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Style for IRRN Contributors

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

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

Genetic evaluation and utilization

OVERALL PROGRESS

RxT-42 or Himdhan, a new, stable, high yielding rice for hilly areas of Himachal Pradesh, India

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Himachal Pradesh (H.P.) is a hilly state with undulating topography and diverse agroclimate conditions that range from subtropical to temperate. In the kharif season, rice is an important crop. It occupies 100,000 ha and is cultivated at altitudes as high as 2,290 m.

Many rice varieties are needed for H.P.'s diverse agroclimatic conditions. Most recommended varieties – including IR579, the recently recommended high yielding variety with good grain quality – are suitable for areas up to 1,070 m. Norin 18 and Norin 8, japonica types recommended for high-altitude areas between 915 and 1,370 m, are not popular with farmers because of their coarse grain and poor cooking quality. China 988 with medium-coarse grain is the only variety that can be cultivated from the plains up to an altitude of 1,525 m. It is the most widely grown recommended variety, but it is susceptible to blast disease and lodging, and needs to be replaced.

The experimental line RxT-42 consistently performed well and outyielded China 988, Norin 18, and IR579 in the All India Coordinated Rice Improvement Project (AICRIP) and H. P. University trials from 1970–76. Its overall yield, based on 25 AICRIP trials, was 4.1 t/ha, an increase of about 13% over that for China 988 (3.6 tlha) (see table). In yearly trials, RxT-42 outyielded China 988 by 5.4 to 28.4%.

Overall mean yield of RxT-42 and China 988 from 1970 to 1976. Himachal Pradesh, India.

Year	No. of locations	Average yield (t/ha)	
		RxT-42	China 988
1910	1	6.3	4.9
1911	5	5.1	4.2
1912	2	4.2	3.9
1913	10	5.1	4.3
1914	1	4.1	3.1
1915	10	3.6	3.4
1916	33	3.1	3.4
Mean		4.1	3.6

Yield stability parameters for 20 rices tested in the Elite Varieties Trials (EVT) during 1975 and 1976 in 14 environments, at elevations ranging from 308 to 1,371 m, indicated that RxT-42 had average performance (mean yield, 2.4 kg per 2- × 3-m plot) and high stability (regression, 0.87 and deviation from regression, 0.01 6). It yielded significantly higher than China 988.

RxT-42 can easily replace China 988 at elevations of up to 1,370 m in H.P. and other hilly areas of India, and has recently been recommended to the State Variety Release Committee for release under the name Himdhan. The AICRIP Annual Workshop also recommended it for release in H.P. in April 1977.

RxT-42 is a progeny of the cross R-575/TN1. R-575 is a purple-leaved, tall, stiff-strawed, and blast-resistant local recommended variety. RxT-42 matures only 2 to 4 days later than China 988 and has more spikelets per panicle and higher test weight.

Breeding methods used in 10 Asian nations

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

As part of an IRRI study of rice breeding programs in Asia, a survey was made of the breeding methods used in hybridization programs by 31 rice breeders at 24 research centers in 10 Asian countries. The project, initiated in 1975, was partially funded by a research grant from the Rockefeller Foundation.

The breeding methods used by 31 rice breeders at 24 agricultural experiment stations and universities in 10 Asian countries, 1975.

Breeding method	Choice of method: 1st no.	1st %	2nd no.	2nd %	3rd no.	3rd %	4th no.	4th %	Users[a] no.	Users[a] %
Pedigree	21	68	3	10	3	10	2	6	29	94
Backcross	2	6	10	32	5	16	2	6	19	60
Bulk	1	3	9	29	5	16	0	0	15	48
Mutation[b]	0	0	3	10	4	13	5	16	12	39
Combination	6	19	3	10	5	16	4	13	18	58
Others	1	3	1	**3**	5	16	1	3	8	26
No indication	0	0	2	**6**	4	13	17	55	–	–

[a] The number and percentage of 31 breeders who indicated that they used each method as at least one of their breeding systems.

[b] Chemica, radiation, or natural.

Sixty-eight percent of the breeders (21) depended primarily on the pedigree method of breeding (see table); two breeders depended mostly on the backcross method, and one on the bulk method. Six breeders (19%) indicated that they depended primarily on a combination of breeding techniques.

Ninety-four percent of all breeders surveyed used the pedigree system (in combination with other methods); 60% used the backcross method; and 48%, the bulk system.

Although none of the breeders depended primarily on mutation breeding (chemical, radiation, or natural) in their programs, 39% used mutation in combination with other methods.

ARC 11775 — an Assam rice cultivar that is promising for rainfed lowlands

K. I. James, rice breeder; P. A. Varkey, junior rice breeder, and T. K. Mitran, research aide, All India Coordinated Rice Improvement Project, Rice Research Station, Pattambi, Kerala, India

Kerala state grows 395,000 ha of monsoon rice. More than 80% of the area under autumn rice is sown in dry soil in mid-April during the premonsoon showers and later flooded as the southwest monsoon advances. Farmers dry sow the autumn rice so they can harvest it early and immediately transplant the winter rice, which depends on the meager and erratic northeast monsoon rains. The autumn rice crop is subjected to two major stresses: drought during initial growth stages and weeds. A few semidwarf rices withstand some drought but they are more prone to smothering by weeds than are the local tall varieties. Farmers prefer tall, nonlodging rice with a lush canopy of leaves. But the present tall cultivars lodge, even before panicle emergence, and suffer severe yield losses.

Preliminary investigations indicated the adaptability for dry sowing of some elite International Rice Yield Nursery (IRYN) rices of intermediate stature.

Among the rices in the Assam Rice Collection, the accession ARC 11775 has been identified as drought tolerant, tall, nonlodging, and fertilizer responsive, with a high degree of blast resistance. Its seed-to-seed growth duration is 105 to 110 days vs. 130 to 135 days for the most popular tall varieties (See table).

The yield per day of ARC 11775 is double that of the all local variety now grown. Earliness without yield loss is desirable for autumn rice so that popular winter rices can be transplanted earlier in rainfed paddies.

Characteristics of ARC 11775 a promising cultivar for rainfed lowlands, and a tall local variety. Kerala,India.

Variety	Growth duration (days)	Yield (t/ha)	Yield (kg/day)	Kernel color
ARC 11775	106	2.5	26.6	White
Ptb 26 (local tall indica)	135	1.8	13.0	Red

Suakoko 8 — a new rice variety recommended for iron-toxic swamps in Liberia

S. S. Virmani, A. F. Tubman, F. Sumo, and P. M. Worzi, rice breeders and agronomists, International Institute of Tropical Agriculture and Ministry of Agriculture Rice Project at Suakoko, Monrovia, Liberia

Rice varieties with genetic tolerance to iron toxicity are considered useful in many inland valley swamps in Liberia, where symptoms of the disorder develop in most rice crops. Gissi 27, a local variety recommended for deep waterlogged swamps, is tolerant of iron toxicity. But being tall, photoperiod sensitive, and late maturing (165 – 170 days), it cannot be used for double-cropping or for high-technology rice cultivation. lR5 is recommended for inland valley swamps, but it is susceptible to iron toxicity, which reduces its yields by as much as 40%.

More than 3,000 rice varieties have been screened and tested during the past 4 years at the Central Agricultural Experiment Station, Suakoko. Emphasis has been on varietal tolerance for iron toxicity in inland swamps. The most significant result is the selection of the line 2526 (Siam 25/Malunja[3]), which is tolerant of iron toxicity and has been named Suakoko 8 by the Liberian Ministry of Agriculture.

In trials across the country during the past 3 years, Suakoko 8 outyielded IR5 by about 20% in iron-toxic swamps. Under nontoxic conditions, IR5 and Suakoko 8 yield similarly but farmers in various parts of Liberia prefer Suakoko 8 because it has better cooking quality and is more palatable.

Mr. A. J. Carpenter, then rice agronomist, Food and Agriculture Organization, United Nations

Development Program, introduced the 2526 strain from Malaysia in 1973. Because the line was heterogeneous, it was further selected at Suakoko for adaptability and uniformity. The released population of Suakoko 8 is fairly uniform, photoperiod insensitive, and matures in about 140 days. It has good seedling vigor; good tillering ability; semicompact plant type; intermediate culms of intermediate diameter; intermediate senescence; well-exserted, long, and heavy panicles; glabrous, pale green, and intermediate leaves; and erect flag leaves. Its grains are long, slender, and translucent. It suffers less damage than IR5 from the important diseases such as blast, sheath rot, sheath blight, leaf scald, and brown spot, as well as caseworm. Because it is photoperiod insensitive, Suakoko 8 is also superior to Gissi 27. Its plant type is well suited to Liberian peasant farm conditions of imperfect water control, moderate fertilization, and manual harvesting.

During the 1977 wet season, Suakoko 8 seed were distributed for minikit and production kit trials. Seed is expected to reach a large number of farmers for planting in the 1978 wet season.

