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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 following guidelines and style:

Style

- Use the metric system in all papers. Avoid national units of measure (such as cavans, rai, etc.).
- Express all yields in tons per hectare (t/ha) or, with small-scale studies, in grams per pot (g/pot) or grams per row (g/row).
- Define in footnotes or legends any abbreviations or symbols used in a figure or table.
- Place the name or denotation of compounds or chemicals near the unit of measure. For example: 60 kg N/ha; not 60 kg/ ha N.
- The US dollar is the standard monetary unit for the *IRRN.* Data in other currencies should be converted to US$.
- Abbreviate names of standard units of measure when they follow a number. For example: 20 kg/ha.
- When using abbreviations other than for units of measure, spell out the full name the first time of reference, with 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 I2 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.
- Usee common — not trade — names for commercial chemicals and, when feasible, equipment.
- Do not include references in IRRN contributions.
- Pest surveys should be quantified with data (% infection, degree of severity, etc.).

Genetic evaluation and utilization

OVERALL PROGRESS

Induction of sprouting resistance in Mahsuri

N. P. Sarma and Ashok Parnaik, Central Rice Research Institute (CRRI), Cuttack - 753006, India

Mahsuri, a superior selection from an indica-japonica hybridization program, was selected in Malaysia and introduced into India in 1965. The high yielding, weakly photoperiod-sensitive tall variety (140-150 cm) is popular in the wet season because of its moderate resistance to lodging, medium-slender grains, and higher grain number per panicles. Mahsuri's major defect is its in situ germination of grains in the panicle (see figure). Natural precipitation and the humid climate as the crop matures in parts of India induce preharvest grain sprouting and cause heavy losses. Incorporation of moderate dormancy into Mahsuri would help reduce grain losses. Perhaps the best way of incorporating dormancy is to induce that trait through mutation. It is well known that genetic changes induced through mutations will be within the confines of the well-adapted genotype.

Mahsuri seeds were exposed to y-rays (30 r), and also treated with the newly discovered and potent mutagen sodium azide (1.5×10^{-3} M for 6 hours; pH 3). A total of 8,540 M_2 plants derived from 362 M_1 plant families were raised to screen for induced mutations in 1979 kharif. Three panicles each of 3,150 M_2 plants from γ-ray and azide treatments were subjected to germination tests immediately after harvest.

Grains in panicles of Mahsuri often sprout before harvest (left). Sprouting resistance has been induced in M_2 lines of Mahsuri (right). CRRI, India.

Presoaked panicles of Mahsuri parent, when rolled in paper towel and incubated at 32 ± 1°C normally sprout in 24-36 hours. But 71 M_2 lines were isolated in which sprouting was delayed considerably. The variants with delayed sprouting time have been advanced to the M_3 for critical and confirmatory sprouting tests to eliminate variations due to other than genetic causes. ■

Sri Lanka releases three new rice varieties

Rice Improvement Program, Department of Agriculture, Sri Lanka

The varietal release committee of the Department of Agriculture, Sri Lanka, has approved the release of three new improved rice varieties: BG400-1, BG276-5, and BW100.

BG400-1 (0B678/ / IR20/H4), bred at the Central Rice Breeding Station, Batalagoda, is of medium growth duration (130 days). It has resistance to gall midge and to blast and bacterial blight diseases. Its grain is medium-long and stores better than BG90-2, the variety it is to replace.

BG276-5 (OB678/2*BG34-8), bred at Batalagoda, is an early-maturing variety (90 days) with resistance to gall midge and to blast and bacterial blight. Its grain is medium-long.

BW100 (H501//Podiwee A8/H5),

bred at the Agricultural Research Station, Bombuwela, is a 120-day samba rice variety recommended for cultivation in the low-country wet zone of Sri Lanka. It is resistant to blast, has tolerance for iron toxicity and is moderately resistant to gall midge and storage pests. It has good grain quality. ■

Performance of IET7041 in nitrogen variety trial

P. S. Nageswara Rao, assistant agronomist; and C. Bhaskara Rao, rice breeder, Andhra Pradesh Agricultural University (APAU), India

A field trial was conducted on a black clayey soil with high organic matter content, medium phosphorus and high potassium contents, and a pH of 7.5 during kharif (Jun-Nov) 1979 at the Regional Center, All India Coordinated Rice Improvement Project, Maruteru, A. P. Six prerelease lines and two released varieties (Table 1) constituted the main plots, and four nitrogen levels were the subplots in a split-plot design with three replications. A basal application of 30 kg P_2O_5 and 30 kg K_2O/ha was applied. Nitrogen was applied 50% at transplanting, 25% at 25 days after transplanting (DT), and 25% at 50 DT.

IET7041 (MTU7029), developed at APAU, yielded highest (Table 2). The optimum level of nitrogen for it was 30 kg/ha. It had the highest panicle number at all nitrogen levels.

IET7041 should be suited for good yields on soils with high organic matter at lower nitrogen inputs in kharif on the Krishna and Godavari deltas of A.P. ■

Table 1. Details of entries in nitrogen variety trial, APAU, 1979 kharif.

IET no.	Designation	Cross	Maturity (days)	100-grain wt (g)	Rice type[a]
5656	RP975-109-2	Sona/RPW6-13	155	26	LB
5854	RP1017-76-1-4-3	Sona/Mahsuri	150	18	MS
6056	RP894-61-1-3-7-2	CR44-35/W12708	155	19	MS
6212	RP1064-14-2-2	RP31-49-2/Patnai 23	155	25	SB
6314	RP1045-23-2-1	RP31-49-2/LMN	160	25	SB
7041	MTU7029	Vasista/Mahsuri	155	19	MS
	Pankaj (check)		155	28	LB
	Mahsuri (check)		150	16	MS

[a]LB = long, bold; SB = short, bold; MS = medium, slender.

Table 2. Summary of results of nitrogen variety trial, APAU, 1979 kharif.

Nitrogen level (kg/ha)	Grain yield (t/ha)							
	IET7041	IET5656	Pankaj	IET6314	IET6056	IET6212	IET5854	Mahsuri (check)
0	5.9	5.1	5.0	4.6	5.0	4.1	4.5	3.8
30	6.0	5.2	4.9	4.8	4.3	4.1	4.1	3.2
60	6.3	5.2	5.0	4.8	4.1	4.4	3.7	3.2
90	6.4	4.8	4.6	4.3	4.5	4.3	3.0	2.4

C.D. (P = 0.05) for varieties, 0.6 t/ha; for nitrogen levels, 0.3 t/ha.

GENETIC EVALUATION AND UTILIZATION

Disease resistance

Studies on false-smut disease caused by *Ustilaginoidea virens* on paddy in Karnataka, India

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

False smut on paddy has occurred in Karnataka for more than 3 decades. The preliminary survey conducted for more than 5 years indicates that the disease occurs on both modern and local improved varieties throughout the state during the kharif, particularly on varieties that are late sown and flower late (usually from November). The data collected indicate that the disease incidence on some varieties varies from less than 1% to more than 50%. The percentage of incidence has been taken on the panicle basis, irrespective of the number of smut balls formed on each panicle.

Some varieties showed less than 10% incidence: IET2885 (7.92), IET2886 (5.62), IET1789 (1.08), IR26 (0.48), IET2295 (4.33), Sona (0.77), and IET3359 (1.42). Varieties among the IRON entries of kharif 1976 that showed more than 50% disease incidence were IR4427-315-2-3, IR4442-45-2-1, IR4722-36-1, IR5853-31, and IR2863-31-3. Among the NSN entries of kharif 1976 with more than 50% disease incidence were RP894-61-1-10-7, RP974-4-7-6-2, RP6-590-22-5-4-1, Biplat, and IR2071-588-1-1-1.

Further information indicates that the number of smut balls varies from 1 to 6/panicle; 2-4 smut balls have been observed on more than 50% of infected panicles; 1-6 smut balls have been observed on 16%, 32%, 26%, 14%, 8.20%, and 3.80% of infected panicles.

Further studies on varieties GMR-2 (IET2885) and Rasi (IET1444), which were in insecticidal trials, showed more than 30% incidence on some treatments. These varieties were late sown and flowered late. When the same varieties were early sown and thus flowered early, they were not at all infected. This indicates that the time of flowering has some influence on disease incidence. ■

Varietal resistance to tungro

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Tungro virus disease first appeared in Tanjore district, Tamil Nadu, in 1978. In the 1979 thaladi season, some devastated fields of tungro-affected paddy were plowed under. The disease appears starting in the early kuruvai season and damage becomes severe in late kuruvai, samba, and thaladi. To select tungro-resistant varieties, observations were made in 3 sets (6 entries/set) of plantings made in kuruvai (6 plantings in Jun-Jul), samba (2 plantings, Oct), and thaladi (6 plantings, Oct-Nov). Among the 18 varieties (see table), TKM9 was best for kuruvai; CR1009, C025, and AD3488 for samba; and Ponni for thaladi. ■

Sources of varietal resistance to rice tungro virus. Tamil Nadu, India.

Variety	Rice tungro virus (%)
Kuruvai	
ADT31	48.4
TKM9	13.8
AS3704	26.6
PL29	22.9
AD8991	48.9
AD6120	22.1
Samba	
C025	10.0
CO40	63.6
NLR9672	56.1
CR1009	9.5
AD7496	54.6
AD3488	15.3
Thaladi	
ASD15	27.8
ADT32	30.0
ADT35	19.9
IR34	16.0
Ponni	8.2
AD9408	20.8

Fake smut and bunt diseases in IRON entries

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In 1979 kharif, the natural incidence of false smut *Ustilaginoidea virens* Cke. (Takahashi) and bunt *Tilletia barclayana* Bref. (Sacc. & Syd.) diseases was observed in the International Rice Observational Nursery (IRON) trial at CRRI. The diseases occurred on 11 of 345 entries. The infected panicles and grains per panicle were counted from randomly selected plants of each of the 11 entries (see table).

The maximum false smut infection (22%) was in CR1022; that of bunt (12%) was in B541B-PN-58-5-3-1. The maximum number of false smut-infected grains (1-6) was in CR1013.

Most of the entries flowered in late October. One week before and after flowering the maximum/minimum temperature was 33° / 24° C; relative humidity was 88-95%, and sunshine hours, about 9-10. Rain fell on only 1 day during the period. The crop was irrigated when necessary. ■

Occurrence of false smut and bunt diseases in entries of the International Rice Observational Nursery at CRRI, Cuttack, Orissa, India.

Entry	Plant infection (%)	Infected grains (no./panicle)
False smut.		
CR1022 (Jagannath natural cross)	22	1–2
CR1016 (Waikoku/T90(40)	20	1–2
CR101 3 (Jagannath natural cross)	16	1–6
IET6080 (RP894-15-2-1-1) CR44-35/W12708	16	1–3
IET6426, CRM9-3633-18, GEB24 mutant	8	1–4
IET6056 (RP894-61-1-3-7-2) CR44-35/W12708	4	1–2
IET6496 (R22-2-10.1) IRI/Sigadis	2	0–1
BW100 (H50l/Sel. 306)	2	1–2
BW78-7 (H501/Sel. 306)	2	1–2
Bunt		
B541B-PN-58-5-3-1, Politai-l/IR1108-2	12	1–3
B2360-8-5-L-R-4-3, IR2180-2/IR2178-1	6	1–3

Records of heavy attack of bunt and false smut of rice

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Although bunt [*Tilletia barclayana* (Bref.) Sacc. & Syd. = *Neovossia horrida* (Tak.) Padwick & Khan] and false smut [*Claviceps virens* (Cke.) Sakurai ex Nakata = *Ustilaginoides virens* (Cke.) Tak.] are widespread diseases of rice in Assam, they are considered minor because they affect only a few grains. With the introduction of new cultivars and application of fertilizers, occurrences of the diseases are, however, on the increase. Two unusually heavy occurrences in the Rice Experimental Station at Titabar and the surrounding areas in 1964 and 1965 are reported (Table 1, 2). The information gives the average percentage of infected grains of the infected panicles only and does not

Table 1. Infected grains due to bunt and false smut (alone or combined) on infected panicles, Assam, India, 1964.

