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Contents

Genetic evaluation and utilization

OVERALL PROGRESS

Agronomic evaluation of some leading cultivars for the Turkish rice breeding program

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The evaluation of the world's leading rice material — the first and most important step in rice improvement — not only facilitates selection of the most suitable parents, but also enhances their cultivation.

Agronomic characters of the material listed in the table, evaluated for 3 years, indicate that:

- Cultivars of Italian origin (grown widely in Turkey) did not perform as well as U.S. and Russian cultivars. But U.S. varieties needed a longer vegetative period and Russian varieties had smaller kernels.
- Despite its shorter culms and higher tiller number, the indica group was unsuitable because of other problems. The same was true for indica-japonica hybrids.
- No superior agronomic characteristics were observed among the local varieties, except for the shorter vegetative period in the cultivar Sarikilçik. ■

Performance (3-yr av) at Izmir, Turkey, of 18 rice varieties and lines of different origins.

Variety	Grain yield (g/plant)	Panicles (no./plant)	Grains (no./plant)	T.K.W.[a] (g)	Maturity[b] (days)	Plant ht (cm)
			IRRI			
IR747B2	12.6	16.2	53.1	18.54	110	62
IR1561-228-3	11.2	13.8	59.1	17.96	133	64
IR2037-625	14.0	12.6	83.1	16.86	123	59
IR2307-64	23.1	14.5	94.3	20.81	119	65
IR2307-117	12.7	14.4	71.5	15.27	128	62
			TURKEY			
Dawn (USA)	13.8	5.7	124.4	21.81	120	100
Tongil (Korean)	12.0	8.2	78.2	26.12	116	56
Sarikilçik	11.1	12.0	34.8	32.62	77	81
Akçeltik	10.9	10.5	41.1	27.96	83	96
Sariçeltik	14.4	10.1	56.2	27.01	97	109
			USSR			
Kuban	16.1	9.6	87.5	26.31	82	91
Krasnodorky 424	14.4	7.6	114.3	27.32	83	100
			ITALY			
Ribe	13.1	6.2	71.4	29.62	88	85
Baldo	14.0	7.0	71.3	34.71	84	82
Rocca	12.5	7.9	64.8	30.95	88	83
			USA			
Caloro	13.5	6.3	112.6	24.58	122	104
CS-S4	15.8	7.5	108.7	23.76	122	103
Calrose	27.2	11.1	129.5	24.02	122	104
LSD 5%	3.00	2.29	10.95	0.90	–	3.28

[a]Thousand kernel wt. [b]Days from seeding to harvest.

Breeding behavior of a cross between two lowland varieties

S. K. Bardhan Roy, Rice Research Station, Chinsurah, Hooghly, West Bengal, India

Pankaj (P_1) and O.C. 1393 (P_2) were crossed at Chinsurah in 1976 kharif in a program to develop intermediate height, high yielding genotypes suitable for the lowlands where water level fluctuates (10–15 cm) depending on rainfall.

O.C. 1393 is a strongly photoperiod-sensitive local variety adapted to the lowlands, and Pankaj (a selection of IR5), is the only high yielding variety widely cultivated in the lowlands during kharif in West Bengal.

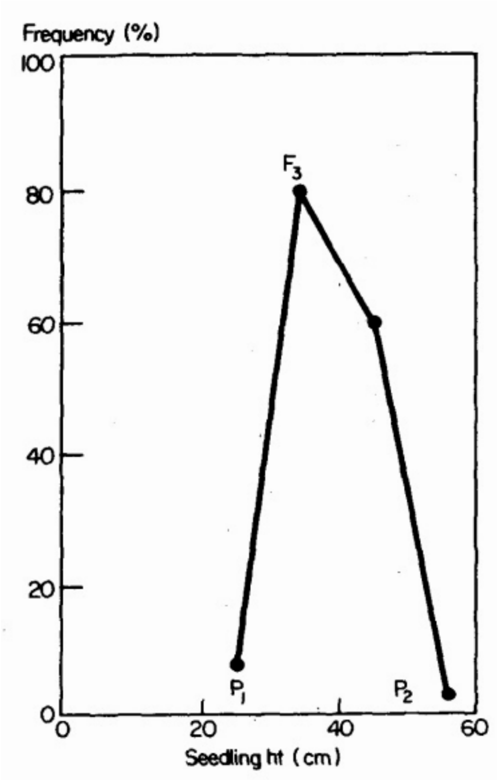
F_1 seeds from the cross were grown in the field in 1977 kharif. Photoperiod sensitivity is considered an essential trait for varieties grown during this season. Therefore, F_2 populations were sown in January and grown during 1978 boro to separate early, long-duration, and photoperiod sensitive segregates. More than 60% of the plants flowered by May; the remaining plants flowered at the end of October or in November and, at 22°52'N latitude, were assumed to be photoperiod responsive. O.C. 1393 flowered only in November 1978 whereas Pankaj flowered irregularly.