India's national gene bank in international cooperation

J. K. Roy and A. Ashok Rao, Central Rice Research Institute, Cuttack-6, India

The national rice germ plasm bank of India is maintained at the Central Rice Research Institute, Cuttack. The collection started with about 2,000 varieties obtained from the paddy breeding station, Coimbatore, in 1946–47. It gradually increased as varieties were obtained from different states and abroad by request and exchange. About 10,000 additional varieties were added from systematic surveys from Jeypore tract of Orissa (1955–59); Manipur state (1965–70); northeastern India (Assam Rice Collection, 1968–71); and new collections, mostly from upland and rainfed tracts of nine states (1976–77). The national gene bank at present consists of 14,905 varieties (Table 1).

Supplying traditional cultivars to scientists and institutions inside India and abroad is an important activity of the national center. About 5,000 varieties have been sent to scientists and institutions in 24 countries during the last decade. A few countries and institutions that have received large numbers of accessions, particularly from 1974 to 1977, are shown in Table 2.

Table 1. Present status of national gene bank at Central Rice Research Institute, Cuttack, India.

Source	Varieties (no.)			
	Early maturity	Medium maturity	Late maturity	Total
World collection (AC no.)	1,386	1,254	924	3,564
Jeypore Botanical Survey (JBS no.)	241	1,006	321	1,568
Manipur collection (MNP no.)	40	495	224	759
Assam Rice Collection (ARC no.)	447	4,874	207	5,528
Miscellaneous collection	550	1,155	350	2,055
New collection from states (NCS no., duration not yet classified)	–	–	–	1,431
Total	2,664	8,784	2,026	14,905

Table 2. Countries and institutions that have received major supplies of seed from the national gene bank, Central Rice Research Institute, Cuttack, India.

Country	Varieties supplied (no.)				
	1974	1975	1976	1977	Total
IRRI (Philippines)	22	24	65	2,893	3,004
USSR	22	32	41	253 [a]	348
West Africa	28	34	69	8	139
Vietnam	–	41	9	–	50
USA	–	–	1	33	34
Liberia	–	35	–	–	35
Total	72	166	185	3,187	3,610

[a] Includes material committed to be sent.

Newest rice varieties in 10 Asian nations

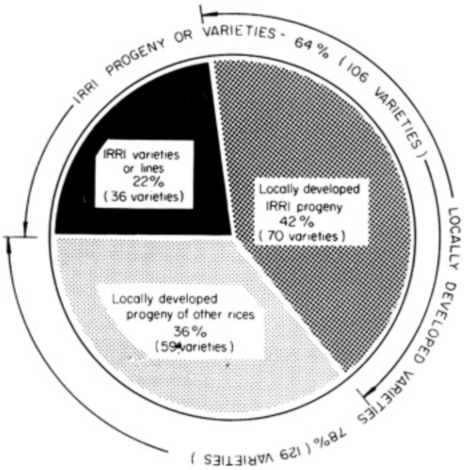
Thomas R. Hargrove, associate editor, International Rice Research Institute

To determine the types of new rice varieties going out to farmers in Asia, IRRI surveyed rice breeders at 29 research centers in 10 countries on the varieties that had been released by their stations during the previous 5 years. The research project, initiated in 1975, was partially funded by a research grant from the Rockefeller Foundation.

Twenty-seven of the experiment stations had released 165 new varieties (two stations had not released any varieties during the time period). For all stations surveyed, the average number of released varieties was 5.7, or a little more than one new variety per year. For only the stations that had released varieties during the 5-year period, the average was 6.1 varieties/station.

Next, each breeder was asked how many of the new varieties had been bred locally (within his country) and how many had come from IRRI. Breeders were also asked to name the parents of locally bred varieties.

Seventy-eight percent of the 165 varieties had been bred in the countries where they were released; 22% were developed at IRRI (see figure).



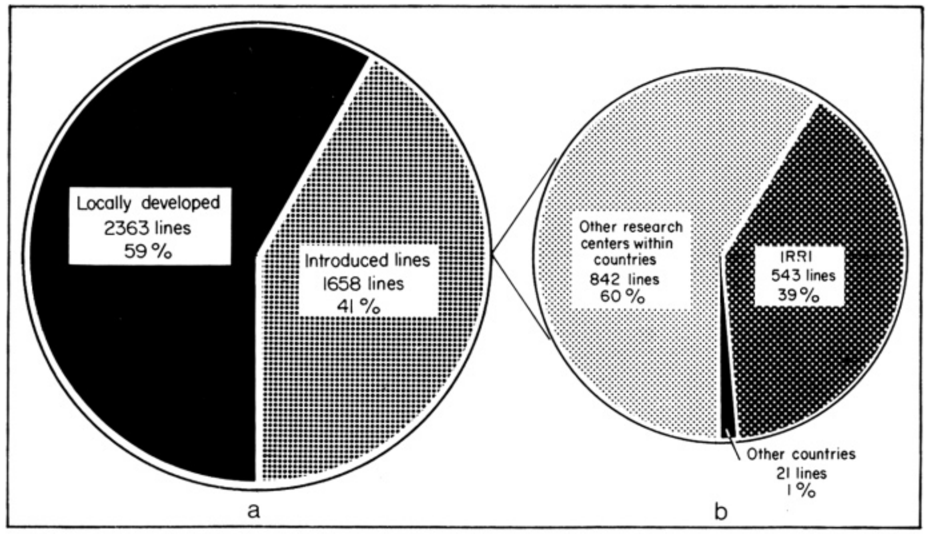
Of 165 new rice varieties released to farmers in Asia over a 5-year period, 64% either were progeny of IRRI rices or were IRRI varieties or experimental lines. Twenty-two percent of the rices were developed at IRRI and 42% were progeny of local crosses involving an IRRI parent. One hundred and sixty-five newest varieties released from 1970 to 1975 at 29 agricultural experiment stations and universities in 10 Asian nations, 1975.

Forty-two percent of the varieties were progeny of crosses involving an IRRI variety or line as a parent. (Of the 129 *locally developed* varieties, 54% were IRRI progeny.) A total of 64% of the sample of 165 newest varieties in 10 countries were either progeny of IRRI rices or had been developed at IRRI.

Advanced breeding lines in 10 Asian nations

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

Because most of the future rice varieties released for farmer use in Asia will come from advanced yield trials, IRRI collected information on the types of plant materials included in the trials. Rice breeders were surveyed at 28 research centers in 10 countries in mid-1975. The research project was partially funded by a research grant from The Rockefeller Foundation.



Data were collected on 4,021 breeding lines of rice in 27 advanced yield trials in Asia. *a.* Fifty-nine percent of the advanced lines originated from crosses made at the local research centers; 41% originated from crosses made outside of the local centers. *b.* Of 1,406 introduced tines in 17 trials, 60% came from other research centers in the same country and 39%, from IRRI. From a survey of advanced experimental lines of rice in 9 Asian nations, 1975.

It was found that 4,163 advanced breeding lines were being tested in 29 yield trials at the 28 stations. The mean number was 144 lines/trial, with a range of from 12 to 630 lines/trial.

For most of the trials, the responsible breeder indicated how many of the advanced lines were developed at that station and how many came from outside sources (other breeding centers in that country, other countries, or IRRI). These data were collected on 4,021 breeding lines in 27 advanced yield trials in 9 countries.

Fifty-nine percent of the genetic material (2363 lines) originated from local crosses made at the breeders' stations; 41% (1658 lines) originated outside of the stations (see figure, *a*).

Next, the origin was determined of the introduced lines (the advanced lines that did *not* come from local crosses). Data were obtained for 1,406 of the introduced breeding lines in 17 advanced yield trials in 8 countries.

Sixty percent of the introduced genetic material (842 lines) came from crosses made at other research centers within the same country as the surveyed experiment station; 39% (543 lines) came from IRRI; and about 1% (21 lines) came from breeding programs in other Asian nations (see figure, *b).*

To further measure the diversity of the genetic background of improved local lines, breeders at 20 research centers in 8 countries were asked to indicate the number of crosses from which they selected 3,791 locally developed lines in 22 advanced trials. The lines had been selected from 443 crosses – an average of 8.6 advanced lines/cross.

Effect of seedling on the growth and yield of rice varieties

S. S. Singh, staff and R. K. Tarat, M. Sc. graduate student, Department of Agronomy, Allahabad Agricultural Institute, Allahabad-211007, U. P., India

Rice varieties Bala, Saket 1, and Ratna were transplanted at 24, 29, 34, 44, and 49 days to study the growth behavior and extent of yield reduction when transplanting is delayed. The experiment was conducted at Allahabad Agricultural Institute during the 1976 kharif season using a split-plot design with four replications. Varieties were in main plots and seedlings of different ages were in subplots.

When older seedlings of the short-duration variety Bala were transplanted, tiller number and yield were consistently reduced. Saket 1 and Ratna (medium- and long-duration rices) gave higher values when planted at 29 days of age than when planted at any other age (see table). The short-duration variety may be transplanted until the age of 34 days, Yield components of three rice varieties transplanted at different seedling ages. Allahabad Agricultural Institute, India.