Disease	Infected panicles (no.)	Total no. of grain	Total no. of affected grain	Affected grain (%)
Bunt	19	3608	1239	34.21
False smut	7	1298	473	36.44
Bunt + false smut	2	329	188	57.14

Table 2. Bunt- and false smut-infected grains on affected panicles of different cultivars, Assam, India, 1965.

Cultivar	Bunt-infected grain (%)	False smut-infected grain (%)
TN1	39.71	–
Unknown	22.34	–
Unknown	1.36	1.49
Unknown	26.32	0.11
Hsinchu 2	10.42	–
Unknown	–	2.01

represent the total field population (on individual panicles bunt varied from 8 to 63% and false smut, 18 to 79% in 1964). ■

Hypersensitive reaction induced by *Xanthomonas oryzae* in the cowpea leaf

K. Tsuchiya, T. W. Mew, and S. Wakimoto, Plant Pathology Department, International Rice Research Institute

Lesion development due to virulent strains of *Xanthomonas oryzae* on rice leaves was remarkably inhibited by both mixing and preinoculation treatments with an avirulent or weakly virulent mutant strain in experiments conducted at the IRRI greenhouse. But no inhibitory effect was observed when the virulent strain was inoculated before the avirulent or weakly virulent strains.

All efforts have failed to induce a hypersensitive reaction (HR) by combining a resistant rice variety and the *X. oryzae* strain. But cowpea was found to be a suitable indicator for HR induction. HR was rapidly induced by both virulent wild strains exemplified by different virulence groups and by virulent induced mutants. Only living cells of bacteria could induce HR, and critical numbers for induction seemed to be 2-5 × 10^6 cells/ml. None of heat-killed bacterial cells, cell-free supernatants, or polysaccharide fraction prepared from the bacterial culture induced HR. On the other hand, avirulent strains either delayed HR or did not induce it at all. ■

Resistance to bacterial blight

V. Mariappan, Valluva Paridasan, and P. Durairaj, Coimbatore, India

Rice cultivars were screened for resistance to bacterial blight disease. The plants were raised in pots containing wetland soil and in the field spaced 20 x 10 cm. Fertilizers were applied at 120-60-60 kg NPK/ha. The plants were inoculated at three stages: seedling (20 days), tillering (50 days), and boot-leaf. The disease severity was scored on a scale of 0-9. Many cultivars were rated susceptible; a few were moderately resistant.

Interestingly, ASD5 was resistant, comparable with TKM6 until tillering. IR22 and IR26 were moderately susceptible and ASD5 was resistant in the tillering stage. But ASD5 became infected in the panicle-emergence stage. Progeny of ASD5—TNAU7124 and TNAU15776 — also scored resistant until tillering and were moderately susceptible in the boot-leaf stage. The contribution of resistance by IR22 and IR20 in those two cultivars appears insufficient. ASD15 (IR22/IR26) is also susceptible (see table).

ASD5 has potential resistance until the tillering stage to the bacterium strain that causes severe damage to most of the improved rice varieties known to be bacterial-blight resistant. ■

Reaction of rice varieties or cultures to bacterial blight disease.

Variety or culture	Disease severity scale[a]					
	Seedling		Tillering		Boot-leaf	
	Pots	Field	Pots	Field	Pots	Field
BJ1	0	0	0	0	0	0
Sigadis	0	0	0	0	1	0
TKM6	1	0	1	0	1	1
ASD5	1	0	1	1	5	5
IR22	1	1	5	3	5	5
IR26	3	1	5	5	5	5
Pankaj	1	1	3	1	3	3
TN1	5	5	7	7	7	7
TNAU7124 (ASD5/IR22)	1	1	1	1	5	3
TNAU15776 (IR20/ASD5)	1	1	1	1	5	3
ASD15 (IR22/IR26)	3	3	7	7	7	7

[a]0 = not affected, 9 = highly susceptible.

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

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To determine possible strains of tungro virus and biotypes of tungro vectors in various localities, the life span and tungro transmission of *Nephotettix virescens* collected and reared locally were tested on seedlings of 10 rice varieties in the AICRIP greenhouse, Rajendranagar, India, 12-30 September 1978. Two hundred adult insects, 10 females and 10 males for each variety, were given an acquisition access time of 3 days on tungro-diseased plants. The insects survived 1 to 18 days on 1-week-old seedlings. Their average life span was 4.6 days (5.0 days for female insects and 4.2 days for the male).

When the average life span was used to indicate the effect of rice variety on the insect, Gam Pai 30-12-15, IR34, Ptb 18, and Ambemohar 159 showed more resistance to the insect than Habiganj

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.

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

Variety	Life span (days)		Infective insects (%)	Retention (days)		Infected seedlings		
	Longest	Av[a]		Longest	Av	%	No./ insect	No./ infective insect
TN1	18	6.4 a	95	4	1.8	37	1.60	1.68
IR26	7	5.6 ab	80	3	1.4	26	1.10	1.38
Habiganj DW8	8	5.2 ab	80	3	1.4	35	1.15	1.44
Pankhari 203	14	4.8 bc	75	2	1.1	22	0.80	1.07
Latisail	8	4.8 bc	75	3	2.2	30	1.25	1.67
Kataribhog	8	4.8 bc	75	2	1.3	24	1.00	1.33
Ambemohar 159	8	4.2 cd	85	3	1.6	38	1.40	1.65
Ptb 18	8	3.7 cd	85	2	1.5	40	1.25	1.47
IR34	8	3.7 cd	70	1	1.0	22	0.70	1.00
Gam Pai 30-12-15	8	2.8 d	75	1	1.0	27	0.75	1.00
Max or av	18	4.6	80	4	1.4	30	1.10	1.37

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

DW8, IR26, and TN1 (see table).

About 30% of 729 seedlings inoculated by the viruliferous insects became infected. There seemed to be no remarkable differences among the 10 rice varieties as far as tungro transmission was concerned. However, the insects were less efficient in transmitting the tungro virus to IR34, Gam Pai 30-12-15, and Pankhari 203 than to the other varieties (see table). Those three might be more resistant to tungro than the others in the test. ■

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

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As part of the RTV Collaborative Project, an IRRI study investigated the life span and tungro transmission of *Nephotettix virescens* in the IRRI greenhouse from 15 May to 28 June, 1978. In two trials, 800 adult insects — 40 females and 40 males on 10 varieties — were given an acquisition access time of 4 days on tungro-diseased seedlings. The insects survived 1 to 23 days. The average life span was 4.8 days (5.0 days for female insects, and 4.6 days for the male).

The short life span on IR34, Gam Pai 30-1.12015, Ptb 18, and Pankhari 203 indicated that these varieties were more resistant to the insect than were the six others in the test (see table).

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

Variety	Life span (days)		Infective insects (%)	Retention (days)		Infected seedlings		
	Longest	Av[a]		Longest	Av	%	No./ insect	No./ infective insect
Habiganj DW8	23	7.3 a	14	1	1.0	3	0.14	1.00
Kataribhog	14	7.2 a	18	2	1.2	4	0.19	1.07
IR26	12	5.9 b	81	4	1.6	31	1.24	1.52
TN1	15	5.7 b	89	4	1.5	36	1.28	1.44
Ambemohar 159	19	5.5 b	48	3	1.2	16	0.56	1.18
Latisail	13	5.4 b	71	5	1.5	27	0.99	1.39
Pankhari 203	11	3.8 c	5	2	1.3	2	0.05	1.00
Ptb 18	9	2.6 d	45	2	1.0	18	0.45	1.00
Gam Pai 30-12-15	6	2.6 d	48	2	1.0	20	0.49	1.03
IR34	6	2.3 d	54	2	1.0	25	0.55	1.02
Max or av	23	4.8	47	5	1.5	18	0.60	1.17

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

Of 2,637 seedlings of 10 rice varieties inoculated by the insects, 18% developed tungro. Insect efficiency in transmitting the tungro virus was lowest with Pankhari 203, Habiganj DW8, and Kataribhog. ■

GENETIC EVALUATION AND UTILIZATION

Deep water

Anatomical studies of rice varieties tolerant of and susceptible to complete submergence at seedling stage

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Leaf sheath and leaf blades from 12 varieties were collected in 10-day-old seedlings to study the anatomical differences between varieties tolerant of the susceptible to complete submergence.

The number of vascular bundles on the first and second leaf blades varied among the varieties; however, the difference between the tolerant and susceptible varieties was not significant.

The leaf sheath is characterized by the presence of a large air space which alternates with the vascular bundles and is separated by narrow bands of parenchyma. The number of vascular bundles in the first and second leaf sheaths of the tolerant and susceptible varieties did not show any difference or correlation to submergence tolerance.

The role of the air space in submergence has not been studied. It possibly is important because it may serve as an oxygen reservoir or, if the leaf tips are above the water level, as passageway for transporting oxygen from the leaf blade to the roots. Thus, the air space might play an important role in maintaining the integrity of the cells. On the other hand, the occurrence of large air spaces may result in spongy, weak leaf sheaths that would make the plant prone to lodging when the water level recedes.

The percentage of air space per unit area was negatively and significantly correlated to submergence tolerance (r = -0.5997*). The air spaces on the first leaf sheath already were developed at the time of submergence. In the second leaf sheath, the susceptible varieties showed earlier development of air space and had more of it than the tolerant varieties 10 days after seeding. The total number of air space in the first and second leaf sheath also was correlated negatively to submergence tolerance (r = -0.6657*).

The number of layers and thickness of the sclerenchyma layer of the first leaf sheath of the rice seedlings tested did not correlate with submergence tolerance. However, the tolerant varieties FR13A and Nam Sagui 19 showed one layer more than the other varieties. There are variations in thickness in both tolerant and susceptible varieties.

Anatomically, the main significant difference between tolerant and susceptible varieties was in the percentage of the area occupied by air space and the number of air spaces. The more susceptible varieties had more air spaces. ■

Effect of flash flood on performance of some rice varieties

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An adaptive trial with eight popular, longduration entries was conducted at Block Seed Farm, Panskura, Midnapore District, West Bengal during 1978 kharif. These rainfed lowland entries represented tall indicas (NC1281 and OC1393), semidwarf cultivars (CR1014, CR1009, IET5656 and Pankaj) and a new semitall selection, CN540, along with Mahsuri.

Thirtyday-old seedlings of each cultivar were planted at 20- x 10-cm spacing in a 50-m^2 area during mid-July. The crop was deeply submerged by an unprecedented flood at 70 days after transplanting (end Sep) in 1978. The water depth was 3 m and the crop remained fully submerged for 10 days. Immediately after the flood water receded, it appeared that all the varieties had perished. But varieties with regenerative capacity subsequently developed fresh tillers from the live culms. After panicle emergence in the regenerated tillers, data on percentage of surviving culms and different yield attributes (number of tillers, panicle length, plant height, flag leaf length, number of fertile grains per panicle, exertion and total number of nodes per plant) were taken.