Seeds from the individual photoperiod sensitive plants (F_3) and the two parents were grown in lowland plots at IRRI during the 1979 dry season.

Seedling heights at 21 days after seeding (DS) averaged 41.7 cm for O.C. 1393, 30.9 cm for Pankaj, and 39.5 cm for the F_3 population with a range of 30–52 cm. The F_3 population consisted of intermediate or semitall types with an inclination toward O.C. 1393, the taller parent. A transgressive segregation toward the taller types, shown by the range, may be due to a gene for tallness in Pankaj, which is lacking in O.C. 1393. When the two varieties are crossed, the combination of genes produces plants taller than O.C. 1393.

The frequency distribution of F_3 seedling heights showed a normal curve (see figure). This character appears to be polygenic in nature and wide segregates in the F_3 population indicate a possibility of producing intermediate plants from the population.

At 31 DS the F_3 population and the



Frequency distribution of the F_3 population of the cross between Pankaj (P_1) and O.C. 1393 (P_2) among seedling heights.

parents were submerged in water maintained between 45 and 50 cm. After 12 days, 67.4% of the O.C. 1393, 34.1% of the progeny lines, and 27.0% of the Pankaj plants survived.

The increase in height (i.e. elongation ability) of the survivors averaged 66.2 cm for the F_3 lines, 73.2 cm for O.C. 1393, and 45.5 cm for Pankaj.

Thus, Pankaj as a parent in a lowland crossing program may produce desired intermediate plant height with good tolerance for submergence.■

Contribution of tillers produced at different weeks to panicle formation

Abdur Rashid Gomosta and Md. Zahurul Haque, Bangladesh Rice Research Institute, Joydebpur, Dacca

The potential contribution to panicle formation of tillers produced in different weeks was investigated during the wet season. The short-duration variety Chandina and the medium-duration variety IR8 were grown in pots to avoid mutual shading.

Seedlings of both varieties started producing tillers the second week after sowing. The tillers produced each week until the 7th week after sowing were marked with wire rings.

In both varieties tillers produced within the third week were 93 to 100% productive and those produced in the fourth week 70 to 73% productive. Tillers produced in the 5th week were only 15% (IR8) and 34% (Chandina) productive (see table). None of the tillers produced during the 6th and 7th week developed panicles.

The panicle length, number of spikelets per panicle, and weight per panicle were the highest in the primary panicle and decreased in subsequent panicles. However, the highest contribution to the total panicle weight was from panicles produced by the 3d- and 4th-week tillers. The 100-grain weight did not vary much among the panicles; however, it was extremely low in the panicles from 5th-week tillers.

A rice plant, whether of short or medium duration, has the potential to produce panicles from 5th-week tillers during the wet season. Such panicles contribute little, however, to the total panicle weight of a plant.■

Productive tillers and other yield components of Chandina and IR8 (av of 10 replications).

Variety	Tillers	Productive tiller (%)	Panicle length (cm)	Spikelets (no./panicle)	Wt/panicle (g)	100-grain wt (g)	Contribution to total panicle wt (%)
Chandina	Primary	100	22	133	1.70	2.19	6
	2d wk	100	21	114	1.50	2.18	12
	3d wk	94	22	117	1.40	2.18	42
	4th wk	13	20	81	0.90	2.10	31
	5th wk	34	18	64	0.70	1.88	8
IR8	Primary	100	23	124	2.00	2.37	10
	2d wk	85	23	114	2.00	2.36	18
	3d wk	93	22	100	1.60	2.28	37
	4th wk	70	21	85	1.30	2.32	30
	5th wk	15	18	57	0.60	1.80	3

Tillering pattern of dwarf indica rice and its contribution to grain yield

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The growth and development of tillers — the prime units of grain production — directly affect the economic and total biological yields. Because basic research on tillering patterns is meager, the present study was undertaken on Cauvery cultivar, an early maturing semidwarf indica rice.