Seedling age (days)	Effective tillers (no./hill)[a]			Grains (panicle/no.)			1,000-grain wt (g)			Yield (t/ha)		
	Bala	Saket 1	Ratna	Bala	Saket 1	Ratna	Bala	Saket 1	Ratna	Bala	Saket 1	Ratna
24	12.5	9.7	13.7	122	140	119	18.5	19.8	19.4	2.6	3.2	3.1
29	10.2	11.1	13.8	116	152	124	18.5	19.7	19.5	2.6	3.6	3.8
34	9.9	10.4	13.1	111	135	118	17.9	19.6	19.1	2.4	3.0	2.9
39	8.6	9.7	12.3	100	132	114	17.7	19.3	19.1	1.3	2.9	2.8
44	7.3	9.5	10.4	93	132	107	17.3	19.2	18.8	1.0	2.1	2.0
49	5.2	7.4	8.7	89	123	105	17.3	18.2	18.3	1.0	1.6	1.0

[a]Two seedlings planted per hill at 20 × 20 cm.

while the medium- and long-duration varieties may be transplanted until 39 days for profitable rice production.

The experiment is being repeated in 1977 to better quantify the growth and yield performance of short-, medium-, and long-duration rice varieties under Indian conditions.

GENETIC EVALUATION & UTILIZATION

Grain quality

The mechanism of gibberellic-acid action on rice

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Treating rice with gibberellic acid (GA) produces long and thin stems and causes lodging. Silica content in the cell walls of stems of treated plants is equal to that of control plants. GA inhibits tillering and activates ramification. Spikelet sterility becomes high and panicle weight becomes low.

GA reduces the content of riboflavin and free thiamine in leaves, but increases the content of total thiamine and cocarboxylase. It competitively inhibits flavin oxydases and increases indoleacetic acid (IAA) content. In the apexes of plants treated with GA, the ratio of RNA to DNA increases but the total protein content does not. The number of electrophoretical fractions of acid albumins decreases.

GA increases the variability of free amino acids set, but reduces their total content in primordial panicles of rice. The content of free proline is reduced rather sharply, while that of histones is increased. The stream of information from nucleus to cytoplasm grows narrow with GA. GA is likely to affect the information transfer system.

Hence, this is the mechanism of GA action: proline (initiator of flowering) content is reduced, but the content of both histones (repressors of the generative group of genes) and growth stimulators (IAA) is increased.

GENETIC EVALUATION & UTILIZATION

Disease resistance

New sources of resistance to bacterial leaf streek of rice

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Bacterial leaf streak of rice, caused by *Xanthomonas translucens,* f. sp. *oryzicola,* is becoming a more important disease with intensive cultivation of newly introduced high yielding varieties. Both the early- and late-duration rices have been observed to become susceptible under conditions of high humidity, cloudiness, and drizzles. Thus the disease can become severe in high-rainfall areas of eastern and northeastern India. At the Central Rice Research Institute (CRRI), a severe incidence of the disease appeared on the variety Pankaj during kharif 1972. Several fixed cultivars of upland rice grown during kharif 1977 were also severely affected.

Out of 50 artificially inoculated cultivars from the Assam Rice Collections, ARC 13899 and ARC 13962 were found resistant. Among the popular varieties tested, NC 1281 was highly resistant. It is being extensively used at CRRI to develop high yielding varieties that are sensitive to photoperiod. It has good tolerance to gall midge and is considered to have high photosynthetic ability under low light intensity. Several F_4 progeny from the cross NC 1281/ Pankaj were artificially inoculated during kharif 1977. The progeny clearly segregated for susceptibility or resistance to bacterial leaf streak. That shows that the inheritance may be simple and it may not be difficult to fix resistant lines.

Reactions of certain rice cultivars to sheath rot disease

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A field trial in the 1977 kar season (July–October) observed the reactions of 130 rice cultivars to sheath rot caused by *Acrocylindrium oryzae* by natural infection at earhead maturity stage. Six of the rices were completely disease free (see table) and 18 were relatively resistant, with disease incidence ranging from 2.4 to 20.0%. AS 5127 showed the maximum disease incidence (89%). The incidence in the rest of the cultivars ranged from 0 to 20%.

Reaction of rice varieties to sheath rot disease. Tamil Nadu state, India.

Rice cultivar	Disease incidence (%)
AS 5821	0
AS 6975	0
AS 2992	0
Cult. 1287	0
Cult. 3226	0
Cult. 6403	0
Cult. 2692	2
AS 2572	3
Cult. 643	4
AD 5983	5
AS 2522	7
AS 5277	8
CRM 95-15-12-4	8
AS 5250	9
CR95-721-3	10
AS 6479	12
CR15-7-392-11-4	13
Cult. 1145	14
AS 2444	14
AS 2887	15
AD 6148	15
AD 608	19
AS 4417	19
CR 94-214	20
AS 5127	89

GENETIC EVALUATION & UTILIZATION

Insect resistance

Evaluation of the 1977 International Rice Stem Borer Nursery at IRRI

E. A. Heinrichs, entomologist, and L. Malabuyoc, and C. Vega, research assistants, International Rice Research Institute

The International Rice Stem Borer Nursery (IRSBN) of the International Rice Testing Program was first conducted in 1976. The 1977 IRSBN consists of 83 entries submitted by rice scientists from 4 countries. Seed sets have been sent to 10 countries.

At IRRI, the 1977 IRSBN was evaluated against the striped borer *Chilo* suppressalis and the yellow stem borer *Tryporyza incertulas.* For the striped borer test, two replicates of two rows, each consisting of 20 hills, were planted. The IRSBN was infested by allowing adults reared from larvae and from eggs that had been placed on an early planted, susceptible variety to oviposit on the test entries. Deadhearts were counted at 60 days after transplanting (DT). In the yellow borer test, three replicates of 2 rows, each consisting of 20 plants, were transplanted. At 30 DT 5 newly hatched larvae were placed on each plant with a camel's hair brush. At 75 DT deadhearts were counted.

No entry had a high level of resistance. Several entries had intermediate resistance to one of the stem borer species but only a few had intermediate resistance to both (see table). Entries showing the most resistance had about 50% fewer deadhearts than the susceptible check. The lines IET 2845, IET 5540, and IRI 820-52-2 also had intermediate levels of resistance against the stem borer population, which was predominantly *Chilo polychrysus* in the 1976 IRSBN planted in Thailand.

No entry in the yellow borer test was significantly more resistant than the resistant check IR1820-52-2. A few lines in the striped borer test were only slightly better than the resistant check W1263. Thus, no sources with high levels of resistance to the two stem borers are

Entries in the 1977 IRSBN that had intermediate levels of resistance against both *Tryporyzu incertulas* and *Chilo suppressalis.* IRRI screenhouse, 1977.

IRTP entry no.	Designation	Cross	Deadhearts (%) *T. incertulas* 75DT[a]	Deadhearts (%) *C. suppressalis* 60 DT
10	IET 2845	TKM6/IR8	23	32
26	IET 5540	IR22/NP30	20	36
33	IR1514 A-E666	IR20/TKM6	19	29
36	IR2328-491-1-1-1	IR8///IR8/Dawn//IR8/ KAK/4/K8 Mut.	20	35
38	IR2798-143-3-2	IR1529-680/IR1913-41/ IR1514 A-E666	21	36
47	IR4791-89	IR3342/IR3341	21	30
55	IR5201-122-2	IR1820-52-2/IR2061464-2	18	35
65	CR157-392-4	Vijaya/Ptb 10	20	37
72	IR3941-97-1	CR126-42-5/IR2061-213	17	31
75	IR36	IR1561//IR24/*Oryza nivara*/// CR94-13	19	35
	Resistant checks			
	IR1820-52-2	IR1539-60/IR1416-128-5-19	19	
	W 1263			45
	Susceptible check			
	Rexoro		52	72

[a]Days after transplanting.

currently available for use in breeding programs.

Two approaches are being used to increase the level of resistance:

1. diallel crosses of lines with intermediate levels of resistance; and

2. continued evaluation of the world collection to identify donor varieties with high levels of resistance.

We would appreciate hearing from scientists who may have recently identified additional sources of resistance to various stem borer species.

Greenhouse and field evaluation of the 1977 International Rice Brown Planthopper Nursery at IRRI

E. A. Heinrichs, entomologist,
F. Medrano, assistant scientist, and
V. Viajante, research assistant,
Department of Entomology, International Rice Research Institute

The objectives of the International Rice Brown Planthopper Nursery (IRBPHN) are to determine the presence and distribution of BPH biotypes in Asia and to encourage the use of BPH-resistant germ plasm in rice improvement programs. The 1977 IRBPHN consists of 128 entries submitted by scientists in 7 countries and IRRI. Seed sets have been sent to 11 countries for testing.

We evaluated the 1977 IRBPHN against BPH biotypes 1,2, and 3 in the IRRI greenhouse, using the standard seedbox technique, and in the field. To induce high and evenly distributed BPH field populations, we alternated 4-m-long rows of the test entries and of the tungro-resistant but BPH-susceptible line IR1917-3-17. Seven rows of IR1917-3-17 were also planted as borders at each end of the alternating rows. The susceptible border rows were sprayed at 14-day intervals, beginning at 20 days after transplanting (DT), with 0.04% methyl parathion for the first two sprays and 0.025% Cypermethrin (WL43467), a synthetic pyrethroid, to induce a resurgence of the BPH. (If insecticide is not used to induce BPH populations, the population will generally be too low and poorly distributed for reliable readings of damage.) The border became hopperburned at 70 DT; shortly thereafter the alternate rows of IR1917-3-17 and the susceptible entries were damaged. Field damage was rated when plants in the adjacent susceptible row died and again at 95 DT (because BPH migrated from the dead susceptible plants to the surviving resistant plants).