The two tall indicas, viz, NC1281 and OC1393, had no surviving culms, CN540 had 87.76% live hills after postflood regeneration and produced the most panicles per square meter (Table 1). In terms of panicle yield per plant, panicle length, and number of filled grains per panicle, CN540 performed better than Mahsuri (Table 2). CR1009 produced a few panicles under similar conditions, but showed maximum sterility (88.65%).

CN540 represents a semitall plant type with long slender grains (9.7 x 2.3 mm). Its superior performance in rainfed lowland and flash-flood conditions might be an advantage over Mahsuri, a variety that has gained considerable popularity during kharif in India. ■

Table 1. Effect of flash flood on the performance of some rice genotypes.

Variety	Hills counted (mean no.)	Hills surviving (mean no.) after flooding	Damaged hills (%)	Panicles (mean no./m^2)
CN540	49	43	12.24	152
Mahsuri	49	39	20.40	129
CR1014	49	33	32.65	85
IET5656	49	29	40.81	60
CR1009	49	9	81.63	9
OC1393	49	Nil	100.00	Nil
NC1281	49	Nil	100.00	Nil
Pankaj (check)	49	15	69.38	11

Table 2. Mean performance of 6 rice varieties with respect to different characters.

Variety	Panicle yield (g/plant)	Tillers (no./plant)	Plant ht (cm)	Panicle length (cm)	Flag leaf length (cm)	Fertile grains (no./panicle)	Sterile grains (no./panicle)	Exsertion (cm)	Nodes (no./plant)	Fertile-sterile grain ratio (F:S)
CN540	4.66	3.97	125.21	22.53	23.26	79.33	12.00	3.44	10.23	6.61
Mahsuri	3.08	3.14	119.07	16.35	18.03	62.93	9.21	4.20	10.06	6.83
CR1014	2.24	2.64	113.46	18.10	22.05	68.26	25.59	5.53	10.40	2.66
IET5656	1.60	2.15	83.73	15.67	15.86	35.88	13.22	–	11.23	2.71
CR1009	1.22	1.07	75.48	14.83	16.26	20.80	36.17	1.16	10.26	1.12
Pankaj (check)	0.85	0.86	76.81	15.69	19.44	42.11	22.05	0.73	9.33	1.90
LSD (0.05)	1.25	1.16	4.15	2.90	1.94	7.97	4.75	1.47	1.90	

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.

GENETIC EVALUATION AND UTILIZATION

Drought resistance

IR5178-1-1-4, an outstanding drought-tolerant line

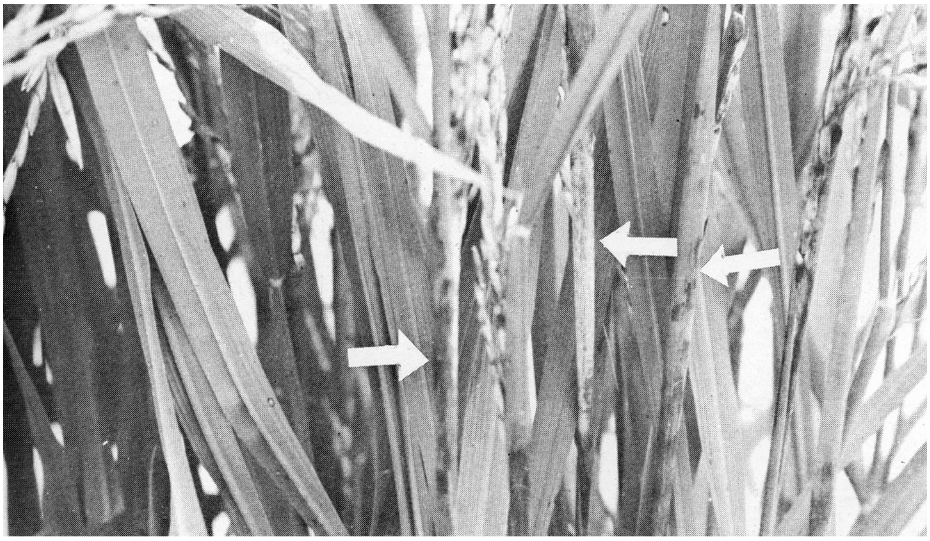
U. P. Singh and K. Singh, Rice Research Station (RRS), Nagina (Bijnor), out campus of University of Agriculture and Technology, Pantnagar, Nainital, India

Moisture level and stress affect the performance of rice. In 1979, reduced rainfall at the RRS, Nagina U.P., lasted 88 days. The normal rainfall during the monsoon season is 800 mm, but in 1979, only 337.5 mm was recorded. Between 25 July and 20 October only 27 mm of rain fell.

During 1979 kharif, the International Upland Rice Yield Nursery (IURYN) seeds were sown on 29 June. Nagina 22 was sown as a local check. Only two varieties, lR5178-1-1-4 and Nagina 22 flowered and set seed (see photo). They produced yields of 1.43 and 0.27 t/ha, respectively (see table). The non-flowering varieties dried up.

The crop did not suffer from moisture stress during the first 26 days of the drought (29 Jun - 25 Jul); therefore, crop establishment was good. But moisture stress was acute after that period.

The performance of IR5178-1-1-4 under acute moisture stress was remarkable. The mechanism of its drought tolerance needs investigation. ■



Nagina scientists at IURYN plot. Rice breeder points out the seeded variety.

Performance of IR5178-1-1-4 and the check Nagina 22 in the IURYN. Rice Research Station, Nagina, India, 1979.

Variety	Days to heading	Days to maturity	Plant ht (cm)	Panicle length (cm)	Grain yield (t/ha)
IR5178-1-1-4	57	88	85.2	18.1	1.43
Nagina 22	81	109	58.1	16.4	0.27

GENETIC EVALUATION AND UTILIZATION

Temperature tolerance

Thermosensitivity of aus and boro varieties of Bangladesh

A. R. Gomosta, senior scientific officer; and M. Z. Haque, head, Plant Physiology Division, Bangladesh Rice Research Institute (BRRI), Joydebpur, Dacca

Aus and boro varieties are photoperiod-insensitive rice groups of Bangladesh. They have been cultivated for centuries under distinct ecological conditions. The vegetative, reproductive, and ripening phases of aus varieties always experience high temperature but the greater part of the life cycle of boro varieties is subject to cold temperature.

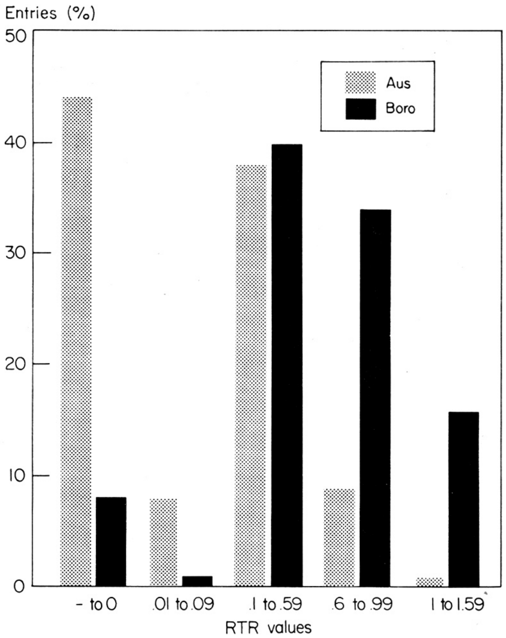
To determine whether the two rice groups are really distinct ecotypes in terms of thermosensitivity, 40-day-old seedlings of 80 boro and 133 aus varieties were transplanted in January 1978 in a puddled field. There were 2 seedlings/hill spaced 25 × 15 cm. The tillering potentiality in cold temperature was used as an index of thermosensitivity and measured as relative tillering rate (RTR):

$$RTR = \frac{\text{Final tiller} - \text{initial tiller number}}{\text{Initial tiller number}}$$

The RTR of all test materials was computed 30 days after transplanting

(DT), the coldest period during their tillering stage. The minimum temperature varied between 9.1°C and 14.5°C, and the mean temperature, between 14.8°C and 20.65°C. More than 90% of the aus entries had from negative to 0.59 RTR, but more than 90% of the boro were in the range of 0.10 to 1.59 (see figure). Negative to zero RTR indicated either failure to survive or no tiller production.

To compare tillering potentiality by group, the average RTR values of 50 aus and 50 boro varieties were determined at 10-day intervals up to 50 DT. During the 30-day period after transplanting, the boro varieties had 3 times higher RTR values, indicating their better adaptability to cold temperature. From 30 to 50 DT, the RTR values of the two groups were similar. The temperature during this period was higher than that of the 30-day period after transplanting.



Frequency distribution of boro and aus varieties according to relative tillering rates (RTR) at 0-30 days after transplanting.

Thus, the two traditional rice groups may be considered as two ecotypes. Perhaps, during the evolution process, only the boro varieties of the photoperiod-insensitive rice groups of Bangladesh became adapted to cold climates through natural selection. ■

Pest management and control DISEASES

Severe blast outbreak during 1979-80 boro in Bangladesh

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About a decade ago, blast was a major rice disease in Bangladesh. But with changes in cultivation patterns, the introduction of improved blast-resistant varieties, and changes from rainfed to irrigated culture disease incidence has remained low since 1968.

During the 1980 boro (Nov. 1979-May 1980), however, blast broke out in almost all regions of Bangladesh. Chandina, IR8, Pajam, and Pusa II were attacked (see table). Attacks on BR3, BR6, BR7, and Purbachi were, however, mild. BR8, BR9, and Pajam also had neck blast. No indigenous variety was infected. Severe infection destroyed fields of Pajam in Dacca and Sylhet areas; fields of Chandina, Pajam, and Pusa-II in Comilla; and fields of IR8 and Pajam in Barisal and Chittagong. At the Dacca-Narayanganj-Demra (DND) project area, IR8 was infected only in plots severely attacked by ufra nematode *Ditylenchus angustus.* In the north and northwest, only mild and scattered infections were observed but in east, southeast, and central Bangladesh the incidence was severe.

Incidence of blast during 1979–80 boro in some areas of Bangladesh.

Area	Blast difference[a] on different varieties						
	Chandina	IR8	Pajam II	Pusa II	Purbachi	Other improved varieties[b]	Local
Barisal	–	VS	L	–	M	L	N
Chittagong	L	VS	S	–	L	L	N
Comilla	VS	L	S	VS	L	L	N
Dacca	L	L	VS	–	L	L	N
Sylhet	L	L	S	–	L	L	N
Northern districts	L	L	L	–	L	L	L

[a]VS = very severe (disease incidence [DI] 7–9), S = severe (DI 5–7), M = moderate (DI 3–5, L = low (DI 1–3), N = nil. A dash (–) means the variety is not grown in the area. [b]Include BR3, BR6, BR7, BR8, and BR9.

The following factors were considered favorable for the development of blast disease during that season:

1. From October 1979 to April 1980 there was low night (10-25°C) and high day (24–25°C) temperatures.
2. The relative humidity of the atmosphere was high (92—95% at 0600 and 44-77% at 1200) during this period.
3. Dew formation on leaves was quite heavy at night during those months.
4. The affected plots were mostly dry because of scanty irrigation water during early crop growth.
5. The affected fields were mostly at

slightly higher locations (medium high to medium low lands).

6. Farmers normally used low or even no potassic fertilizers during the last few years.

7. Rice is cultivated continuously in almost all three seasons in some places. Usually only Paiam, the suscentible variety, is used for three consecutive seasons.

