference in weights is the actual amount of moisture absorbed from that environment.

The technique has been used in measuring the temperature and moisture levels in the area surrounding a crop of HR12 (a tall, low-tillering variety) and IET1444 (a semidwarf, high-tillering variety). Statistically the data were highly significant (see table).

Microclimate in tall (HR12) and semidwarf (IET1444) rice varieties. AICRIP, Hyderabad, India.

	Av tempera-ture (°C)		Av atmospheric humidity (g)	
	Near outer tillers	Near inner tillers	Near outer tillers	Near inner tillers
		HRl2		
Around plot	32.58	31.25	0.020	0.025
Within plot	30.92	29.75	0.023	0.032
		IETl444		
Around plot	31.00	29.83	0.020	0.023
Within plot	29.92	28.83	0.020	0.024



Trend in temperature and humidity fluctuations (variety: IET4141), Hyderabad, India.

The figure shows the temperature and moisture levels of another semidwarf, IET4141, recorded over a 2-day period.

The method is simple and useful in categorizing the moisture-temperature relationships in restricted areas within a plant canopy to explain pest buildup. Further studies on the relationship between microclimate and the buildup of brown planthoppers and fungal pathogens in high-tillering semidwarf varieties with dense canopies are under way. ■

Effect of low temperature and low light intensity on the heading stage and flowering of indica rice

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Rice plants in southern China are sometimes damaged at the heading stage by low temperature and low light intensity in autumn. Thus, the sterility of late-season rice varieties caused by cold temperature can be an important constraint to rice production.

We examined the effect of cold temperature and low light on the physiological characters of rice anthers and flowers, and on the distribution or assimilation of ^{14}C and ^{32}P in rice organs. Our objective was to identify agronomic practices that prevent cold injury in rice cultivation.

A low night temperature of 12° C and a high day temperature of 22° C were maintained in artificial light cabinets. Light intensity was maintained at about 2,000 lx and relative humidity from 71 to 83%.

The respiratory intensity of rice plant florets decreased by 7.5% and that of anthers decreased by 25% after 24 hours of cold temperature and low light treatment. It decreased by 36.1 % and 8 1.2% in the 48-hour treatment, and by 30.6% and 75.0% in the 106-hour treatment. Thus, prolongation of cold temperature and low light intensity seriously damaged the anthers.

In the first experiment with ^{14}C (Table 1) the ^{14}C values (counts per minute [cpm]/50 mg) and the total ^{14}C values differed markedly. The control flag leaf contained 4,497 cpm/ 50 mg and a total of 18,263 cpm; the treated flag leaf had 6,309 cpm/ 50 mg and a total of 23,953 cpm. Cold temperature and low light impeded the translocation of photosynthetic products of ^{14}C from the flag leaf to the other organs and decreased their exported percentage. But the total ^{14}C content (1 29,697 cpm) of treated plants was less than that of ‘the control plants (377,471 cpm). The total ^{14}C contents decreased in organs other than the flag leaf. In treated roots, it decreased even more (treated roots, 44 cpm/ 50 mg and 712 total cpm; control roots, 9,999 cpm/ 50 mg and 157,369 total cpm). Thus the roots injured by cold temperature and low light were famished and received less energy. On the other hand, cold temperature and low light

Table 1. Effect of cold temperature and low light on the export and distribution of photosynthetic products of ^{14}C (^{14}C supplied before treatment with cold temperature and low light). Guangzhou, China.

Organ	^{14}C content					
	Control[a] (natural condition)			Treated[a] with cold temp and low light		
	cpm/50 mg	Total cpm	%	cpm/50 mg	Total cpm	%
Flag leaf	4,497 ± 637	18,263	4.8	6,039 ± 795	23,953	1.8
Flag leaf sheath	2,091 ± 402	13,327	3.5	1,636 ± 346	8,630	6.6
Functional leaf blade	1,039 ± 934	10,993	2.9	20 ± 11	197	0.2
Functional leaf sheath	954 ± 303	9,571	2.5	32 ± 12	292	0.2
Panicle	5,703 ± 1,299	99,118	26.3	4,358 ± 2,113	52,304	40.3
Stem	3,490 ± 1,716	68,830	18.2	2,540 ± 1,040	43,609	33.6
Root	9,999 ± 4,216	157,369	41.7	44 ± 1.5	712	0.6
Total cpm in rice plant		377,471	100		129,697	100

[a]cpm = counts per minute (radioactive isotope intensity).

decreased the root's activities and photosynthetic products. From these results, we can deduce that the root is damaged more seriously than the other organs are.