In the greenhouse test, breeding lines from Indonesia, Thailand, Taiwan, Korea, and Japan lacked resistance to biotype 2 (see table), which is the prevalent biotype in parts of Indonesia and the Philippines today. Only Indian and Sri Lankan entries had resistance to biotype 2. The photosensitive varieties from India and Sri Lanka such as Babawee, Rathu Heenati, and Ptb 33 (plus several not included in the table) and the lines CRl57-380-292, CR 157-392-4, and IET 5122 were resistant to all three biotypes.

Field screening results indicated that biotype 2 was predominant. Field reactions were generally comparable with those in the greenhouse, but field

Resistance of selected 1977 International Rice Brown Planthopper Nursery varieties in greenhouse and field studies. IRRI, 1977.

IRTP entry no.	Designation	Origin	Damage rating[a] Greenhouse Biotype 1	2	3	Field 1st observation[b]	95 DT[c]	BPH[d] (no./hill) (field)
8	B2360-11-3-2-3	Indonesia	1	9	1	3	5	4852
11	Bogor 1	Indonesia	1	9	1	6	9	5707
14	Bogor 8	Indonesia	1	9	1	2	7	2731
34	BKNBR 1094-78-2	Thailand	1	8	3	5	7	3061
38	BR1030-11-2	Thailand	1	9	2	6	9	2356
47	Chianan shen yu 11	Taiwan	1	8	2	9	9	2415
49	CR94-13	India	1	3	8	1	5	3688
51	CR157-380-292	India	1	2	4	2	7	2825
52	CR157-392-284	India	2	4	8	2	3	2294
53	CR157-3924	India	1	3	4	2	5	2285
54	CR118-22-527	India	5	6	8	2	5	3271
56	CR179-1-717	India	1	2	8	2	3	2474
57	CR190-62-13	India	1	5	7	3	5	1060
63	IET 5118	India	3	7	5	2	5	2535
64	IET 5119	India	1	7	4	3	7	3110
65	IET 5120	India	3	4	5	2	3	853
66	IET 5122	India	1	2	2	1	3	655
69	IR8 M16	India	1	6	6	6	6	1299
71	IR26	IRRI	3	9	2	6	9	2314
74	Iri 329	Korea	1	8	2	9	9	1468
77	RD9	Thailand	1	9	4	5	9	1287
79	Taichung shen yu 221	Taiwan	1	8	2	7	9	1113
87	WX 324-8-3	Korea	1	9	2	9	9	1523
91	ARC 6650	India	3	2	9	3	3	606
93	ARC 14529	India	4	3	5	1	1	603
95	Babawee (bph 4 gene)	Sri Lanka	1	1	2	1	1	1449
119	Rathu Heenati (Bph 3 gene)	India	1	1	1	1	1	236
127	7512-146	Japan	1	8	6	8	9	1513
	Susceptible check							
	TN1	Taiwan	9	9	9	9	9	1528
	Resistant check							
	Mudgo (Bph 1 gene)	India	1	9	1	2	7	1102
	ASD 7 (bph 2 gene)	India	1	3	9	2	6	653
	Ptb 33	India	1	2	1	1	2	434

[a]Based on the Standard Evaluation System rating: 0 = no damage; 9 = all plants dead. Greenhouse reading based on an average of 3 replicates and field ratings on 2 replicates.
[b]First field observation ratings taken when the adjacent susceptible variety died.
[c]Days after transplanting.
[d]BPH count taken on hills at 80 DT with a D-Vac suction machine. Av. of 3 hills.

screening detected differences in resistance levels more precisely. For example, in this and in previous field studies, Bogor 8 has always been more resistant than Bogor 1 and the other 10 Bogor lines (not included in the table). Also, Mudgo, whose greenhouse reactions to biotype 2 are generally similar to those of IR26 (susceptible, as both have BPH 1 gene), exhibits more resistance in the field.

Insect pressure was extremely high at 95 DT in the field screening and only the highly resistant lines such as CR157-392-284, CR179-1-717, IET 5120, IET 5122, ARC 6650, ARC 14529, and the photosensitive varieties Babawee, Rathu Heenati, and Ptb 33 were resistant.

More varieties and breeding lines with resistance to biotype 2 and with multigenic resistance to several biotypes need to be included in the 1978 IRBPHN.

GENETIC EVALUATION & UTILIZATION

Deep water

Stem borer incidence in deep-water rice

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Studies on deep-water rice in Bangladesh in 1977 revealed a surprisingly high incidence of stem borers in the vegetative phase of the crop (Apr. to mid-Sept.). The investigations involved regular pest surveys of farmers' fields in deep-water rice areas and an intensive study of the population dynamics of stem borers in two fields in Keraniganj and Manikganj, Dacca district. Stem borer incidence was assessed mainly by dissecting individual stems (usually 100 to 200 stems), and also by counting egg masses and moths.

Stem borer larvae were found in each of 24 dissections from fields in Comilla, Dacca, Faridpur, Noakhali, Pabna, and Tangail districts. In 71% of the dissections, more than 10% of the stems were infested; in 33%, more than 20% were infested.

At the population dynamics site at Keraniganj, from late June to mid-September, the incidence of infested stems varied from 20 to 38%; at Manikganj it varied from 36 to 47%. In a new deep-water tank at Joydebpur planted to the variety Habiganj Aman II, 52% of the stems had been attacked by early September.

In a quick survey of some deep-water rice areas in Thailand, Burma, and India, stem borers were the most important pest; more than 10% of the stems were infested in several fields.

The yellow stem borer *Tryporyza incertulas* was constantly the dominant species and appears well-adapted to deep-water rice. Larvae feed in the hollow section of the stem. Because this section is usually submerged, the activity is not reflected by deadheart incidence; some dissections showed more than 30% infested stems without a single deadheart. For that reason, and because rising floodwater can submerge deadhearts in a few days, early and midseason stem borer damage in deep-water rice has probably been overlooked and thus underestimated in the past.

We do not yet know the effect of high levels of early stem damage, but yields are probably lowered. With the manifold problems of using insecticides on deep-water rice, the yellow stem borer presents a considerable challenge to breeders and entomologists.

GENETIC EVALUATION & UIILIZATION

Adverse soils

Aluminum toxicity and phosphorus deficiency in acid sulfate soils of Thailand

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Broadcast rice with symptoms that resembled those described for aluminum toxicity were observed in the eastern Bangkok Plain (between Pathum Thani and Nakhon Nayok) in June 1977. Older leaves had an orange-yellow discoloration along the margins and sometimes between the veins. Most plants also suffered from moderate to severe phosphorus deficiency.

This deep-water rice area (about 0.25 million ha) has moderately acid sulfate soils (pH 4.0–4.7). The symptoms were most noticeable with increasing acidity (4.0–4.3) and plants were almost dead in a field where road construction had removed the surface soil and exposed the highly acid subsoil.

Rice in the area is broadcast after the first rains in April or May, but flooding

Chemical analysis of plant samples. Eastern Bangkok Plain, Thailand.

	Elements			
	Fe (ppm)	Al (ppm)	K (%)	P (%)
Affected plants	309	911	0.93	0.031
Healthy plants	175	171	2.21	0.069
Normal levels	< 300	< 300	> 1.0	> 0.1

does not begin until June or July. Because the crop grows in dry soil for 2 to 4 months, it does not benefit from the increase in pH on flooding, which lowers the harmful levels of aluminum.

Plants of the traditional variety Nang Kiew with orange-yellow discolorations were sampled on 23 June near Bang-or. The crop had been broadcast on 10 May on soil classified as Sulfic Tropaquept. The affected plants had higher aluminum and lower phosphorus contents than healthy plants from the same field.

Aluminum toxicity in wetland rice has received relatively little attention because the high amount of dissolved aluminum normally disappears soon after flooding, even on very acid soils. Aluminum toxicity may be a major factor limiting production in deep-water rice an acid sulfate soils as long as good irrigation facilities are lacking and no fertilizer is applied. Introduction of varieties adapted to high aluminum and low phosphorus should help increase rice production in the area.

GENETIC EVALUATION & UTILIZATION

International rice testing program

Three IRTP monitoring tours in 1977

In 1977, the International Rice Testing Program (IRTP) sponsored three monitoring tours to enable rice scientists from various countries to observe the performance of materials from different sources in the international nurseries and to become better acquainted with other rice research in the regions.

The first tour focused on rice in the arid regions. All participants visited Sudan, Egypt, and Pakistan, and several visited Punjab state, India. The group observed the vast potential for rice production in the region and similar breeding objectives in various countries in the region. They noted that many current IRTP entries from the humid tropics were not suited to the region and that active local breeding programs were developing promising materials. The group therefore recommended the establishment of an International Rice Arid Regions Observational Nursery (IRARON) where national programs in the region could enter their best rices along with selected entries from IRRI and other IRTP nurseries. Entries should have the following traits: high yielding ability; long, slender grain (scented and nonscented); early maturity (110 – 130 days); tolerance to salinity, alkalinity, and zinc deficiency; early growth vigor; resistance to stem borer, blast, and brown spot; and tolerance to high temperature. Dr. M. S. Balal of Egypt will pack and dispatch the nurseries to interested arid-region scientists in March 1978. The IRTP will make field books and analyze and publish the results. Those interested in conducting the nursery should contact the Joint Coordinator of IRTP at IRRI.