In addition to the above factors, the development of new virulent races of the highly variable causal fungus *Pyricularia oryzae* and the immigration to Bangladesh of spores of races different from those already present are also possible. Thus, the identification of the new races and of the number of races existing in Bangladesh and efforts to find chemical control measures are immediate steps being taken in the research programs of the BRRI Pathology Division. Studies on the interaction of ufra and blast have also been undertaken. ■

Varietal and insecticidal trial against rice tungro virus

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A trial with 10 test cultivars, which aimed at determining the effect of insecticidal treatment on the control of the vector insect of rice tungro virus (RTV), was laid out in split plots with 3 replications during 1979 thaladi. The treatments were: root soaking with FMC 35001 24% EC at 0.04% along with 1% urea for 20 minutes, maximum protection in which carbofuran 3% G was applied at 0.5 kg a.i./ha 10, 25, and 45 days after transplanting (DT); and an untreated control.

ADT 32 and AD 7211 had low percentages of RTV while ADT 31 and AD 9105 had high percentages (see table).

Data on rice tungro virus (RTV) incidence from an insecticidal trial, Tamil Nadu, India, 1979 thaladi.

Variety	RTV incidence (%)			
	Root soaking	Max protection	Control	Mean
AD 10969	56.0	52.3	52.0	53.4
AD 7211	25.3	22.0	27.7	25.0
TKM 9	39.3	35.3	41.7	38.8
AD 6120	62.7	63.7	60.7	62.4
AD 12599	68.7	58.7	67.3	64.9
ADT 32	33.3	10.3	22.3	22.0
ASD 15	42.7	14.3	46.0	34.3
IR20	56.3	16.3	45.3	39.3
ADT 31	92.3	93.0	100.0	95.1
AD 9105	97.7	92.7	100.0	96.8
Mean	57.4	45.9	56.3	

	Insecticidal treatment	Varieties	Interaction
C.D. (P = 0.05%)	2.3	5.4	3.2

In seven varieties – ADT 31, AD 9105, AD 6120, AD 12599, AD 10969, TKM 9 and AD 7211 – insecticidal treatment did not appreciably reduce RTV incidence by controlling the vector insects.

In IR20, ASDl5, and ADT32, maximum protection gave good reduction of RTV. ■

Outbreak of glume discoloration in Haryana, India

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Grain spotting, also known as glume discoloration (GLD) or dirty panicle, appears sporadically each crop season in Haryana on Basmati 370 and late-emerging panicles of IR8 and Jaya. Seventy-two percent discolored grains was recorded on RP967-4-1-10 and 31.5% in Basmati 370 in the 1978 wet season. Of the mycoflora associated with harvested grains, *Trichoconis padwickii* (in 60-80% discolored grains) was predominant over *Curvularia lunata, Drechslera oryzae, Phoma* sp., *Fusarium semitectum, F. moniliforme,* and *Pyricularia oryzae.*

A glume discoloration outbreak occurred in September 1979, after a long drought followed by rainfall and a storm when the crop was in the panicle-emergence stage. All emerging panicles had dirty brown or black grains. Symptoms appeared before the milk stage, and caused farmers to fear that they would not even get seed for their next crop. Pollen grains were viable, but no one could predict if grains would form. High sterility of spikelets and their

Occurrence of glume discoloration (GLD) under natural conditions at the Kaul Rice Research Station, India, in 1979 kharif.

Score	GLD (%)	Cultivars showing discoloration		
		No.	%	Designation
1	<1	110	38	Improved Sona, PAU1-608A, Sabarmati, R36-2486
3	1–5	58	20	Pusa 2-21, Prasad
5	5–25	35	12	Palman 579, Sona, Badshah Pasand
7	25–50	37	13	Basmati 370, IR36, PR106
9	>50	60	20	Ratna, Jaya, RP967-4-7-4, RP967-4-1-10,RP967-11-4-22

dirty color led to prediction of heavy losses, but the spikelets later filled. The table shows GLD incidence on various cultivars.

Isolations on PDA from affected glumes and grains showed *C. lunata* (in 80% discolored grains) and *F. semitectum* (5%). Unlike in the 1978 wet season, *C. lunata* was prominent.

Inoculating *C. lunata* on emerged panicles by spraying and dipping, and on the boot stage by injecting spore or mycelial suspensions on three dates produced symptoms of dirty panicle on almost all glumes and grains. *F. semitectum* did not produce discoloration by any of the tested inoculation procedures. ■

Survival of sclerotia of *Corticium sasakii* at different soil depths

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Sclerotia of *Corticium sasakii* (Shirai) Matsumoto — the rice sheath blight fungus — were grown on sterilized rice grain for 1½ months and then placed in a layer of 5, 10, and 15 cm deep soil respectively, in clay pots. On 17 August 1978, the pots were buried in a highland where the level of the soil of the pot and that of the field were the same. The soil in the pot contained 0.336% organic carbon, 0.09% N, 57.3 kg available P_2O_5/ha, 1,111.5 kg available K_2O/ha and pH 6.95. The sclerotia with the soil mass from the different depths were taken out at monthly intervals, starting at 3 months of burial, and retrieved by washing over a mesh. These were then surface-sterilized with mercuric chloride and viability was tested by growing them on potato dextrose agar mixed with streptomycin sulfate.

Viability of sclerotia of *C. sarakii* buried at different soil depths (observation from 15 sclerotia). Assam, India.

Observation time (mo after start of study)	Viability of sclerotia (%) at soil depth of 5 cm	10cm	15 cm
3	1	1	2
4	1	1	1
6	1	1	2
7	2	2	2
8	1	2	1

The table shows that the viability of sclerotia dropped considerably after 3 months (first observation) and remained almost the same, regardless of the depth of burial, up to 8 months (last observation). Sclerotia from the different soil depths were found to be colonized by different organisms including *Trichoderma viride,* but those retrieved from below 5 cm were colonized most and those from below 15 cm least. ■

Effect of seed treatment with fungicides in improving germination of sheath rot-infected seeds

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Sheath rot disease of rice caused by *Sarocladium attenuatum* Gams and Hawkworth caused grain discoloration of seeds in varieties ADT31, Bhavani, CO39, and CO40. In all four varieties, 45% of seeds died before emergence and seedlings that survived were about 30%. (Table 1).

Six fungicides were tested for their efficiency in the control of seed germination failure. For each treatment 50 g seeds showing infection symptoms was treated with fungicides at 2 g or 2 ml/kg seed. The seeds were then sown in pots containing 2 kg sterilized wetland soil. Untreated infected seeds were sown as the control. Another set of seeds treated with fungicides was stored in the laboratory at 25± 1°C for 6 months, then tested for germination 10 days after sowing.

Benomyl and panoctine improved seed germination best, both immediately after the treatment and after 6 months storage (Table 2). ■

Table 1. Data on germination[a] of 4 varieties. Tamil Nadu, India.

Variety	Pre-emergence death (no.)	Post emergence death (no.)	Seedlings that survived (no.)
ADT31	45	24	31
Bhavani	42	26	32
CO39	45	30	25
CO40	41	29	30

[a]Mean of 3 replications.

Table 2. Effect of fungicide seed treatment on germination. Tamil Nadu, India.

Fungicide	Germination[a] (%) Immediately after seed treatment	After 6 mo storage
TMTD	60 (51)	47 (43)
Captan	72 (58)	56 (48)
Agrosan	66 (54)	52 (46)
Panoctine	75 (60)	67 (55)
Panoram	55 (48)	43 (41)
Benomyl	82 (65)	76 (61)
Control	44 (42)	24 (30)
SED	4.06	2.38
CD	(P = 0.05) 8.72	(P = 0.05) 5.11

[a]Mean of 3 replications. Figures in parentheses are transformed values.

Influence of diammonium phosphate on brown spot disease of rice

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Brown spot of rice caused by *Helminthosporium oryzae* is very severe at the seedling stage during *navarai* (Nov-Mar) and *thaladi* (Oct-Feb) seasons. A field experiment was conducted in a randomized block design with four replications during 1979 navarai. IR20, which is susceptible to brown leaf spot disease, was raised in a 5- x 2-m plot. Diammonium phosphate (DAP) was applied to the nursery and disease incidence was observed. The treatments were: 1) wet seed treatment with DAP at 0.5% for 10 hours; 2) sprouted seed treatment with DAP at 0.5% for 30 minutes; 3) basal dressing of 500 g DAP/10 m^2; 4) topdressing of 500 g DAP/10 m^2 on the 7th day; 5) topdressing of 500 g DAP/10 m^2 on the 15th day; 6) foliar spraying with 0.5% DAP on the 7th day; 7) foliar spraying with 0.5% DAP on the 15th day; 8) topdressing of 500 g DAP/10 m^2 on the

20th day; 9) untreated control. The disease count was taken on the 30th day after sowing. All the modes of application of DAP on the rice nursery significantly reduced seedling infection by the brown spot pathogen. Among the treatments, topdressing of 500 g DAP/10 m^2 on the 7th day was highly effective in eliminating seedling infection. It resulted in healthy and vigorous rice seedlings. The results indicated that the brown spot disease at the seedling stage can be controlled by application of DAP. ■

Yellow wilt of rice in the lower Amazon Basin, Brazil

C. Y. Hsieh, Instituto de Pesquisa IRl, Belém, Pará, Brazil

In mechanical cultivation of irrigated rice in the lower Amazon Basin, the yellow wilt problem of the rice plant was first noted in a few commercial rice-producing fields during the second crop season of 1978. The disorder became more serious during the first and second crop seasons of 1979. The rice variety IR22 was commercially grown in the varzea marshland soils.

In most cases, the growth of the rice plant proceeded normally till 1 to 2 weeks before the flowering-milk stages. After these stages, the older leaves started dying off rapidly while the younger leaves turned yellow-brown and gradually died back from the tips. About 1 to 2 weeks before harvest, a sudden withering of the yellow-brown leaves occurred. Ripening was accelerated and at harvest the affected plants looked dehydrated, dirty, weak and droopy without a single green or light yellow leaf. Such a crop had many decayed and dead roots and was usually accompanied by an attack by *Helminthosporium* leaf spot and/ or *Cercospora* leaf spot and/ or *Pyricularia* neck blast and/ or *Rhizoctonia* sheath blight. However, such attacks appeared to be secondary. The low photosynthetic activity of the leaves and the poor root system resulted in a low grain yield. Because the leaves dried and died before maturation and the same panicle contained green as well as ripe grains, it was hard to determine the appropriate time for harvesting. The grain quality was usually poor. In some cases, where the disorder occurred before the flowering stage, the growth of the rice plant was poor, a yellow-brown discoloration appeared on the tips of green leaves and the older leaves dried and died starting from the tips. At the flowering stage the panicles varied in height and few leaves remained green. The withering of leaves proceeded more quickly and was accelerated by drainage for harvesting. Such a symptom occurred mostly on the plants grown in the low organic soils. The name "yellow wilt" was used because of the yellowing and wilt symptoms.