The total ^{32}P content and the content per 50 mg in each organ affected by cold temperature and low light, except the panicle, were almost the same as those in the control organs (Table 2). The ^{32}P content in the treated panicles was 31.6% that in the control panicles, which indicates that cold temperature and low light impeded the translocation of ^{32}P from roots to panicles. That illustrates that cold temperature and low light can greatly harm panicle growth. ■

Table 2. Effect of cold temperature and low light on the absorption and distribution of ^{32}P in the rice plant. Guangzhou, China.

Organ	^{32}P (com/50 mg)	
	Control (natural conditions)	Treated with cold temp and low light
Leaf blade	438 ± 33	434 ± 49
Leaf sheath	399 ± 31	428 ± 103
Stem	365 ± 21	361 ± 61
Panicle	436 ± 61	138 ± 6

Measuring the tensile strength of japonica-indica hybrid rices in Korea

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In Korea, about 76% of the paddy fields are planted to japonica-indica hybrid rices.

The rice spikelet's tensile strength at harvest was measured in japonica-indica hybrid rices and compared with that in japonica rices. The abscission layer between the pedicel and the rachilla of the spikelet also was studied.

The japonica-indica rices generally had lower tensile strength than the japonica rices (see table). Yushin had the lowest tensile strength (98 g), and Milyang 21 had the highest (188 g). However, Milyang 21 had lower strength than Nongbeak, which had the lowest value among the japonica recommended rice varieties. Akibare had the highest tensile strength among the japonica-type rices tested.

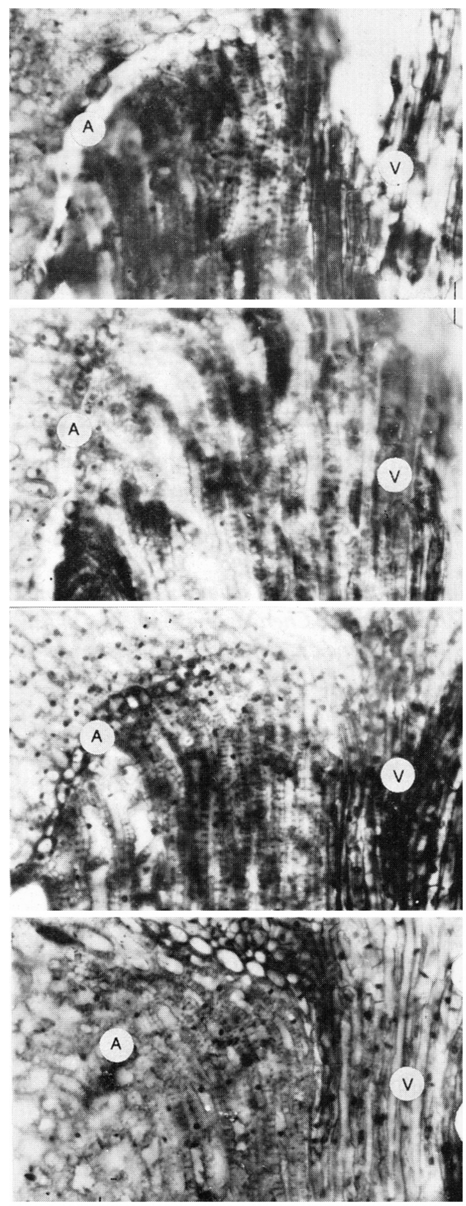
In the japonica-indica varieties Yushin and Milyang 21, the parenchymatous cells of the abscission layer, which extends from the epidermis to near the central vascular tissue in the pedicel, collapsed (see figure). In the japonica Jojeongjo, however, the parenchymatous cells did not collapse and in Akibare, also a japonica, the abscission layer could not be found.