Scientists on the IRTP monitoring tour to East India and Nepal inspecting an International Upland Rice Observational Nursery at the Rice Research Station, Ranchi, Bihar, India.

The second IRTP monitoring tour focused on rice improvement in Nepal and northern India. In Nepal's Kathmandu Valley, varieties need some cold tolerance and blast resistance. The Tarai area of Nepal is similar to Bihar state, India, where bacterial blight is a major constraint. Drought was the major problem in southern Bihar and in the Faizabad area of eastern Uttar Pradesh, India. Gall midge was a major constraint around Cuttack and Bhubaneswar, India. The group recommended earlier dispatch of the IRTP nurseries to enable timely planting at all locations. They also recommended entries for the 1978 nurseries and discussed some improvements in the methodology and conduct of future IRTP nurseries.

The third tour was after an IRTP planning conference for Latin America, held at the International Center for Tropical Agriculture (CIAT) in Colombia. It focused on upland rice in Central America and Mexico. The group noted the favorable rainfall patterns and soil types in the region. Yields of many varieties often reached 5 to 6 t/ha. Blast, sheath blight, and leaf scald damaged some varieties considerably at certain locations. The group recommended that efforts to develop varieties with stable blast resistance for the region be intensified and that regional rice improvement programs expand the genetic diversity of their breeding materials. The need for more training of rice scientists and for additional support to national rice research programs was evident to the group.

Below is a list of participants in IRTP monitoring tours during 1977.

1. *Arid regions tour* (Sudan, Egypt, and Pakistan)
   - G. Ghobrial, Sudan
   - M. S. Bald, Egypt
   - M. Moafizad, Iran
   - A. M. Farkhonde, Iran
   - G. McLean, Ford Foundation, Egypt
   - M. Rosero, CIAT/IRRI, Colombia
   - W. R. Coffman, IRRI
   - H. E. Kauffman, IRRI

2. *Nepal and northern India tour*
   - A. N. M. R. Karim, Bangladesh
   - M. Nasiruddin, Bangladesh
   - H. K. Pande, India
   - D. N. Borthakur, India
   - G. Verma, India
   - S. Saran, India
   - B. B. Shahi, Nepal
   - K. P. Shreshta, Nepal
   - D. V. Seshu, IRRI
   - J. C. O'Toole, IRRI

3. *Central America and Mexico tour*
   - J. I. Murillo, Costa Rica
   - W. R. Pazos, Guatemala
   - L. H. Aragon, Mexico
   - E. Espinosa, Panama
   - M. Rosero, CIAT/IRRI, Colombia
   - S. K. De Datta, IRRI
   - D. V. Seshu, IRRl
   - H. E. Kauffman, IRRI

Pest management and control

DISEASES

Potash nutrition and sheath blight disease

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

The effect of potash application on the development of sheath blight, caused by *Rhizoctonia solani,* was investigated in a pot-culture experiment during the 1976 wet season (June–September) with ADT 31 used as the susceptible rice variety. Muriate of potash as basal dressing was applied at 0,49,99, 148, 198, and 247 kg K_2O/ha (converted from kg/acre). Nitrogen at 123 kg/ha was applied as urea and phosphorus at 62 kg P_2O_5/ha as superphosphate to all treatments. Disease intensity and yield were recorded.

Potassium application reduced the disease incidence significantly. As the potash levels increased, the disease incidence decreased, with a corresponding increase in yield (see table). Investigation reveals that potash nutrition gives rice resistance to sheath blight.

Effect of potash on the incidence of sheath blight disease. Tamil Nadu, India.

Potash level (kg K_2O/ha)	Mean disease index	Decrease in disease over control (%)	Mean grain yield (g/pot)	Increase in yield over control (%)
0	81	–	11	–
49	76	6	11	6
99	65	20	12	15
148	61	24	14	26
198	55	33	15	42
247	49	39	16	50
C.D. (P = 0.01)				

Bioassay of rice ragged stunt virus

T. Senboku and E. Shibata, University of Hokkaido, Sapporo, Japan; and E. R. Tiongco and K. C. Ling, International Rice Research Institute

The infectivity of rice ragged stunt virus was determined by the injection method at the University of Hokkaido, Japan. Fresh leaves of diseased plants of IR3839-1, infected in the Philippines, were macerated in a buffer solution and centrifuged. The supernate was injected by a fine glass capillary into the body of brown planthoppers *Nilaparvata lugens.* The insects had been reared for years in Sapporo, where natural occurrence of ragged stunt had not been observed.

Of 40 insects that received the supernate injection, 21 survived for 2 weeks afterward. They were used to inoculate seedlings of the rice variety Mihonishiki, at 3 insects/seedling for an inoculation feeding period of 3 days. The same insects were then transferred to inoculate another set of seedlings for 3 days. All 14 inoculated seedlings developed symptoms of the disease.

In addition to supporting the viral nature of ragged stunt, the experiment showed that the injection method can be used in bioassay of the virus.

Ragged stunt disease in Thailand

Praphas Weerapat, rice breeder, and Sompong Pongprasert, rice entomologist, Rice Division, Department of Agriculture, Ministry of Agriculture and Cooperatives, Bangkhen, Bangkok-9, Thailand

Ragged stunt disease, transmitted by *Nilaparvata lugens,* was first noted in Thailand by Dr. E. A. Heinrichs, IRRI entomologist, during an October 1977 visit to the Bangkhen and Rangsit Rice Experiment Stations. It caused serious yield losses in the variety RD7 around Bangkok at the end of the 1977 wet season. About 3,200 ha of RD7 in Chachengsao province, central plains region, were severely infected; in many fields, 90% of the plants failed to produce normal panicles. Average yields were about 0.4 t/ha; however, the resistant variety RD9 and some traditional tall varieties grown in the area yielded normally. Farmers reported a heavy infestation of brown planthopper at the beginning of the season, but there were no severe losses from hopperburn.

Much of the affected area was planted by broadcasting pregerminated seed, so plant spacing was close. Surprisingly, transplanted crops of traditional tall, susceptible varieties in adjacent fields were normal.

Symptoms on the diseased plants were similar to those described in the October 1977 issue of the *IRRI Reporter* except that leaves were not extremely distorted. Stunting was so extensive and severe in some fields that farmers plowed their crops under before flowering so they could plant a dry-season crop.

Pest management and control

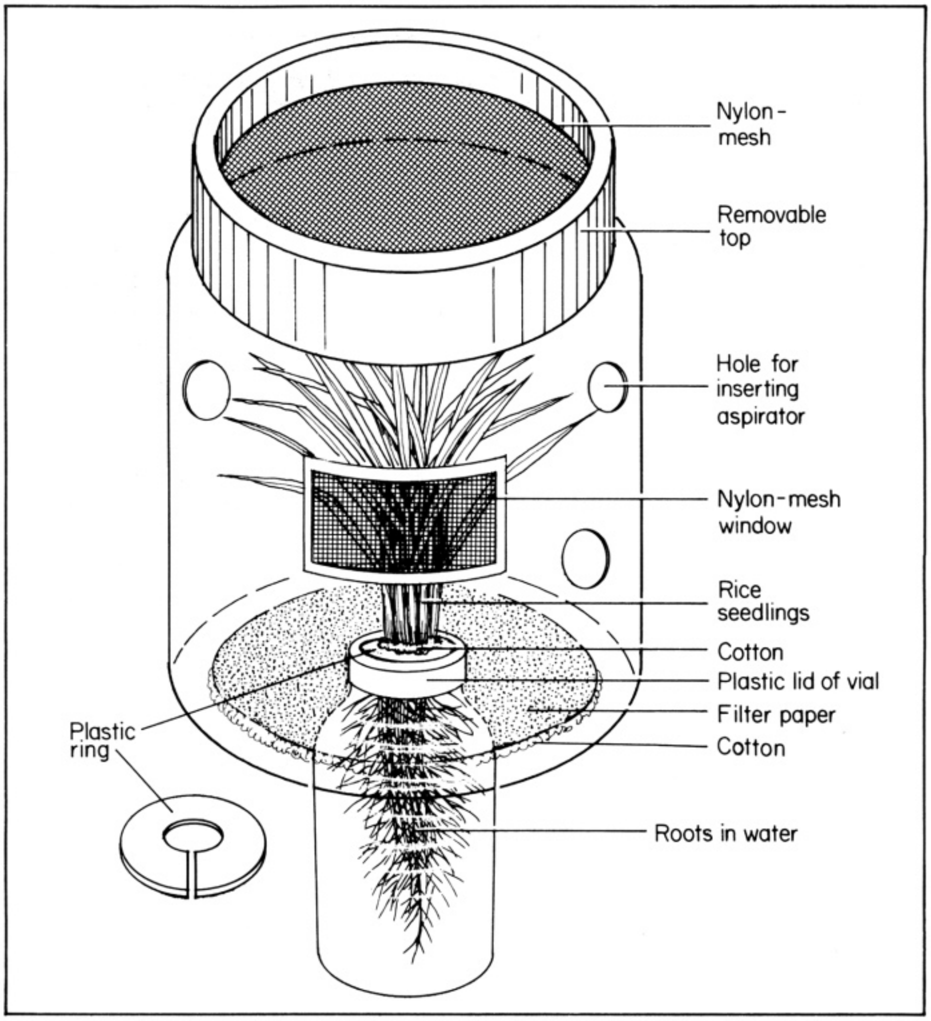
INSECTS

A new cage for rearing hopper parasites

Girish Chandra, Entomology Department, International Rice Research Institute

A new cage to rear parasites of rice leafhoppers and planthoppers has been developed. The main disadvantages of the traditional system of rearing hoppers in glass tubes or plastic mylar cages are eliminated in the new cage. Such disadvantages include excessive moisture, difficulty in changing food plants, contamination by soil-inhabiting nematodes, mortality and loss of parasite larvae and pupae (especially those that pupate in the soil), and difficulty in rearing large numbers of hoppers.