Primary tillers flowered earliest, followed by secondary and tertiary tillers (see table). Growth parameters, such as plant height and number of rachillae per panicle, were higher in primary tillers. Leaf emergence was rapid and relative growth rate high in the mother culm and primary tillers. Early tillers originating at the same time had better vascular connections with the mother shoot. The diameter of internodes in tertiary tillers that emerged early was nearly double that of later internodes. Because of a large source for carbon assimilation (green leaves) and more sink capacity for accumulating photosynthates (panicles), the primary tillers contributed nearly half of the

Growth parameters and tillering pattern of Cauvery, a semidwarf indica rice, Varanasi, India.

Designation of tiller	Flowering days (no.) from germination	Ht (cm)	Bearing tillers (%)	Rachillae (no./pmick)	Yield contribution (%)
Mother culm	74	102.1	100	115.0	10
Primary bearing	76	99.3	95	103.2	50
Secondary bearing	77	94.5	71	101.7	35
Tertiary bearing	80	93.2	48	98.3	5

dry matter toward grain yield.

Tertiary tillers that emerged late were partially developed, and mostly unproductive, and their mortality was high. Their vascular connections with the vascular elements of the main culm were poor. Because they areunsuccessful in the intraplant competition for photosynthate and other growth requirements, they contribute less to grain yield. ■

Rice research priorities in Brazil

E. P. Silveira, Federal Agricultural Research System (EMBRAPA), P. O. Box 1061, 86.100 Londrina, Parana state, Brazil

Brazil is the largest rice producer and consumer in the western hemisphere. About 5 million ha have been cultivated annually in the last 5 years. In 1977, 8.9 million t of rice was produced and annual per capita consumption rose to 45 kg. About 80% of Brazilian rice is grown in the uplands where seasonal distribution of rainfall causes wide yield fluctuations. Average yields are about 1.5 t/ha in upland areas and 3.7 t/ha on irrigated land. Nearly all the I7 Brazilian states are involved in rice production, but 8 states produce 92%. The biggest upland rice-producing area is in the west central *Cerrado-Savanna* region. The production in this region, which has some 3.5 million ha of rice land, is sometimes more important than

Rice research priorities, Brazil, 1977.

Discipline	Priority level by state[a]																
	RS	SC	PR	SP	RJ	ES	MG	GO	DF	MS	SE	AL	PI	MA	RO	AM	PA
• Crop breeding, genetics, and physiology																	
Disease resistance	1	1	1	1	I	1	1	1	–	1	1	1	1	1	1	1	1
Insect resistance	2	2	2	2	2	2	2	2	–	2	2	2	2	2	2	2	2
Threshing resistance	–	–	–	1*	–	–	1*	1*	–	1*	–	–	1	1	–	–	–
Lodging resistance	–	–	1	1	–	–	1	1	–	1	–	–	–	–	1	–	–
Drought resistance	–	–	1*	–	1*	–	1*	1*	1*	1*	–	–	–	–	1*	–	–
Low temperature tolerance	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Poor soils tolerance	–	2*	1*	1*	–	–	1*	1*	1*	1*	1*	1*	1*	1*	1*	–	–
Agronomic traits	2	2	2	2	2	2	2	2	2	2	3	3	3	3	2	2	2
• Crop protection																	
Management and control of weeds	1	3	2	1	1	1	2	2	2	2	3	3	3	3	2	2	1
Survey and control of pests	2	2	2	2	2	2	2	2	2	2	3	3	2	2	2	2	2
Survey and control of diseases	1	1	1	2	1	1	1	1	1	1	2	2	1	1	I	1	1
• Cropping system																	
Companion crop	–	–	–	–	–	–	–	–	–	–	–	–	2	1	3	–	–
Rotation	1	2	1	1	2	2	1	1	1	1	–	–	2	2	2	1	1
Ecological adaptability	–	–	1	1	–	–	1	1	1	1	–	–	2	2	2	1	1
Cultural practices	2	2	2	2	2	2	2	2	2	2	1	1	3	1	1	1	2
Economic viability of the systems	1	2	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
• Soil and water management and conservation																	
Relation soil-water-plant	2	2	1	1	2	2	1	1	2	1	1	1	2	1	2	1	1
Irrigation methods	1	–	1	1	–	–	1	1	1	1	2	2	3	2	2	1	1
Drainage methods	1	1	–	–	1	1	–	–	–	–	2	2	–	3	–	1	1
Mineral nutrition	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3
Fertility	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Erosion control	–	–	3	3	–	–	3	3	3	3	–	–	3	3	3	–	–
• Autoecology																	
Climatic conditions	2	2	2	2	2	2	2	2	2	2	1	1	3	2	2	2	2
Ecophysiology	2	3	2	2	3	3	2	2	2	2	3	3	3	2	2	3	3
• Seed production and technology																	
Production and seed analysis	2	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
Transportation and storage	2	3	3	3	–	–	3	2	–	2	–	–	–	–	–	–	–
Processing and storage	3	–	3	3	–	–	3	3	–	3	–	–	–	–	–	2	2
Seed quality	1	2	3	3	2	2	3	3	3	3	–	–	–	3	3	–	–
• Design of farm machinery and agricultural mechanization																	
Cultivation equipment	1	–	2	1	2	2	2	2	–	2	–	–	–	–	–	–	–
Processing equipment	1	–	2	1	2	2	2	2	–	2	–	–	–	–	–	–	–