The results show that the abscission layer of the japonica-indica hybrid rices in Korea is the same as that of indica rice. ■

Degree of grain shedding of the recommended rice varieties in Korea.

Variety	Tensile strength (g) ± S.D.
Japonica-indica hybrid rice	
Yushin	98 ± 32.9
Suwon 258	100 ± 29.0
Suwon 251	107 ± 33.8
Milyang 23	119 ± 36.0
Nopoong	131 ± 38.5
Joseng tongil	133 ± 34.1
Rekyeong	134 ± 35.4
Tongil-chal	142 ± 35.4
Yeongnamjoseng	147 ± 34.6
Iri 326	156 ± 33.0
Milyang 30	165 ± 38.2
Suwon 264	183 ± 38.6
Milyang 21	188 ± 30.7
Japonica rice	
Nongbeak	195 ± 32.7
Satominori	226 ± 43.9
Palkeum	237 ± 47.9
Akibare	245 ± 42.9
Jinheung	245 ± 51.0
Jojeongio[a]	94 ± 34.0

[a]Local variety in old time.



Micrographs of longitudinal sections of the abscission layer in Yushin (top), Milyang 21 (second), Jojeongjo (third), and Akibare (bottom). Note the difference in collapse of the cells of the abscission layer (A). V = vascular tissue.

Rice-based cropping systems

Yield of 10 mungbean cultivars evaluated in intensive ricebased cropping systems

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One serious constraint to expanding mungbean production in the tropics is time. Most cultivars require more than a month for flowering and pod setting. Sequential cluster maturation necessitates frequent hand harvesting. This study was undertaken to select an early-maturing mungbean with high yield potential for inclusion in intensive rice-based cropping systems.

Ten mungbean cultivars were evaluated under eight growing conditions at IRRI in 1978-80. Yield at harvest (first priming at 60-65 days after sowing [DS], second at 70-75 DS, and third at 85-90 DS) for each growing condition was used to calculate a mean maturity index:

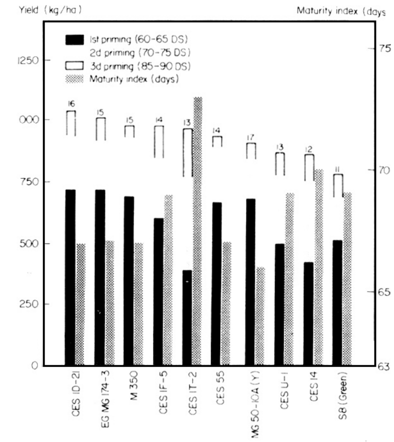
$$\frac{\Sigma \text{ (days from planting to each harvest)} \times \text{(yield at each harvest)}}{\text{total yield}}$$

Cultivars differed considerably in yield at harvest (see figure).

Based on daily production and mean maturity indices, CES IT-2, CESU-I, S8 (Green), CES IF-5, and CES 14 were late maturing and had relatively low yields. Among them CES IT-2 and S8 (Green) are characterized by long reproductive flushes, indicating that a considerable proportion of harvest can be expected at third priming. In areas where agriculture is not so intensive and moisture is not limiting, these cultivars may be grown successfully.

Cultivars high-yielding on a daily basis were MG 50-10A(Y), CES ID-21, M350, and EG Mg 174-3, producing about 90% of total yield at 60-70 DS.

About 95% of the total production of CES 55, M350, and MG 50-10A(Y) was harvested from the first and second primings. This indicates that these cultivars are early-maturing (lowest mean maturity index), with flowering occurring mostly in two reproductive flushes.



Proportions of total yield harvested at 3 different dates (mean of 8 trials) for 10 mungbean cultivars. IRRI, 1978-80. DS = days after sowing. The figure above each bar indicates daily production (kg/ha).