The new cage, which is easy to build, is made of a 17' × 12-cm cylindrical transparent plastic container with a removable top (see figure). For aeration, a piece of nylon mesh cloth is fixed to the lid and another to the side window. A vial lid with a plastic screwcap and a large hole in the top is firmly cemented in a hole at the bottom of the container. Thus, the glass vial can be unscrewed and detached while its lid remains attached to the cage. Rice seedling roots are inserted in the water-filled vial and a plastic ring with a small hole, which fits in the vial lid, is fixed around the seedling stems. The space left around the stems is then plugged with cotton. Rice seedlings are easily inserted in the cage through the large hole in the vial lid. A layer of wet cotton spread on the bottom of the cage and covered with filter paper will hold sufficient moisture to maintain the hoppers. Field-collected hoppers are released in the cage through the small holes in the cage walls with an aspirator.



New cage for rearing hopper parasites.

The holes are then plugged with cotton balls. About 100 hoppers can be reared in the cage. Rice seedlings can be changed when necessary and moisture can be maintained by dropping water on the filter paper. The emerged larvae of parasites usually pupate at the bottom of the cage or on the leaves and can easily be seen through the transparent plastic.

The cage has been very useful for breeding hopper parasites, for observing their behavior and life cycles, and for determining the efficiency of parasites and predators in hopper control.

Natural parasitism of *Telenomus* on eggs of the stink bug *Oebalus insularis* in Mexico

Agricultural Experiment Station, Instituto Nacional de Investigaciones Agricolas (INIA), Campeche, Mexico

In Campeche, where rice is rainfed, one of the most important pests is the stink bug *Oebalus insularis.* The bug's eggs are parasitized by the Scelionid *Telenomus* sp. On a total of 63,527 eggs collected during the rice-growing seasons of 1975, 1976, and 1977, parasitism averaged 65.5%.

***Paradosa annandalei,* a predatory spider of the brown planthopper**

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The brown planthopper (BPH) *Nilaparvata lugens* has become a major pest in the intensive rice-growing areas of India in recent years. In the rabi (dry-season) crop of 1977, three species of predatory spiders were highly active in keeping the BPH under check at the Rice Research Unit, Bapatla.

Interestingly, the predators preyed in different vertical zones of the rice crop, thereby facilitating coordinated pest control. *Paradosa annandalei* was observed preying on BPH for the first time. It was active at the base of the rice clump, where BPH population was high. The two other spiders, *Agriope pulchelle* and *Tetragnatha sutherlandi,* were in webs at the top of the plant where they preyed on all insects, including BPH, that were caught in the webs.

To study their feeding potential, individual adult spiders of each of the three species were kept in 15- × 2.5-cm test tubes. Nine replicates were maintained for each species. Thirty BPH adults were released daily into each tube to determine the daily feeding capacity of each species. Hoppers remaining in each tube were counted after 24 hours.

Paradosa annandalei consumed an average of 18 adult hoppers/day; *A. pulchelle,* 16/day; and *T. sutherlandi,* 14/day. IRRI reported in 1974 that over a 3-day period a single predatory spider of *Lycosa pseudoannulata* killed about 25 BPH nymphs/day, or about 15 adults/day in a cage with 100 BPH.

Brown planthoppers in West Bengal, India

D. K. Nath and S. C. Sen, Rice Research Station, Chinsurah, West Bengal, India

Although the brown planthopper (BPH) was observed in rice in West Bengal as early as 1968, it was first noted in serious proportions in a small area of Hoogly district in 1973. In 1975 2,000 ha in three districts were infested. In 1976, the total affected area in another district was 100 ha. In 1977, more than 4,000 ha in 6 districts were affected. Surveillance records showed that BPH was present in many other areas but that its population reached an economic injury level only under certain agroecological conditions, particularly in areas where the land was flooded, densely cropped, sprayed with contact insecticide in the early vegetative phase, etc. At the grain-filling stage summer (boro) rice was more prone to pest damage than winter (kharif) rice. Macropterous forms were prevalent in seedbeds where large numbers of mirid predators and many spider species were also found. Records over 5 years indicate that BPH infestations assumed alarming dimensions during alternate years, and that it was steadily spreading to new localities.

The rice leaf roller in the Solomon Islands

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The leaf roller *Susumia exigua* has always been a pest of rice in the Solomon Islands. When dryland rice was grown, the pest was considered less important than the armyworm. When irrigated rice began to be grown, the brown planthopper overshadowed the leaf roller, but when IRRI rice varieties began to be grown exclusively, the leaf roller's importance increased. In 1975, more than 50% of the leaves in some fields were rolled.

In 1977, the leaf roller became the most serious rice pest in the Solomon Islands. Every field was attacked; often 100% of the leaves were rolled. The first attack came within 20 days of rice germination. The first generation with a 30-day life cycle was followed by a second that also attacked plants in all fields, especially their flag leaves. The effects of the first generation are not known, but heavy flag leaf attacks lowered yields by 10%.

Leaf roller is easily controlled by insecticide spraying. Many insecticides are suitable, but Orthene is favored. Gamma BHC and parathion are also highly effective. However, leaf roller control has given rise to the bigger problem of brown planthopper resurgence. Spraying the leaf roller to prevent flag leaf attack at the heading stage often leads to a large buildup of brown planthoppers that migrate to other crops after harvest.

Another leaf roller, *Cnaphalocrosis medinalis,* also occurs in the Solomons but is less abundant than *S. exigua.* A braconid parasite of the larva has been found, but less than 1% parasitism occurs. A chalcid parasite of the pupal stage has also been found. Its degree of parasitism appears to be about 5%. No varietal resistance has been observed.

We are studying the effect of each of the two generations of leaf roller on rice yields. Various insecticides, including the bacteria *Bacillus thuringiensis* are being evaluated to determine their efficiency in leaf roller control and their effect on the brown planthopper and its predators.

Paddy water application of carbofuran for stem borer control

S. Kandsamy, G. Varadharajan, M. Krishnan, and V. K. R. Sathiyanandam, Paddy Experiment Station, Aduthurai, Tamil Nadu state, India (adapted from the Aduthurai Reporter)

Carbofuran 3% G at treatment levels of 0.5, 1.0, and 2.0 kg a.i./ha was broadcast at 15 days after transplanting (DT) in an experiment on pest control using the variety ADT 31. Infestation data were taken at 30 DT.

For the stem borer, carbofuran at 0.5 kg a.i./ha effectively reduced deadhearts; increased doses of granules provided no better stem borer control (see table).

Control of stem borer with carbofuran. Aduthurai, India.

Carbofuran 3% G (kg a.i./ha)	Deadhearts/10.8 sq m No.	Transformed value
0.0	83	8.3
0.5	13	3.3
1.0	7	2.5
2.0	6	2.2
C.D. (P = 0.05)		2.5

Effectiveness of root-soaking in insecticides for pest control in paddy

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Four insecticides—chlorpyrifos, cartap, carbofuran, and lindane—were compared as root-soak treatments at 0.04% concentration with the variety ADT 31 during the 1977 kuruvai (June–Sept). Urea at 1% was digested in the treatment solutions. Gelatin at 6% in treatment solution was compared with no gelatin for root-soaking durations of 20,40, and 60 minutes.

Observations were made at 15 and 30 days after transplanting (DT) for whorl maggot, at 25 DT for jassids, and at 30 DT for stem borer. The treatments did not differ significantly in control of whorl maggot or jassids.

The differences in stem borer control among the four insecticides were statistically significant. Chlorpyrifos and cartap were equally superior to carbofuran and lindane for stem borer control (see table).

Soaking for 20,40, and 60 minutes with and without gelatin produced about equally significant effects. All treatments, except 1 soaking for 20 minutes in gelatin solution, were better than the control. There was no advantage in using gelatin.

Effectiveness of insecticides and root-soaking durations against deadheart damage caused by stem borers. Aduthurai, Tamil Nadu, India.

Treatment	Deadhearts/unit No.	Transformed value
Insecticides		
Chlorpyrifos	11.8	3.9
Cartap	18.6	4.6
Carbofuran	35.8	6.5
Lindane	30.0	5.9
C.D. (P = 0.05)		1.9
Duration of soaking		
With gelatin		
20 min	48.2	6.2
40 min	24.9	4.1
60 min	28.2	5.0
Without gelatin		
20 min	26.5	4.9
40 min	28.0	4.9
60 min	15.4	3.8
Untreated control	53.8	6.9
C.D. (P = 0.05)		1.5

Soil and crop management

Paddy straw mat as a nursery bed cover for summer paddy crops

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Only a single kharif crop of paddy is now grown in the Punjab, but short-duration rice varieties may make a second summer crop of paddy possible. Such a summer crop would have to be transplanted in the second half of April, after the wheat harvest, and nurseries would have to be sown in February or early March, when *the soil temperature is low. This study* was undertaken to develop practical technology for raising the soil temperature to improve seed germination and nursery growth.