[a]RS = Rio Grande Do SuI, SC = Santa Catarina, PR = Parana, SP = Sao Paulo, RJ = Rio de Janeiro, ES = Espirito Santo, MG = Minas Gerais, GO = Goias, DF = Distrito Federal, MS = Masso Grosso Do Sul, SE = Sergipe, AL = Alagoas, PI = Piaui, MA = Maranhao, RO = Rondonia, AM = Amazonas, PA = Pará.

that in the 700,000 ha of irrigated rice land in Rio Grande do Sul and Santa Catarina states. Throughout the uplands rice is commonly cultivated as a *grub crop* after the land has been cleared. It generally gives way to corn, soybean, cotton, or pasture in the third year. This type of *grub farming* appears to be short-lived.

Rice research priorities have been determined by the Brazilian Agricultural Research Indicative Plan for 1980 to 1985 (see table). Research projects for 1979 are being developed either by the 11 EMBRAPA units or by the 10 state cooperative institutions. ■

Ten IRTP monitoring tours in 1978

The International Rice Testing Program (IRTP) sponsored 10 monitoring tours in 1978 to enable rice scientists from various countries to observe how materials from different sources perform in the international nurseries and to become better acquainted with other rice research in their regions. The IRTP continued the trend of making the monitoring tours coincide with workshops or planning sessions, which gives scientists the opportunity to observe the problems first-hand in the field under different conditions immediately before discussing them at the workshops.

The monitoring tour to South India and Sri Lanka coincided with a planning meeting held at Peradeniya, Sri Lanka, to finalize plans for the 1978 nurseries. The Rainfed Rice Monitoring Tour to Indonesia preceded the International Rice Research Conference at IRRI, which focused on rainfed rice. The Deepwater Rice Monitoring Tour preceded the International Workshop on Deepwater Rice held in Calcutta in August. Likewise, the Cold Tolerance Monitoring Tour was tied up with the Cold Tolerance Workshop in Korea, jointly sponsored by IRTP and Korea's Office of Rural Development. In West Africa the first regional monitoring tour was linked with a West African Rice Development Association (WARDA) Workshop held in Ibadan, Nigeria.

Plans for many future IRTP nurseries are finalized during the monitoring tours. Scientists are also able to see the strengths and weaknesses in various national rice research programs.

Monitoring tours in 1978 and scientists who participated are listed below:

South India/Sri Lanka 30 January–9 February
Bangladesh – M. S. Ahmad, D.G. Kanter
India – K. M. Bala Subramaniam, M. Dagg, K. I. James, V. T. John, M. B. Kalode
Indonesia – H. M. Beachell, B. H. Siwi
Sri Lanka – I. Gunawardena, D. Jayawardena, A. D. Somapala
Thailand – Sermsak Awakul
IRRI – E. A. Heinrichs, H. E. Kauffman, G. S. Khush, E. M. Mendoza, T. W. Mew, D. V. Seshu