A combination of factors including iron toxicity, potassium deficiency and incidence of *Helminthosporium* leaf spot and/ or *Cercospora* leaf spot and/ or *Pyricularia* neck blast and/ or *Rhizoctonia* sheath blight diseases is suspected as the possible main cause of yellow wilt. Recent studies have demonstrated that the yellow wilt disorder is associated with potassium deficiency in the soil solution and the low potassium content of the plants. Increase in the supply of potassium fertilizer from the previously recommended 20–30 kg/ ha to the presently recommended 70–90 kg/ ha and use of split potassium application technique have noticeably alleviated the disorder. Three tentative remedies having been recommended for the disorder include: 1) submergence of the varzea marshland soils for at least 1 month before planting; 2) increase in the supply of potassium fertilizer up to 70–90 kg/ ha and use of split potassium application; and 3) application of higher amount of potassium fertilizer at about maximum tillering stage but avoidance of excessive nitrogen dressing at this stage. ■

Pest management and control INSECTS

Effect of storage time on insecticide-treated rice seeds

M. S. Venugopal, postdoctoral fellow; and J. A. Litsinger, entomologist, International Rice Research Institute

Insecticide treatment of rice seed has several advantages and has application for direct-seeded rice (dryland or wetland) and transplanted rice in the seedbed. Insecticides considered for seed treatment should satisfy certain requirements before recommendation; the most important is that they must not adversely affect germination of seeds or the seedlings. Sometimes seed are not sown immediately after treatment, so we measured the effect of storage on germination in an experiment from July to September 1979 with eight insecticides –carbofuran, bendiocarb, phenthoate, chlorthiophos, methoxychlor, cartap, formetanate, and promecarb. A 25% gum arabic water solution (sticker) was added to IR36 seeds in a plastic bag and the seeds were hand-agitated until the surfaces were evenly coated. Insecticides were then added at 10 g a.i./kg and the seeds were agitated again to ensure uniform coverage. The treated seeds were then dried in the shade and stored for 8 weeks in a nonairconditioned room (temp, 28-30°C; relative humidity, 80%). Germination percentage was taken at weekly intervals by placing 25 seeds in petri dishes on filter paper with moistened cotton wads. Each treatment was replicated four times and arranged in a completely randomized design.

All insecticides showed phytotoxicity up to 8 weeks after treatment (see table). Chlorthiophos, promecarb, and bendiocarb had immediate phytotoxic effects on seeds germinated on the same day

Changes in percentage of germination of insecticide-treated[a] seeds of IR36 with time of storage. IRRI, 1979.

Insecticide	Germination (%) at indicated weeks after treatment[b]								
	0[c]	1	2	3	4	5	6	7	8
Carbofuran (Furadan 2 F)	90 abc	90 ab	90 a	75 abc	85 b	80 ab	75 bc	75 bc	75 bc
Bendiocarb 80 WP	75 bc	85 ab	85 ab	95 a	95 ab	85 a	85 b	85 b	95 a
Phenthoate (Pennant 40 SP)	95 ab	85 ab	70 bc	65 c	80 b	75 ab	70 c	70 c	75 bc
Chlorthiophos (Celathion 25 SP)	65 c	90 ab	95 a	70 bc	95 ab	65 bc	75 bc	80 bc	70 c
Methoxychlor (Marlate 50 SP)	90 abc	90 ab	90 a	90 ab	85 b	75 ab	65 c	75 bc	75 bc
Cartap (Padan 50 SP)	90 ab	25 c	35 d	0 e	0 d	0 d	0 d	0 d	0 d
Formetanate (Dicarzol50)	95 bc	85 ab	65 c	30 d	25 c	0 d	0 d	0 d	0 d
Promecarb (Carbamult 38)	75 bc	75 b	70 bc	55 cd	90 ab	55 c	65 c	70 c	85 b
Check	100 a	95 a	95 a	95 a	100 a	80 a	95 a	100 a	100 a
CV (%)	20.7	19.0	18.3	22.3	18.7	16.6	15.9	12.3	14.0

[a]All insecticides were applied at 10 g a.i./kg seed, with 25% gum arabic water solution as sticker. Av of 4 replications, 25 seeds/replication. [b]In a column, means followed by a common letter are not significantly different at the 5% level. [c]Day of treatment.

that they were treated. But bendiocarb-treated seeds showed no phytotoxic effects from 1 to 5 weeks after treatment, indicating that the insecticide degraded over the 1st week to a less active ingredient. Cartap and formetanate were highly phytotoxic for 1 to 2 weeks, respectively, after storage, indicating that degradation products were perhaps toxic. ■

Dosage calculation charts for sprayable insecticides

J.A. Litsinger, entomologist, International Rice Research Institute

Surveys have shown that farmers apply much lower rates of sprayable insecticides than those recommended. The results are poor insect control and a waste of money and time. Furthermore, underdosing may contribute to the resurgence of some insect pests such as the brown planthopper.

The recommended sprayable insecticide dosage for rice insects in the Philippines is 0.75 kg a.i./ ha. Dosages of less than 0.5 kg. a.i./ ha of certain insecticides are believed to be not only sublethal to most insects pests, but also harmful to natural enemies such as spiders and predatory bugs that move over rice foliage and accumulate a lethal dosage.

The charts given here simplify mathematical calculations for sprayable insecticides. They were developed for use by extension workers in helping farmers calculate lethal dosages. The following information is needed:

- area of field to be sprayed, number of sprayerloads per field the farmer normally uses (regardless of the size of the sprayer or spray volume/ ha, and
- concentration of insecticide [% active ingredient (a. i.)]

First, use Table 1 for both liquid and wettable powder formulations to find the number of sprayerloads for 1 ha. The field size is given at the top of Table 1 for fields 0.2 to 2.0 ha, in increments of 0.2 ha. Find the appropriate column for the field area. Along the lefthand margin find the number of sprayerloads the farmer applies per field. Follow the row horizontally to the correct column to find the number of sprayerloads for 1 ha. For example: 40 sprayerloads/ field for a 1.2- ha field gives 33 sprayerloads/ ha. To find the amount of insecticide to put in each sprayerload, use Table 2 for liquid insecticides or Table 3 for wettable powders. The possible concentrations (15–70% a.i. / ha on the label) of liquid insecticides are presented on the top of Table 2. Along the left margin, find the value nearest to the number of sprayerloads per hectare from Table 1. In our example, if a 50% liquid insecticide is to be used, follow the

Table 1. Calculation of the number of sprayerloads per hectare. IRRI.

Sprayerloads (no./field)	Sprayerloads (no.) when field size is									
	0.2 ha	0.4 ha	0.6 ha	0.8 ha	1.0 ha	1.2 ha	1.4 ha	1.6 ha	1.8 ha	2.0 ha
10	50	25	17	13	10	8	7	6	6	5
20	100	50	33	25	20	17	14	13	11	10
30	150	75	50	38	30	25	21	19	17	15
40	200	100	67	50	40	33	29	25	22	20
50	250	125	83	63	50	42	36	31	28	25
60	300	150	100	75	60	50	43	38	33	30
70	350	175	117	88	70	58	50	44	39	35
80	400	200	133	100	80	67	57	50	44	40
90	450	225	150	113	90	75	64	56	50	45
100	500	250	167	125	100	83	71	63	56	50

Table 2. Calculation of the number of tablespoons of liquid insecticides to add to your sprayer each sprayerload to achieve a dosage of 0.75 kg active ingredient/ha. IRRI.

Sprayerloads (no./ha)[a]	Number of tablespoons per sprayerload of liquid insecticides when insecticide concentration (% a.i.) on the bottle is											
	15	20	25	30	35	40	45	50	55	60	65	70
10	50	38	30	25	21	19	17	15	14	13	12	11
15	33	25	20	17	14	13	11	10	9	8	8	7
20	25	19	15	13	11	9	8	8	7	6	6	5
25	20	15	12	10	9	8	7	6	5	5	5	4
30	17	13	10	8	7	6	6	5	5	4	4	4
35	14	11	9	7	6	5	5	4	4	4	3	3
40	13	9	8	6	5	5	4	4	3	3	3	3
45	11	8	7	6	5	4	4	3	3	3	3	2
50	10	8	6	5	4	4	3	3	3	3	2	2
55	9	7	5	5	4	3	3	3	2	2	2	2
60	8	6	5	4	4	3	3	3	2	2	2	2
65	8	6	5	4	3	3	3	2	2	2	2	2
70	7	5	4	4	3	3	2	2	2	2	2	2

[a]From Table 1.

Table 3. Calculation of the number of tablespoons of wettable powders to add to your sprayer each sprayerload to achieve a dosage of 0.75 kg a.i./ha. IRRI.[a]

Sprayerloads (no./ha)	Number of tablespoons of WP per sprayerload				
	Etrofolan Mipcin Hytox MIPC 50 WP	Shellcarb BPMC 40 WP	Tsumacide MTMC 50 WP	Orthene 75 SP	Sevin Tercyl 85 WP
10	39	51	37	34	38
15	26	34	24	23	25
20	20	25	18	17	19
25	16	20	15	14	15
30	13	17	12	11	13
35	11	14	10	10	11
40	10	13	9	9	9
45	9	11	8	8	8
50	8	10	7	7	8
55	7	9	7	6	7
60	7	8	6	6	6
65	6	8	6	5	6
70	6	7	5	5	5
G/tablespoon	3.8	3.7	4.1	2.9	2.3

[a]WP = wettable powder, SP = soluble powder.

column labeled 50 down to the row designated 35 sprayerloads/ha (33 rounds off to 35). The correct dosage then is 4 tablespoons/sprayerload. Note that a tablespoon = 10 ml.

Table 3 gives calculations for wettable powders. Wettable powders are calculated individually because the weight of one tablespoon of the formulated product varies among insecticides. For liquids we assumed that the weight of 1 liter of insecticide was equal to the weight of 1 liter of water. But wettable powders have different dispersing agents and carriers that have different weights. If a recommended wettable powder insecticide is not in Table 3, use the following formula for 0.75 kg. a.i./ha dosage to calculate the appropriate data in tablespoons for 10–70 sprayerloads/ha:

$$\text{No. of tablespoons} = 750 \times \frac{100}{\text{concentration of product}} \times \frac{1}{\text{sprayerloads (no./ha)}} \times \frac{1}{\text{g/1 tablespoon (10 cc) of product}}$$

Note that you need to know the weight of 1 tablespoon of the formulated product.

Observations on a "blue form" of green leafhopper

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In January 1980 a few colored insects, resembling green leafhopper *Nephotettix virescens* were noticed in the insect maintenance cages at AICRIP headquarters, Hyderabad. Twenty-five such insects, both males and females, were caged on TN1 seedlings. Eight days later the first-instar nymphs appeared and molted within 2-3 days. After that the second-instar nymphs were clearly distinguishable from those of "normal" green leafhopper nymphs. Later generations showed that the blue forms bred true and that the blue and green forms can crossbreed. To determine if the two forms differ in the ability to transmit tungro virus disease, males and females of both forms were released on tungro-infected TN1 plants for 24 hours. Transmission tests showed that as transmitters of rice tungro virus the blue females were as efficient as the green, but the green males were better than the blue. Further work is in progress and the insects have been sent to the Commonwealth Institute of Entomology for identitication. ■

The "knockdown speed" of insecticides against brown planthopper and green leafhopper

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The "knockdown action" of some commonly used pesticides for the control of brown planthopper (BPH) *Nilaparvata lugens* and green leafhopper (GLH) *Nephotettix virescens* (Dist.) was studied.

Single hills (5 plants each) of 25-day-old rice plants were transplanted in plastic pots (3 inches in diameter). Desired concentrations of insecticides were sprayed on the potted plants on a turntable at 25 ml/pot at 5 days after transplanting. Each treatment was replicated twice. The sprayed plants were allowed to dry for 1 hour. Twenty brachypterous BPH females in the 1st experiment and 20 5th-instar GLH nymphs in the 2d, were caged on treated plants with a glass tube covered with muslin. The exposure periods were 1, 2, 4, and 6 hours for BPH and 0.5, 1, 2, and 3 hours for GLH. Mortality was recorded after the exposure periods. Moribund insects were treated as dead. For mortality in the control, the corrected percentage of mortality in the treatment was calculated by Abbott's formula and plotted on log-probit paper against time in hours; graphical Lethal Time (LT_{50}) and Lethal Time 90 (LT_{90}) were calculated for the different insecticides (see table). ■

LT_{50} and LT_{90} values of pesticides against the brown planthopper and green leafhopper. Bhopal, M.P., India.