Conservation of solar heat was compared in four treatments in flat beds (5 × 2 m) and raised beds (8 × 1.5 m) sown on 15 February 1977. In one treatment, the nursery bed was covered with polythene sheet immediately after sowing. The sheet was removed after

A healthy flat bed nursery for summer paddy crops. Punjab Agricultural University, India.

Effect of different covering materials on germination period, germination count, and soil temperature, Punjab Agricultural University, India.

	Treatments				
	Polythene	Paddy	Farmyard manure	Mean	Control
			Time to germination (days)		
Flat bed	6	7	11	8	12
Raised bed	6	6	9	7	–
Mean	6	7	10	–	12
			Stand count at 15 days after sowing (no./100 sq cm)		
Flat bed	35	54	10	33	9
Raised bed	50	44	23	39	–
Mean	43	49	17	–	9
			Mean soil temperature (°C)		
Flat bed					
morning	15	16	11	14	10
evening	27	24	22	24	21
Raised bed					
morning	15	17	12	15	–
evening	28	24	20	24	–

complete seed germination. In another treatment, the nursery bed was covered with manually prepared paddy straw mat, 3 or 4 cm thick, every day before sunset. The bed was uncovered and exposed to the sun during the day. In the third treatment, a layer of farmyard manure, about 0.5 cm thick, was spread on the bed immediately after sowing. The fourth treatment was an uncovered check plot.

Regardless of covering material, seed in the raised beds germinated earlier than those in the flat beds. Symptoms of iron chlorosis appeared in the raised beds at about 7 days after emergence and affected seedlings began to die at about 15 days. Seedlings in the flat beds remained healthy (see photo).

The type of cover affected the germination period and the number of seedlings per 100 sq cm. In the treatments covered with polythene and straw mat, seed began to emerge at 6 and 7 days after sowing, respectively. In the farmyard manure and control treatments, seedling emergence began 10 and 12 days after sowing (see table). The number of seedlings per 100 sq cm was 43 in the polythene treatment, 49 in the paddy straw mat, 17 in the farmyard manure cover, and 9 in the control. The paddy straw mat, followed by polythene, maintained the highest minimum temperature. Polythene, followed closely by paddy straw, maintained the highest evening temperature. Temperatures were lower in the farmyard manure and the control treatments.

The use of polythene may not be practical because of its cost and the accessory material required to properly spread it. But paddy straw mat is readily available to farmers and may be used as a cover to improve germination and hasten nursery growth for summer paddy crops.

Methods of N application and weed control in gogorancah rice culture

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A preliminary trial on methods of N application and weed control was conducted on rice grown under gogorancah culture in Indramayu, Indonesia, during the early 1975–76 wet season. Basal treatments of triple superphosphate and muriate of potash fertilizers at the rates of 45 kg P_2O_5/ha and 50 kg K_2O/ha were used for all plots. Total N used for all treatments was 90 kg/ha.

Root zone placement gave more efficient use of N fertilizer than surface placement (see table). But when weeds were effectively controlled by two weedings, surface application of higher rates of N (80 kg/ha) at 15 days after emergence (DE) gave almost the same yield as root zone placement using 40 kg/ha at 15 DE. Perforan herbicide and one weeding were little better than the unweeded check. Grasses were generally the dominant weeds in the gogorancah culture, followed by sedges. Broadleaved weeds were a minor problem. Surface application using the higher rate of N (80 kg urea/ha) at 15 DE with two weedings gave higher yields than root zone placement using 40 kg/ha and less intensive methods of weeding.

Effects of different methods of N application and weeding on rice grown under gogorancah culture. Cropping Systems Research, Indramayu, Indonesia, 1975–76.

Method of N application[a]	Yield (t/ha) using different weeding methods[b] 1	2	3	4	Av.
Root zone placement[c]	4.8	2.5	2.7	2.5	3.1
Surface banded[c]	3.2	2.4	2.2	1.6	2.3
Surface banded[d]	4.6	1.9	1.9	1.5	2.5
Av.	4.2	2.3	2.2	1.8	

[a]At 15 days after emergence.
[b]Treatment 1 = two hand weedings at 15 and 35 days after seeding (DS); 2 = one hand weeding at 15 DS; 3 = two kg of Perforan (a.i,) applied as preemergence herbicide; 4 = unweeded check.
[c]40 kg N/ha plus 50 kg N/ha at panicle initiation.
[d]80 kg N/ha plus 10 kg N/ha at panicle initiation.

Rice-based cropping systems

Rice varieties tested in interrows of first ratoon crops of sugarcane. Mauritius.

Upland rice in interrows of ratoon sugarcane in Mauritius

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Rice varieties were tested in interrows of first ratoon crops of sugarcane under irrigated and rainfed conditions (see photo).

The trials were sown at two sites on two dates under the conditions listed in Table 1.

Table 1. Experimental conditions at Fuel and Benares, Mauritius.

Condition	Sites: Fuel	Benares
Altitude	125 m	100 m
Soil type	Low Humic Latisol	Low Humic Latisol
Soil pH	5.35	5.1
Cane variety	S 17	S 17
Spacing between cane rows	alternately 227 cm and 97 cm	alternately 227 cm and 97 cm
Rows of rice planted in every 227-cm cane interrow (photo)	4 rows, 20 cm apart	4 rows, 20 cm apart
Irrigation	Overhead	None
Planting dates		
First	9 Sept. 1976	1 Dec. 1976
Second	1 Oct. 1976	15 Dec. 1976

Kwang Loo and Red Plum Zao had short growing cycles and matured well before the cane canopy had covered the interrows (Table 2). Kwang Loo yielded slightly lower than Red Plum. Chen Chui No. 11, a potentially high yielder, had a comparatively longer growing cycle and sometimes did not reach maturity before being shadowed by the cane canopy.

Table 2. Grain yield and other characteristics of rice varieties in interrows of sugarcane ratoons. Fuel and Benares, Mauritius.

Variety	Yield[a] (t/ha) Trial 1	Yield[a] (t/ha) Trial 2	Days to 50% flowering Trial 1	Days to 50% flowering Trial 2	Plant ht (cm) Trial 1	Plant ht (cm) Trial 2
Fuel (irrigated)						
Kwang Loo	1.4	1.0	83	80	50	52
Red Plum Zao	1.6	0.2[b]	89	85	58	59
Chen Chui No. 11	1.6	0.2[b]	97	97	68	70
Benares (rainfed)						
Kwang Loo	0.8	0.8	19	16	65	67
Red Plum Zao	0.9	0.8	79	76	68	71
No. 60	0.5	0.6	68	62	49	55

[a]At 12% moisture content. Twenty-six percent of the sugarcane field was used for rice cultivation. [b]Severely damaged by buds.

Yields in the rainfed trials may have been affected by strong winds and heavy rains during three cyclones near the island during the growth cycle. From the limited data, Red Plum showed promise for cane interrow cultivation under both irrigated and rainfed conditions.

Prospects to increase cropping intensity and production in 5-month irrigation areas

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In the 5-month irrigation areas of Indonesia, rains begin in September and land preparation for upland crops usually begins in October. But farmers cannot prepare the land for lowland rice culture until enough rain has fallen to soften the soil or until irrigation water comes in December. When water needs are met, the farmers prepare the seedbeds and begin to transplant about 30 to 40 days later. Pelita I/1 is harvested from 135 to 140 days after seedbed preparation or from mid-April to May. In May the irrigation water stops and the dry season begins. During this period about 90% of the rice land lies fallow. That area might be made more productive if farmers would plant a short-duration rice early in the rainy season, as soon as the irrigation water arrives or earlier. If IR28 were planted in November, it could be harvested 100 to 115 days later, in March or early April. After the harvest, there would still be enough water from rainfall and residual soil moisture to grow crops for 1 or 2 months. This concept was tested with six cropping patterns.

Two crops of early maturing rice grown in the 5-month irrigation areas gave higher yields and gross returns than a single crop of the medium-maturing Pelita I/1 (see table).

A third crop of mung beans planted early in the rainy season, before the irrigation water arrives, can be productive and profitable. However, mung can be more logically considered as the first crop in the yearly sequence, as farmers consider it now in areas where upland crops are grown.

Average grain yield and income for superimposed study in 5-month irrigation areas. Cropping systems research, Nambahdadi, Lampung, Indonesia, 1975–76.