Southern Region of South America 6–20 March
Argentina – W. Jetter
Brazil – P. S. Carmona, D. M. De Souza, J.F.V. Moraes
Colombia – M. J. Rosero, H. Weeraratne
Peru – J. Fernandez
IRRI – H. E. Kauffman, J.C. O'Toole

Rainfed Rice 7–14 April
India – S. Biswas
Indonesia – H. Anwarhan, H. M. Beachell, I. Manwan, B. H. Siwi, D. M. Tantera
Malaysia – Chen Yok Hwa
Philippines – A. Bueno
Thailand – B. Somrith
IRRI – J. S. Nanda, R. C. Saxena

Observations on Deepwater Rice in Thailand, Bangladesh, and India 9 - 16 August
Bangladesh – B. A. Dewan, D. G. Kanter, M. Nasiruddin
India – C. H. Misra
Indonesia – H. Anwarhan
Thailand – Chai Prechachat, B. R. Jackson, Nopporn Supapoj
IRRI – D. V. Seshu

Cold Tolerance 7–19 September
India – A. R. Hamdani, J. P. Tandon
Indonesia – H. M. Beachell, Z. Harahap
Japan – M. Shibata
Korea – J. H. Lee
Nepal – M. H. Heu, B. B. Shahi
Philippines – A. Ronduen
Taiwan – L. F. Lee
IRRI – H. E. Kauffman, J. S. Nanda, B. S. Vergara

Rice Improvement Activities in Four West African Countries 30 September–7 October
Liberia – M. A. Choudhury
Nigeria – A. O. Abifarin, S. O. Fagade
Sierra Leone – R. A. D. Jones, I. C. Mahapatra
IRRI – D. V. Seshu

Observations on Rice Improvement in the Indus River Plains of Pakistan and India 1–9 October
Pakistan – M. Akbar, I. M. Bhatti, A. Majid, V. E. Ross
India – O. P. Meelu, H. N. Shahi, G. S. Sidhu
IRRI – G. S. Khush

Yield and Observational Nurseries with Focus on Long-Duration Rice 27 October–6 November
Bangladesh – N. M. Miah
India – R. K. Misra, J. R. K. Rao, R. A. Thakur
Thailand – K. Varaporn
IRRI – D. V. Seshu

Observations on Rice Virus Diseases in Indonesia. Thailand, and India 27 October–7 November
India – A. Anjaneyulu, A. Ghosh
Bangladesh – A. K. M. Shahjahan
Indonesia – P. S. Rao, Nasir Saleh
IRRI – H. E. Kauffman, K. C. Ling

Breeding for Drought Resistance in Northern and Eastern India and Northeast Thailand 24 September–2 October
India – M. J. B. Rao, S. C. Prasad
IRRI – T. T. Chang, J. C. O'Toole ■

GENETIC EVALUATION AND UTILIZATION

Grain quality

Jeerakasala — a tall scented rice variety in Kerala, India

N. N. Ramankutty, associate professor, Agronomic Research Station, Chalakudy, and U.P. Bhaskaran, director of research, Kerala Agricultural University (KAU), Vellanikkara, Trichur, Kerala, India

Jeerakasala, a tall, scented rice variety, grows 976 m above sea level in the high ranges of Kerala, known as Wynad. Its white, fine grain gives off a pleasing aroma when cooking — a trait that makes Jeerakasala popular for the preparation of the delicacy *biriyani.* Jeerakasala is also known as *biriyani rice.*

The scent can be detected even in the field when the crop is flowering. The variety brings a premium market price — sometimes more than double that of ordinary varieties.

The photoperiod-sensitive variety is usually sown in June and transplanted in

Mean grain yield of pure line selections of Jeerakasala at the Horticultural Research Station, Ambalavayal, and in farmers' fields. Wynad, Kerala, India.

	Mean grain yield (t/ha)		Remarks
	Research station	Multilocational trials	
Culture 179	2.2	3.3	Scented, profuse awning
Culture 190	2.3	3.0	Scented, tipping tendency
Culture 534	2.2	2.9	Highly scented, no awns
Ryots' bulk	2.4	3.6	

July when southwest monsoons provide sufficient water. It matures by December. Its total growth duration is 180–200 days (depending on sowing time). Its yields average 2.2 to 2.8 t/ha under average management and low fertility (40-20-20 kg NPK/ha). Low management costs and high premium price make Jeerakasala attractive to low-income farmers.