Pesticide	Conc (% active ingredient)	Values (h)			
		Brown planthopper		Green leafhopper	
		LT_{50}	LT_{90}	LT_{50}	LT_{90}
Control	0	–	–	–	–
Methyl parathion	0.025	3.5	5.0	1.6	2.0
Quinalphos	0.025	2.4	5.0	1.5	2.2
Phosphamidon	0.025	2.6	4.0	1.5	2.4
Carbaryl	0.05	2.0	3.0	1.25	1.8
BPMC	0.05	< 1.0	1.0	0.8	1.1
BPMC + carbaryl (1:1)	0.05	1.1	1.8	0.6	0.9
Landrin	0.05	2.0	3.0	1.5	2.5

Leaf folder control through interference in chitin biosynthesis

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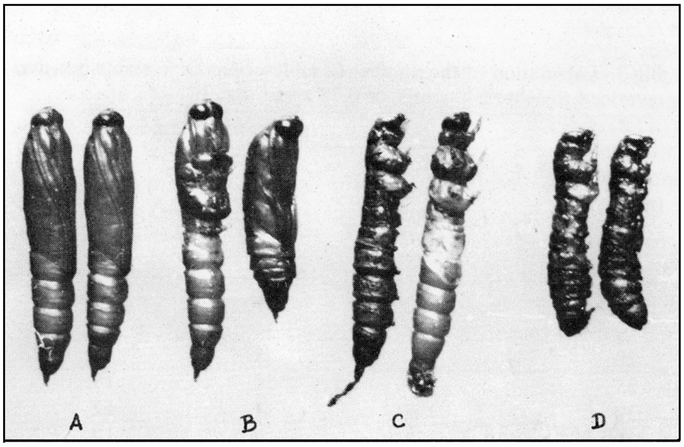
The effect on larvae of the leaf folder *Cnaphalocrosis medinalis* Guenee of a new insecticide Dimilin (R)—with a unique mode of action on insects was studied. Dimilin (diflubenzuron) interferes with chitin biosynthesis and deposition in the insect cuticle. Interference in chitin deposition in the insect exoskeleton leads to inhibition of molting.

Potted TN1 rice plants were sprayed with 200 ppm Dimilin with a hand atomizer. When the spray fluid dried up, final-instar larvae of the leaf folder were released on plants confined in cylindrical polyester cages. The larvae which fed on Dimilin-treated plants formed silken webs, but were unable to molt and develop into pupae (see figure). The insecticide caused deformities: pupae with deformed proboscis and larval-pupal mosaics. The pupal deformities are evidently due to interference in chitin deposition. In all the 5 replications of 10 larvae each, 80% of the test insects were deformed. The result suggests that Dimilin—a new generation of insecticide—has the potential to control the rice leaf folder through physiological inhibition of chitin deposition. ■



Morphogenetic changes in leaf folder larvae that fed on Dimilin®-treated rice leaves. A: normal pupae; B: pupae with deformed proboscis; C & D: larval-pupal mosaics. Tamil Nadu, India.

Irrigation and water management

Effect of irrigation regimes on agronomic characters of rice

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The effects of different irrigation regimes on agronomic traits of the semidwarf rice variety Cauvery were studied in a greenhouse trial. Continuous flooding was the superior irrigation regime in its influence on grain yield and nutrient recovery, but it did not improve the harvest index. Yield and nutrient recovery performance was poor in rice plants grown under continuous saturated conditions. Flooding at the reproductive stage was found to increase yield, nutrient recovery, and harvest index more than flooding at the vegetative stage.

Nutrient recovery was closely associated with yield but harvest index was an independent trait and differed from yield trends. Harvest index decreased successively in the following order of irrigation regime: I_2, I_1, I_4, I_3 (see table). The highest harvest index in treatment I_2 was probably because of proper equili-

Effect of different irrigation regimes on some agronomic characteristics of indica rice, Varanasi, India.

Treatment	Grain yield[a] (g/hill)	Harvest index[a] (%)	Relative efficiency of nutrient recovery (%)	
			Nitrogen	Phosphorus
I_1 Continuous saturation at maximum water-holding capacity	20.3 d	52 b	100	100
I_2 Saturation during vegetative + flooding during reproductive stage	29.4 b	58 a	147	155
I_3 Flooding during vegetative stage + saturation during reproductive stage	23.4 c	43 d	124	142
I_4 Continuous flooding (5 cm depth)	32.9 a	46 c	155	113
Significance	*	*	–	–
C.D. at 5% level	2.13	2.61		

[a]Mean values with the same letter do not differ significantly.

brium between the growth rates in the vegetative and reproductive stages. But although flooding at the vegetative stage increased the rice plant's vegetation appreciably, saturation during the development of reproductive organs caused a setback (see table). ■

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

Blue-green algae in deepwater rice in Mali, West Africa

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Epiphytic algae on rice may contribute to the fertility of paddy soils and may be important where fertilizers are not used. Their presence in deepwater rice has been reported in Bangladesh. This article reports the presence of blue-green algae (BGA) in deepwater rice in Africa.

Stem sections of variety Mogo, *Oryza glaberrima,* including nodal roots and leaf sheaths, were removed from a field of deepwater rice near Mopti, Mali, on 10 October 1978. The water was 165 cm deep. The stem sections were preserved in 2% formalin (39% formaldehyde).

The algae from both the sedimented samples and various parts of the rice plant were examined. The former served as a check for the occurrence and relative abundance of the algae in the latter's habitat. The algae were observed directly through a compound microscope. Temporary mounts were prepared in lactophenol blue from a 2- to 3-mm^2 pieces of leaf sheaths and leaf blades, and from pieces of nodal roots about 1-2 mm long. The cover slips were later sealed with melted paraffin and kept in the herbarium of the UPLB.

Twenty-six species of algae were identified from the material. The table lists the BGA and indicates their relative abundance. BGA constituted the greatest algal bulk in the sample. Of the eight species of BGA identified, seven are nitrogen fixers: *Anabaena torulosa,* A. *vaginicola, Cylindrospermum licheniforme, Gloeocapsa quaternata, Gloeotrichia natans, Hapalosiphon stuhlmanii,* and *Nostoc* sp.

The chlorophytes were well represented (13 species) but only *Bulbochaete* sp. and *Oedogonium* sp. were present in significant numbers. Five species of euglenophytes and diatoms occurred in low numbers. ■

Blue-green algae observed on deepwater rice Mogo, in Mopti, Mali, West Africa.

Species	Relative abundance[a]		
	Leaf/ leaf sheath	Nodal roots	Sediment
Anabaena torulosa (Carm.) Lag.			++++
A. vaginicola Fritsch et Rich	+++	+++	+++
Chroococcus limneticus Lemm.	++	++	++
Cylindrospermum licheniforme (Bory) Kuetz.	+++	++	++
Gloeocapsa quaternata (Breb.) Kuetz.	+		+
Gloeotrichia natans (Hedw.) Rabh.	++++	+++	++++
Hapalosiphon stuhlmanii Hieron.	++++	+++	++++
Nostoc sp.	++++		++

[a]++++ = abundant, +++ = moderate, ++ = rare, + = very rare.

Increasing efficacy of urea in wetland rice cultivation

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Field trials in sandy loam soils for two seasons investigated the efficacy of urea for wetland rice. The experiments were in strip-plot design with 3 main treatments (nitrogen levels, 0, 75, 150 kg/ha) and 6 subtreatments of mode of urea application.

The efficacy of placement of urea by applicator or through paper ball was pronounced when urea was applied in two doses: 1/2 as placement on the 15th day and 1/2 as topdressing on the 35th day after planting (see table). Between the two methods of placement, the paper ball was more efficacious.

An important feature of urea placement was the saving of about 50% of the fertilizer compared to a conventional method of application (1/2 basal + 1/2 topdressing). The yield of 4.0 to 4.2 t/ha obtained in 1980 navarai with the application of 150 kg N/ha by the conventional method was equal to the yield obtained with application of 75 kg N/ha as 1/2 placement on the 15th day + 1/2 as topdressing on the 35th day after planting. ■

Effect of mode of nitrogen application on rice grain yield. PES, Tirurkuppam, Tamil Nadu, India, 1979-80.

Mode of application and N levels [a]	Grain yield (t/ha) for 1979 samba (IR20)				Increase (%) over control	Grain yield (t/ha) for 1980 navarai (TKM9)				Increase (%) over control
	0 N	75 kg N	150 kg N	Mean		0 N	75 kg N	150 kg N	Mean	
T1 = all basal (Conventional methods)	1.6	2.1	2.2	2.0	100	2.1	3.2	4.0	3.1	100
T2 = 1/2 basal + 1/2 topdressed (Conventional methods)	1.5	2.0	2.4	2.0	100	2.0	3.5	4.2	3.2	103
T3 = all by applicator 15 DP	1.6	2.2	2.5	2.1	105	2.0	3.5	4.4	3.3	106
T4 = all by paper ball 15 DP	1.6	2.3	2.7	2.2	110	2.0	3.8	4.5	3.4	110
T5 = 1/2 by applicator 15 DP + 1/2 broadcast 35 DP	1.5	2.5	2.8	2.3	115	2.1	3.9	4.6	3.5	113
T6 = 1/2 by paper ball 15 DP + 1/2 broadcast 35 DP	1.6	2.7	2.9	2.4	120	2.2	4.2	4.8	3.1	119
Mean	1.5	2.3	2.6			2.1	3.7	4.4		
% over control	100	153	173			100	176	210		
	F-test		*SE*	*CD*		*F-test*		*SE*	*CD*	
Main treatment (levels of N)	S**		0.092	0.319		S**		0.034	0.118	
Subtreatment (mode of N application)	S*		0.083	0.250		S**		0.082	0.246	
Interactions:										
a) Sub at main	NS		0.124	–		NS		0.148	–	
b) Main at sub	NS		0.196	–		NS		0.201	–	

[a] DP = days after planting.

Influence of soil water treatments on nutrient availability in soil and yield of dryland rice

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A field experiment on a calcareous Vertisol (pH 8.6, $CaCO_3$ equivalent 9.8%, and organic carbon 0.68%) at MPAU in the 1978 rainy season investigated the effect of soil water treatments on the availability of nutrients in soil and on rice yield. For 15 days before rice was sown the following soil water treatments were given: dry (no irrigation), saturation (about 6 cm irrigation on alternate days), and submergence (2 irrigations daily). Two rice varieties were compared: Karjat 184 (semidwarf, wetland) and Tuljapur 1 (tall, dryland). Soil moisture conditions were maintained at about yield capacity (dryland conditions) throughout crop growth. Changes in nutrient availability as a result of soil water treatments 5 days before sowing were studied and yields of rice grain and straw were recorded.

The available nitrogen, phosphorus, iron, and manganese supply in the soil (see table) increased with soil-water treatments 15 days before sowing. The availability of those nutrients was significantly higher in the presowing soil-submergence treatment compared with the soil saturation and control treatments. This increase in nutrient availability might be due to moderately reducing soil conditions as a result of presowing soil submergence (the Eh value decreased from 501 to 362 mV and the pH decreased from 8.6 to 8.0).

Yields of rice grain and straw were significantly higher in the presowing soil water treatments. Yields of the soil submergence treatment 15 days before sowing were significantly higher than those of the control and the soil-saturation treatments. That could be because of the higher supply of nitrogen phosphorus, iron, and manganese in soil

Nutrient availability in soil and rice yield as influenced by presowing soil water treatments (average of 2 varieties).[a] Maharashtra, India.