Cropping pattern	Yield (t/ha) 1st crop	Yield (t/ha) 2nd crop	Yield (t/ha) 3rd crop	Income[a] (US$/ha) 1st crop	Income[a] (US$/ha) 2nd crop	Income[a] (US$/ha) 3rd crop	Total gross income (US$/ha)
PelitaCorn-Rice bean	4.9	0.7	0.1	707	66	35	808
IR28-IR29-Mung beans	4.0	2.4	1.1	517	352	533	1,462
IR28-Sorghum-ratoon	3.6	2.4	–	5 25	88	–	613
IR28-Soybean-Mung beans	4.0	0.8	1.1	514	220	552	1,346
IR28-Peanut-Mung beans	4.3	0.3	1.0	625	158	449	1,232
IR28-Corn-Mung beans	4.0	2.1	1.2	511	198	597	1,372

[a] Prices of crops determined at the conversion rate of Rp415 = US$1.

C171-136 upland rice compared with Dagge in a rice-corn cropping system in the Philippines

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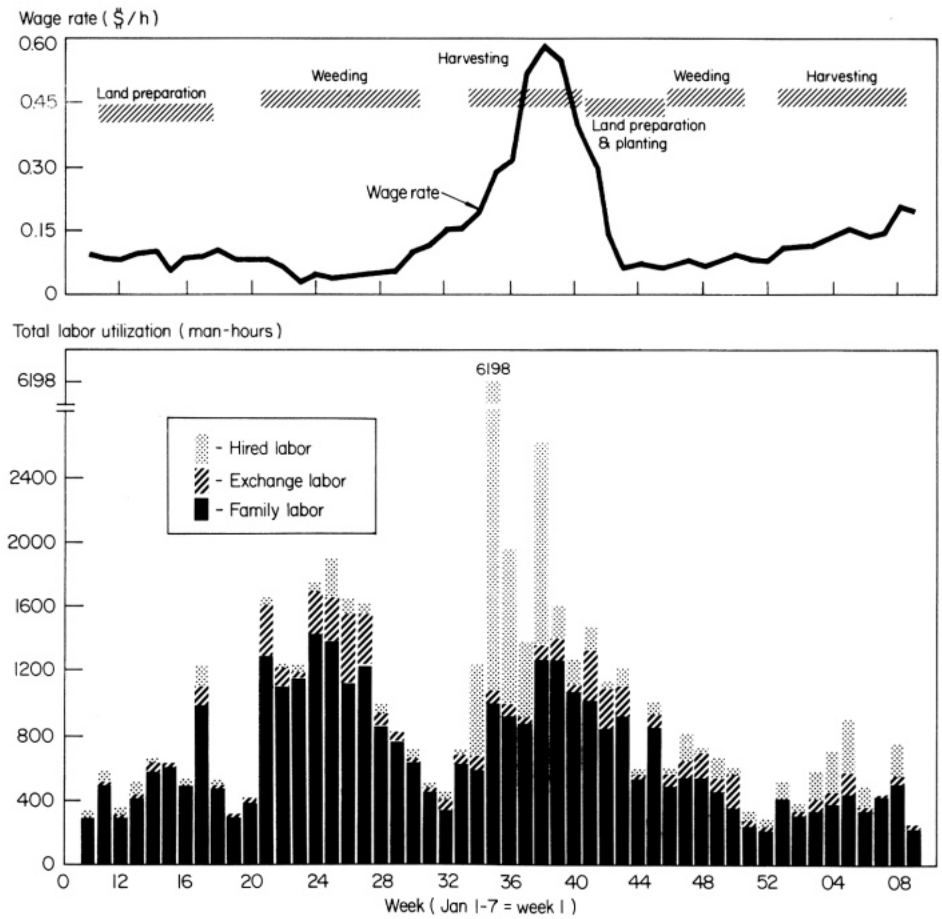
For years, cropping systems researchers have attempted to find an upland rice variety better than the present one, Dagge, in an upland-rice site in Cale, Batangas province, Philippines. Until 1976 all varieties tested in farmers' fields failed, often because they could not withstand farmers' weeding practices, which involve passing a spike-toothed harrow, or *kalmot,* diagonally across the rows at from 10 to 20 days after emergence, followed by one or two interrow cultivations with a *lithao* (wooden furrower) and repeated hand weeding. The *kalmot* usually uprooted improved upland varieties. Furthermore, their shorter plant type often intensified weed problems later in the growing season, increasing labor requirements.

Dagge is harvested by removing individual panicles or cutting the entire



Weekly labor utilization and imputed weekly wage rates on 36 farms in Cale, Batangas province, Philippines, 1915–76.

Performance of C171-136 and Dagge as sole crop and intercrop with corn at constant and variable labor prices for weeding and harvesting, Cale, Batangas province, Philippines, 1977.

	Dagge alone[a]	C1171-136 alone[a]	Dagge +corn[b]	C171-136 + corn[b]
		Rice		
Yield (t/ha)	2.76	4.30	3.26	4.57
Tillers (no./sq m)	185	244	182	193
Gross returns[c] (US$/ha)	525.03	818.50	620.54	869.66
		Corn		
Yield (marketable ears)	–	–	12,466	13,400
Gross return[d] (US$/ha)	–	–	144.22	154.97
Total return (US$/ha)	525.03	818.50	764.76	1,024.63
Input costs[e] (US$/ha)	77.55	77.55	157.82	157.82
		Labor requirement (man-h/ha)		
Land preparation and seeding[f]	95	95	95	95
Weeding	163	95	90	234
Cultural practices[f]	35	35	54	64
Harvest	636	174	825	299[g]
Total labor	929	399	1,064	692
		Assuming constant wages for weeding and harvest ($0. 17/h)[h]		
Labor costs (US$/ha)	179.73	89.39	203.13	140.82
Total cost (US$/ha)	257.28	166.94	361.09	298.78
Net return (US$/ha)	267.76	65 1.56	403.67	693.76
Return to cash (US$/ha)	0.60	1.28	0.48	0.75
		Weeding labor at $0.07/h, harvest labor at $0.34/h[h]		
Labor cost (US$/ha)	271.70	109.93	337.41	171.70
Total costs (US$/ha)	349.25	187.48	495.24	359.52
Net return (US$/ha)	175.78	631.02	269.52	694.97
Return to cash (US$/ha)	0.44	1.24	0.37	0.73
Return to labor (US$/h)	0.48	1.86	0.57	1.25

[a]Average of 6 plots. [b]Average of 3 plots. [c] Palay at US$0.10/kg. [d]Green ears of corn at US$0.01/ear. [e]Seed and fertilizer: seed at US$0.19/kg; fertilizer (ammonium sulfate) at US$8.23/50 kg bag. [f]Includes thinning, replanting, fertilizer application, and cultivation. [g] One plot only for corn. [h] Cultivation and land preparation at US$0.34/h.

plant. Because it matures unevenly, the fields are harvested two or three times. Labor utilization peaks at weeding and harvesting (see figure), causing a substantial difference in imputed wages for hired labor through the year — an important factor in the evaluation of alternative technology.

In 1976 variety trials, the lines C171-136 (from the cross Sigadis/BPI-76) and C166-135 (Intan/B5580-A_1-15) outyielded Dagge. C171-136 was compared with Dagge in split fields under farmer management in Batangas in 1977.

As sole crop, C171-136 yielded an average of 1.5 t/ha more than Dagge; as an intercrop with glutinous corn (which was harvested green), C171-136 yielded 1.3 t/ha more (see table). C171-1 36 and Dagge did not differ significantly in their effect on corn yields, but both yielded slightly higher as intercrops, probably because of the high nitrogen rate applied to the corn.

Because C171-136 matures evenly, the entire crop can immediately be harvested by sickle. Its low labor requirement for harvesting, combined with the increased gross returns, gave it an average increase in net returns of 143% as sole crop and 80% as intercrop over Dagge. The computation assumed a cost of $0.34/hour for any activity requiring animals and a constant cost of $0.17/hour for all other labor inputs.

But it was considered more appropriate to value labor for hand weeding at $0.07/hour and that for harvesting at $0.34/hour, based on the imputed labor wage in Cale (see figure). At these wage rates, the average increase in net return of C171-136 over Dagge was 290% as sole crop and 158% as intercrop (see table).

C171-136 gave higher average returns to labor and cash. But the introduction of corn into the rice crop reduced returns to cash for both C171-136 and C166, and reduced returns to labor for C171-136. The rate at which nitrogen was applied to the corn (90 kg N/ha), in addition to the 75 kg N/ha applied to the rice, may have been too high.

The reduced labor for harvest of C171-136 also may reduce the turnaround time between rice and corn. That allows earlier planting, which results in significantly higher corn yields. C171-136 also produced more tillers per square meter (see table). Although its early growth is slightly slower than that of Dagge, its higher tiller number reduced weed competition.

Invitation to authors

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 paragraphs and a table, figure, or photograph. They are subject to editing and abridgement to meet space limitations. Authors will be identified by name, title, and research organization.

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Announcement

When the first edition of *Standard Evaluation System for Rice* was printed in 1975, it was agreed that the system would be updated after several years of use. The world's rice scientists rapidly and widely adopted the standard scoring system and are now making recommendations to the International Rice Testing Program (IRTP) for its improvement.

The IRTP plans to print the second edition of the *Standard Evaluation System for Rice* during 1978. Each scientist who has used the system is encouraged to make recommendations for improving the scales of particular traits. Suggestions received by 15 April 1978 will be discussed by participants at the International Rice Research Conference in April 1978; the revised publication will be printed about June 1978.

Submit recommendations to: International Rice Testing Program, IRRI, P. O. Box 933, Manila, Philippines

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