This study suggests that cultivar MG 50-10A(Y), with the highest daily production and lowest mean maturity index, can be grown in parts of the humid tropics where cropping intensity is very high and limited time exists for growing a third crop between or after two rice crops. ■

Agronomic evaluation of farmers' dryland monoculture and mixed-cropping practices in Bangladesh

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Bangladeshi farmers practice extensive mixed cropping of dryland cereals — wheat, barley, and Italian millet *Setaria italica* — and pulses and oilseeds — chickpea, lentil, mustard, linseed, and grasspea *Lathyrus sarivus* — in the dry winter or rabi (Oct to Mar). Mixed cropping provides opportunities for increased and diversified agricultural production from limited land. It is a form of risk aversion through crop intensification. It makes efficient use of available soil moisture, suppresses weed growth, and improves soil fertility through the use of legumes.

But productivity of current mixed-cropping practices is generally low. There is considerable scope for improvement, particularly in plant population regulation, conservation of residual soil moisture, crop configuration, planting schedule, and crop establishment.

In the 1979-80 rabi, yields of crops in solid and mixed stands were assessed through crop-cut studies in two adjacent blocks of upland and lowland fields in a dryland farming area (total annual rainfall about 1,438 mm, with 3-4 months wet and more than 6 months dry) on the Ganges river bank in Bangladesh. On both land types rabi crops were preceded by either one or two rainfed rice crops. Visual observation indicated higher soil moisture in the lowland fields than in the upland fields. ■

Av yield of farmers' dryland wheat, barley, and chickpea in monoculture and mixed cropping with residual soil moisture on two land types. BRRI dryland cropping systems research site, Alimganj, Rajshahi district, Bangladesh, 1979-80 dry season.

Land type	Crop species	Sample fields		Yield (t/ha)
		No	%	
Upland	Wheat	6	11	0.93
	Barley	27	50	1.03
	Chickpea	10	19	0.83
	Barley + chickpea	11	20	0.70 + 0.75
Lowland	Wheat	1	2.7	2.21
	Wheat + chickpea	8	21.6	1.11 + 0.74
	Barley + chickpea	28	75.7	0.82 + 1.05

Results indicate that farmers used more mixed cropping (97.3%) in the lowland than in the upland (20%) (see table). Yields from wheat monoculture and barley + chickpea mixed cropping were considerably higher in the lowland, probably because of higher residual soil moisture. In the upland situation, mixed cropping reduced yields of barley by 32% and chickpea by 10%, compared to monoculture yields. But mixed cropping gave a high land equivalent ratio (1:58), indicating a 58% increase in total agronomic production. In the lowland the yield of one wheat monoculture field was almost 100% higher than that in mixed cropping.

Chickpea yields were higher in mixed cropping with barley than with wheat. Considering monoculture and mixed cropping together, barley was grown in 70%, wheat in 11%, and chickpea in 39% of the upland fields. In the lowland fields, barley was grown in 75.7%, wheat in 24.3%, and chickpea in 97.3%. Barley a drought-resistant crop, is grown more widely as a monoculture crop and barley + chickpea is the most predominant mixed-cropping combination.

Announcements

Insecticide evaluation report for 1980 now available

The 1980 report of insecticide tests conducted by IRRI entomologists includes the performance of coded and commercial insecticides tested under greenhouse and field conditions against insect pests of rice, mungbean, cowpea, maize, and sorghum.

The report includes a section on the use of insecticides in rice pest management studies involving yield loss assessments, economics of insect control, and selective toxicity. This report contains 114 tables, 7 figures, and an appendix listing the 104 insecticides tested and the companies providing them.

To obtain a copy, write to: Entomology Department, International Rice Research Institute, Box 933, Manila, Philippines.

Dr. Richard Bradfield dies at 85

Dr. Richard Bradfield, head of IRRI's Multiple Cropping Department from March 1969 to June 1971, professor emeritus of agronomy at Cornell University, and a research consultant and trustee of the Rockefeller Foundation for many years, died on 1 May 1981 at a hospital in Everett, Pa., USA. He was 85 years old.

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