Treatment[b]	Available nutrients in soil (ppm)								Rice yield (t/ha)	
	15th day after soil water treatments				At sowing					
	Nitrogen	Phosphorus	Iron	Manganese	Nitrogen	Phosphorus	Iron	Manganese	Grain	Straw
Presowing soil water treatments										
Dry soil	76.6	10.70	2.63	4.58	83.71	11.64	2.89	4.93	2.61	2.87
Soil saturation	94.5	12.94	3.96	7.80	94.92	12.47	4.02	7.88	2.92	3.31
Soil submergence	107.2	13.22	4.78	8.64	97.70	13.05	4.83	8.75	3.12	3.42
"F" test	**	*	**	**	**	**	**	**	*	*
S.E. ±	2.5	0.58	0.28	0.33	1.33	0.19	0.24	0.32	0.11	0.12
C.D. at 5%	7.7	1.75	0.84	1.01	3.99	0.57	0.73	0.96	0.34	0.35
Rice cultivars										
Karjat 184	No crop standing as nutrient availability in soil was studied up to sowing of rice.								1.82	2.28
Tuljapur 1									3.94	4.16
"F" test									**	**
S.E. ±									0.09	0.09
C.D. at 5%									0.28	0.28

[a]Significance at the 1% (**) and 5% (*) levels. [b]Interaction between presowing soil water treatments and rice cultivars was nonsignificant.

during the early growth stages.

The tall, dryland cultivar Tuljapur 1 yielded significantly more grain and straw than Karjat 184. Dryland soil conditions seem favorable to tall, dryland rice cultivars. ■

Relation of sowing time and seedling age to rice yields during rabi season

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The sowing time and age of rice seedlings must be adjusted carefully during the rabi season to obtain good seed germination and seedling growth during the initial stages when temperature is low and to facilitate early harvest before the rains begin.

An experiment in the 1978 rabi studied the effect of time of nursery sowing and seedling age on the yield of early-maturing rice varieties with and without foliar application of potash. The design was split plot with three replications. Three nursery sowing dates — 21 December, 28 December, and 4 January 1979 —and two seedling ages at transplanting (6 and 7 weeks) were in the main plots. Allocated each to subplot were two early-maturing semidwarf varieties, R155-2601 and Kalinga 2, and two potash application treatments (no foliar application and 1 foliar application, 1% concentration). Fertilizer was applied to all treatments at 80 kg N, 40 kg P_2O_5, and 30 kg K_2O/ha. Seedlings were transplanted at a 20- x 10-cm spacing.

The effect of time of sowing on yield was highly significant. Sowing in the first week of January was superior to sowing in the third and fourth weeks of December (see table). That was because of low temperatures in the third week (25.4° C max, 8.2° C min) and the fourth (25.6° C max, and 8.1° C min) of December. The mean maximum and minimum temperatures from 4 to 10 January were 27.3° C and 10.5° C. Seedling age also gave significant differences. The 7-week-old seedlings performed better than the 6-week-old. Interaction between sowing time and seedling age was not significant.

Kalinga 2 gave significantly higher yields than R155-2601. The effect of foliar application of potash was not significant. ■

Effect of time of nursery sowing and seedling age on the yield of early-maturing rice varieties during the rabi season. Raipur, India, 1978–79.

Sowing date	Seedling age (wk)	Yield (t/ha) R155-2601	Kalinga 2	Mean
21 Dec	6	0.92	1.05	0.99
	7	1.12	1.38	1.25
	Mean	1.02	1.22	1.12
28 Dec	6	0.95	1.20	1.08
	7	1.12	1.37	1.25
	Mean	1.04	1.29	1.16
4 Jan	6	1.16	1.53	1.35
	7	1.23	1.92	1.57
	Mean	1.19	1.73	1.46
Mean	6	1.01	1.26	1.14
	7	1.16	1.56	1.36
Overall mean		1.08	1.41	

For comparison of means of 2 sowing dates, CD at 5% 210.
For comparison of means of 2 seedling ages, CD at 5% 172.
For interaction (sowing date x seedling age), CD at 5% not significant
For comparison of means of 2 varieties, CD at 5% 104.

Field amelioration of an acid sulfate soil for rice with manganese dioxide and lime

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The effects of manganese dioxide (100 kg/ ha) and lime (5 t/ha) on iron toxicity symptoms and yield of IR26 and IR43 on a flooded, acid sulfate soil (a Sulfaquept whose characteristics are in Table 1) were studied in a replicated factorial experiment in a farmer's field in Malinao, Albay, Philippines.

On the basis of iron toxicity symptoms 4 and 8 weeks after transplanting, the best treatment had lime and manganese dioxide and the moderately tolerant IR43. The poorest had the moderately susceptible IR26 but without lime or manganese dioxide (Table 2). Analysis of variance of the symptoms' scores revealed no significant response to lime, but a significant difference between the two varieties and a highly significant, positive response to manganese dioxide.

On the basis of grain yield, the best treatment had IR43 and manganese dioxide, with or without lime (Table 2). The poorest had 1R26 without lime and manganese dioxide. Analysis of variance revealed a nonsignficant response to lime, a highly significant varietal difference, a highly Significant positive response to manganese dioxide, and a highly significant variety and manganese dioxide interaction (Table 3).

IR26 gave a response of 1.2 t/ha to manganese dioxide in the presence of lime. IR43 showed a response of 2.2 t/ha to manganese dioxide in the absence of lime. In the presence of manganese dioxide, lime increased the yield of IR26 by 0.90 t/ha, but in the absence of manganese dioxide, IR43 gave a response of 1.3 t/ha with lime.

The benefits from manganese dioxide are attributed to manganese which, assisted by lime, counteracts physiologially the toxic effects of excess iron. Manganese dioxide, coupled with the tolerant variety and lime, may be an inexpensive ameliorant for acid sulfate soils. ■

Table 1. Some chemical characteristics of the soil at the experimental site, Malinao, Albay, Philippines.

pH of dry soil (1:1 H_2O)	3.5
EC_e (mmho/cm)	1.0
CEC (meq/l00 g)	9.5
Organic C (%)	1.23
Total N (%)	0.15
Active Fe (%)	2.50
Active Mn (%)	0.001
Exchangeable K^+ (meq/100 g)	0.17
Exchangeable SO_4^{2-} (%)	0.27
Available (Olsen) P (ppm)	7.0

Table 2. Effects of lime and manganese dioxide on the severity of iron toxicity symptoms 4 and 8 weeks after transplanting, and on grain yield of 2 rice varieties on an acid sulfate soil. Malinao, Albay, Philippines, 1980 dry season.[a]

Treatment			Iron toxicity score[b]		Yield (t/ha)
Lime	Manganese dioxide	Variety	4 wk after transplanting	8 wk after transplanting	
No	No	IR26	5.8 d	6.0 a	3.6 d
No	Yes	IR26	4.8 cd	5.2 ab	3.9 d
No	No	IR43	4.8 cd	5.5 ab	4.0 cd
No	Yes	IR43	3.5 ab	4.2 bc	6.2 a
Yes	No	IR26	5.2 cd	5.8 a	4.3 cd
Yes	Yes	IR26	4.2 bc	4.8 ab	4.8 bc
Yes	No	IR43	3.5 ab	4.2 bc	5.3 b
Yes	Yes	IR43	3.0 a	4.0 c	6.2 a

[a] Any two means in a column followed by the same letter are not significantly different at the 5% level. [b] On the scale 1 to 9 based on foliar symptoms and general appearance (1 = nearly normal plants, 9 = dead or nearly dead plants).

Table 3. Analysis of variance for grain yield from the acid sulfate soil amelioration plots. Malinao, Albay, Philippines, 1980 dry season.

sv	df	SS	MS	F(obs)
Block	3	2.601	0.867	
Lime (L)	1	4.100	4.100	5.04^{ns}
Error a	3	0.814	0.271	
Variety (V)	1	13.120	13.120	16.84**
L x V	1	0.061	0.061	$<1^{ns}$
Error b	6	4.674	0.779	
Manganese dioxide (M)	1	7.576	7.576	24.52**
L x M	1	0.567	0.567	1.83^{ns}
V x M	1	3.032	3.032	9.81**
L x V x M	1	1.050	1.050	3.40^{ns}
Error c	12	3.711	0.309	
Total	31	41.306		
CV (a) = 10.82% s.e. = 0.28	CV (b) = 18.35%		CV(c) = 11.56%	

Influence of continuous submergence on the kinetics of pH, Eh, and Ec in some acid soils of Assam

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The effect of continuous submergence on the kinetics of electrochemical properties was studied on four typical rice-growing acid soils of Assam in the laboratory.

Continuous submergence brought about significant electrochemical changes in the soil (see table). Within a period of 10 to 15 days after submergence, pH increased significantly, creating an almost neutral soil condition, accompanied by a decrease in Eh and an increase in Ec. The treatment created a favorable soil environment for growing rice. ■

Kinetics of electrochemical properties of soils under submerged conditions (average of two replications). India

Soil no.	21 Mar	23 Mar	27 Mar	30 Mar	31 Apr	1 Apr	3 Apr	8 Apr	14 Apr	22 Apr	28 Jun
					Kinetics of pH of soil						
Soil-1	4.9	5.3	6.3	6.7	6.8	6.7	6.7	6.9	6.9	7.0	6.9
Soil-2	5.0	5.4	6.5	6.7	6.9	6.7	6.7	6.9	6.8	6.8	7.0
Soil-3	4.3	5.0	6.I	6.5	6.8	6.6	6.6	6.9	6.8	6.0	6.1
Soil-4	4.5	4.8	5.3	5.7	6.2	6.3	6.4	6.8	6.8	6.9	7.0
					Kinetics of Ec (mmho/cm) of supernatant liquid						
Soil-I	< 0.05	0.05	0.12	0.18	0.38	0.39	0.41	0.20	0.05	0.05	0.05
Soil-2	< 0.05	0.05	0.05	0.14	0.17	0.19	0.18	0.15	0.05	0.05	0.05
Soil-3	< 0.05	0.05	0.15	0.31	0.42	0.51	0.50	0.22	0.05	0.05	0.05
Soil-4	0.05	0.05	0.05	0.07	0.13	0.26	0.28	0.32	0.11	0.15	0.05
					Kinetics of Eh (mV) of soil						
Soil-1	+160	+115	+15	–130	–130	–173	–175	–178	–168	–158	–135
Soil-2	+178	+120	+20	–110	–135	–150	–180	–163	–160	–145	–130
Soil-3	+205	+ 85	+ 8	–135	–148	–160	–185	–180	–188	–168	–150
Soil-4	+205	+145	+43	+15	–33	– 60	–123	–175	–180	–155	–130

Appraisal of available phosphorus in alluvial soils for rice

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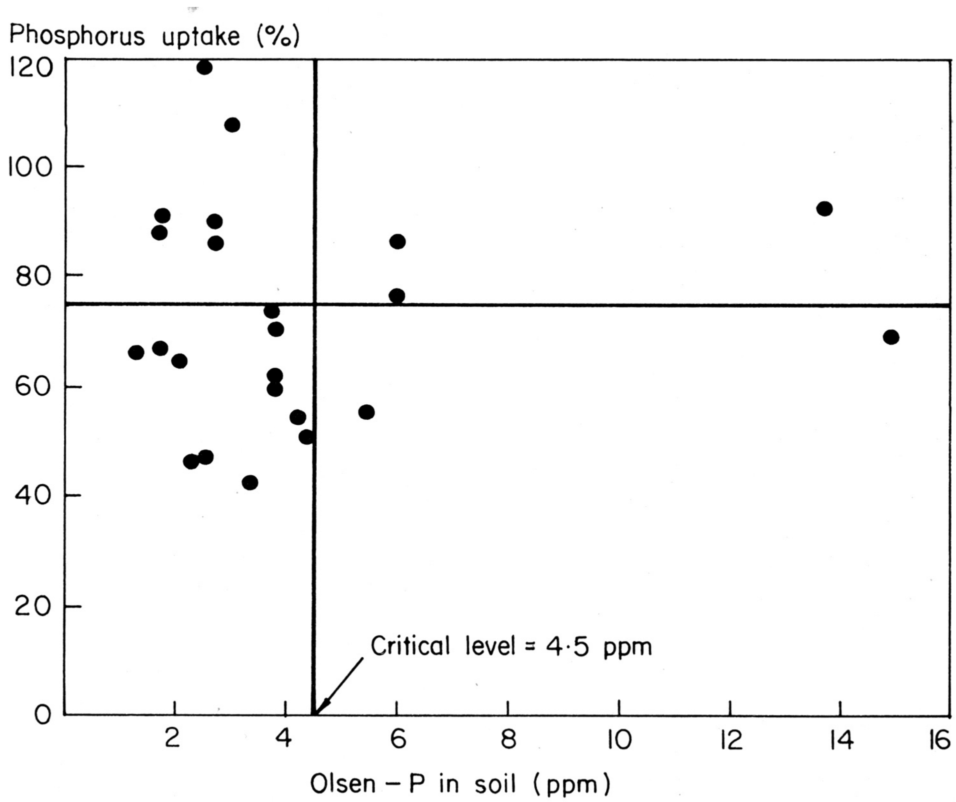
An ideal soil test will satisfactorily predict nutrient availability from the soil and, thus, the potential crop yields. The applicability of different soil test methods for estimating the available phosphorus (P) status of soils varies with soils or crops. This study was to evaluate the suitability of soil-testing methods to predict P availability to rice, and to determine the critical limit of available P for alluvial soils that have essentially alkaline reaction.

Greenhouse pot-culture experiments used 3 kg/pot of surface soil sample (0-15 cm) representing arid brown soil collected from 23 rice-growing sites in Ludhiana district. The pH of the soils tested ranged from 8.8 to 9.4; electrical conductivity, 0.10 to 0.35 mmho/cm; organic carbon, 0.02 to 0.75%; $KMnO_4N$, 11 to 84 ppm; and NH_4OAc extractable K, 23 to 24 ppm. The treatments consisted of a control (no fertilizer P) and 50 ppm P_2O_5 (as superphosphate), replicated three times. Five 20-day-old seedlings of Jaya raised in P-free and sand culture were transplanted in each pot, harvested 60 days later, and analyzed for total P. The soil samples were tested for available P with four extractants — 0.5N $NaHCO_3$, pH 8.5; Bray I and Bray II extractants; and 0.03 N NH_4F+ 0.1% NaEDTA extractant.

The dry-matter yield varied from 7 to 16 g/pot in the no-P treatment and 8 to 21 g/pot in the P-treated pots, indicating that P application increased the dry matter yield from 8 to 114% (yield decreased by 3% in 2 soils). Plant P uptake varied from 11 to 28 mg/pot in the control and 12 to 38 mg/pot in P-treated pots. The increase in P uptake with P treatment from the control varied from -7 to 148%.

Correlation was highly significant (r = 0.49**), between Olsen P of soil and total P uptake by rice, giving the regression equation: $Y = 14.64 + 0.70\ x$ (where Y is total P uptake in mg/pot and x is Olsen P in ppm). Similarly, a significant correlation (r+ 0.44*) was found between Bray I-P in soil and total P uptake by rice. Evidently Olsen's extractant for estimating available P in these soils is more satisfactory for rice.

Rice in soils with Olsen-P below 4.5 ppm (critical level as determined by using the scatter diagram of Cates and Nelson 1965) will respond to P application (see figure). The critical level of 4.5 ppm P was also obtained when the percentage of dry-matter yield or control yield was related to Olsen-P in soils. ■



Relationship between Olsen-P in soil and percentage of phosphorus uptake by rice. Ludhiana, India.

Environment and its influence

Physiological differences in rice desiccation and maturation

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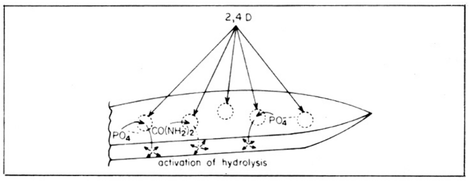
In the USSR, rice is harvested in a period of low temperatures and rains. Therefore, methods to accelerate maturation are being developed and tested. They are desiccation [$MgCl_2$ solution (0.01%) spray on fully ripened rice] and seniccation [mixture of 2,4-D (0.01%) and $Ca(H_2PO_4)_2$ (20%) or $CO(NH_2)_2$ (20%) solutions on milky-wax ripened rice]. Both methods allow the initiation of harvest 7 days earlier, but the mechanisms differ. Desiccation destroys the cells' ability to hold water, drying and killing the plant's vegetative organs, but it does not change the yield or grain quality. When used to seniccate rice, 2, 4-D makes the leaves permeable to inorganic nitrogen or phosphorus, activating the hydrolysis of protoplasmic matters and their movement into the grain (see figure).



Seniccation action on the rice leaf.

Thus seniccation is the artificial accelerator of ripening, which becomes a forced process. Seniccation not only accelerates ripening, but also increases the yield by 0.3 t/ha (arithmetical mean obtained after 5 years of experiments on a total area of 3,500 ha) and improves grain quality. It increases the 1,000-grain mass and seed germination ability. Thus it is more effective than desiccation. We believe that seniccation followed by desiccation is most effective. ■

Rice-based cropping systems

Management and performance of transplanted aus rice in a sample village in Bangladesh

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A monitoring study was conducted on the management and performance of farmers' 1979 aus crop in Salna village, Dacca District. Since the village has irrigation facilities, the major cropping pattern is boro rice-transplanted aman (T. aman) rice. However, some farmers grow local and modern varieties of aus rice in either rainfed or partially irrigated conditions in transplanted aus (T. aus)-T. aman, boro-T. aus, and boro-T. aus-T. aman cropping patterns. Only 12 farmers grew aus rice in the study area and monitoring was through daily record keeping in the fields. Yields were determined by sample crop cutting and expressed in kilograms per hectare at 14% moisture content. The cost and return values were calculated on the basis of actual day-today rates and pri-

Farmers' management practices, yield and returns for the local variety Pukhi and the modem varieties BRI (Chandina), BR3, and BR6 grown as transplanted aus rice in 1979 aus, Salna village, Dacca, Bangladesh.

Item	Aus rice	
	Local	Modern
Samples (%)	33	67
Plowings (av no.)	3	4
Plowings (range)	2–4	3–7
Ladderings (av no.)	2	3
Ladderings (range)	2–3	2–3
Date of transplanting (av)	19 Jun	12 May
Transplanting date (range)	16–19 Jun	25 Apr–13 May
Av seedling age (days)	27	35
Range of seedling age (days)	25–27	26–61
Farmers who used basal N (%)	100	100
Farmers who used topdressed N (%)	50	75
Av rate of N-P_2O_5-K_2O (kg/ha)	50-43-0	63-45-0
Farmers who used organic manure (kg/ha)	0	50
Av rate of organic manure (kg/ha)	0	4173
Farmers who irrigated (%)	0	63
Farmers who did not weed (%)	0	25
Farmers who weeded once (%)	25	0
Farmers who weeded twice (%)	75	75
Farmers who used pest control (%)	0	38
Av field duration (days)	70	88
Range of field duration (days)	65–72	75–105
Av yield (t/ha)	2.34	3.76
Range of yield (t/ha)	2.25–2.47	2.42–4.98
Av cost of production ($/ha)	105.53	142.33
Range of cost of production ($/ha)	90.07–115.87	91.60–165.66
Av net return ($/ha)	458.00	845.27
Range of net return ($/ha)	437.73–482.00	503.73–1163.73

ces prevailing on the farms.

The modern varieties (MV) were transplanted earlier, received more irrigation, (see table) received more fertilizer and organic manure, and, on the average, produced 1.4 t/ha more rough rice than the local variety. Cost of production was $142.33/ha for MV, $105.53/ha for the local variety. On the average, the MV required 18 more days in the field, and gave an increased net return of $387.27/ha over the local variety.

Announcements

International training on seed technology for vegetable crops offered at UPLB

The Second International Course on Seed Technology for Vegetable Crops for the Asian and Pacific region has been organized by the University of the Philippines at Los Baños (UPLB) in cooperation with the International Agricultural Centre at Wageningen, Netherlands.

The course, which will be held at UPLB from 1 September to 19 November 1981, is primarily for those who are involved in vegetable seed development work and hold a B.S. agricultural degree. The course will concentrate on vegetable crops grown in the Asian and Pacific region.

The First International Course on Seed Technology was held in Wageningen April-June 1980.

For a brochure and application forms, write to: Project Directorate, International Training Programme on Seed Technology, P. 0. Box 430, College, Laguna 3720, Philippines. ■

Rice descriptors bulletin available at IRRI

IRRI has recently published a bulletin on rice descriptors and descriptor-stages, prepared by the Rice Advisory Committee of the International Board for Plant Genetic Resources, under joint IBPGR-IRRI sponsorship.

The bulletin provides explanations, illustrations, and decimal codes for 43 morphoagronomic traits, related grain quality characteristics, and reactions to biotic factors. The publication is essential to systematic characterization of rice cultivars and breeding lines. Its contents complement the widely used Standard Evaluation System for Rice (now under revision) and help the standardization and computerized processing of crop data.

The bulletin is being sent to major agricultural universities and rice research stations of the world. Libraries that serve rice workers engaged in genetic conservation, plant breeding, and problem-area research may request a complimentary copy from: Genetic Resources Program, International Rice Research Institute, P.O. Box 933, Manila, Philippines. ■

New publication on rice

Rice Cultivation for the Million; Diagnosis and Prescription for Improving Rice Cultivation, by Dr. Seizo Matsushima, was first published in 1966. The book has now been translated into English; 38 previous editions of the Japanese version have been published. *Rice cultivation for the million* contains new theories and techniques for improving rice cultivation, obtained by the author during 40 years of research.

The new book, published by the Japan Scientific Societies Press, is available in the U. S. and Canada from International Scholarly Book Services (ISBS), 2130 Pacific Avenue, Forest Grove, Oregon 97116, USA. ■

Dr. T. T. Chang, IRRI geneticist.

T. T. Chang receives International Agronomy Award

The American Society of Agronomy (ASA) awarded the 1980 International Service in Agronomy Award to Dr. T. T. Chang, IRRI geneticist and leader of IRRI's Genetic Resources Program, at the Society's annual meeting at Detroit, Michigan, USA.

In honoring Dr. Chang, the ASA recognized his contributions to rice improvement, genetic conservation of rice, and training of young rice scientists on worldwide basis for more than 22 years. In 1978 the ASA elected Dr. Chang as a Society Fellow. In 1969, Mr. H. M. Beachell, Dr. P. R. Jennings, and Dr. Chang shared the John Scott Award of the City of Philadelphia for the development of IR8.

Dr. Chang has served as chairman of the International Board for Plant Genetic Resources (IBPGR)-IRRI Rice Advisory Committee. He is a director of the Society for the Advancement of Breeding and Researches in Asia and Oceania (SABRAO). ■

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