Varietal improvement by pure line selection is in final stages at the KAU Horticultural Research Station, Ambalavayal, Wynad. Three cultures with varying degrees of awning showed different yield potentials at the research station and in farmers' fields. The mean grain yield at the Research Station in experimental plots and the yield obtained in multilocational trials from 1976–77 to 1978–79 are presented in the table. ■

Quality classification of rice

K. R. Bhattacharya, C. M. Sowbhagya, and Y. M. Indudhara Swamy, Discipline of Rice and Pulse Technology, Central Food Technological Research Institute, Mysore – 570013, India

Some physicochemical properties of 177 samples (169 varieties) of rice from various agricultural research stations in India were determined. The samples included 129 traditional tall Indian varieties (76 high-amylose, 27 scented and 10 nonscented intermediate-amylose, 6 low-amylose, and 10 waxy varieties), 31 modern semidwarf varieties (including 2 medium- and 1 low-amylose), 5 long-grain American rices (including Century Patna 231, a low-amylose type), 4 bulu rices of Indonesia, and 8 low-amylose introductions (4 ponlai, 2 japonica, 2 indica x japonica).

With some minor exceptions, the results follow the pattern shown in the table. Results of earlier work in this institute also agree with this pattern. We conclude that rice can be tentatively classified into eight quality types.

An interesting point is that high- and intermediate-amylose rices each have three distinct quality types. The distinctions in the first group can be explained on the basis of clear differences in their hot-water-insoluble amylose content, but those in the second need further research. ■

Quality classification of 177 samples (169 varieties) of milled rice, Mysore, India.

Quality type	Examples	Samples (no.)	Amylose (% dry basis)		Alkali reaction type	EMC-S[a] (% wet basis)	BD_r [b] (%)	Cooked rice[c]	
			Total	Hot-water-insoluble				Sticki-ness	Consis-tency
I. High-amylose A	IR8, IR22, Jaya	10	>26	>15	B, mixed B	28.5–30	0– 5	Very low	Very high
II. High-amylose B	GEB 24, Slo 13, Co 32	32	>26	12.5–15	A, B_1	26.5–28.5	16–27		
III. High-amylose C	T 141, Slo 16, Tkm 6	58	>26	≤12.5	A, B_1	26.5–28.5	31–55		
IV. Intermediate-amylose A (scented)	Basmati 370, T 9, Br 9	26	23–26	7–10	Mixed C	27.5–29	56–81		
V. Intermediate-amylose B	Kuki, Abor red, Tengo	21	23–26	7–10	Mixed C	29.5–31	56–78		
VI. Intermediate-amylose C (bulu)	Baok, Benong 130	4	23–25	7–10	Mixed C	27.5–29	134–157		
VII. Low-amylose	Norin 29, Tainan 3, Phoudum	16	15–22	6– 9	C	30–32	111–153		
VIII. Waxy	Asm 44, Purple puttu	10	<5	–	D	34–36	252–333	Very high	Very low

[a] Equilibrium moisture content attained by milled rice when soaked in water at room temperature.
[b] Relative breakdown $\left(\frac{\text{breakdown} \times 100}{\text{total setback}}\right)$ in Brabender viscogram. Ranges shown are values interpolated at a peak viscosity of 1,000 Brabender units in about 50 selected samples viscographed at several slurry concentrations each. The remaining samples were viscographed only at about 9% (dry basis) concentration, their BD_r type being read from standard curves.
[c] Stickiness of cooked rice by our sieve test, and consistency (hardness) by the Haake consistometer were determined only in about 50 selected samples.

Publication list on rice insects available at IRRI

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

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

GENETIC EVALUATION AND UTILIZATION

Disease resistance

Screening of rice varieties and lines against stem rot in Bangladesh

A. Hossain, A. K. M. Shahjahan, and S. A. Miah. Bangladesh Rice Research Institute (BRRI), Joydebpur, Dacca, Bangladesh

To isolate and identify sources of resistance to stem rot of rice caused by *Sclerotium oryzae* Catt. (*Leptosphaeria salvinii* [Catt.] Kr & Web), 1,005 varieties and lines collected from the BRRI germplasm bank and advanced breeding lines were screened during 1978 boro, aus, and T. aman seasons in BRRI fields.

One-month-old seedlings were transplanted at 25- x 20-cm spacing in 2-m single rows. A check variety, Iratom-38 or TN1, was planted after every 10 entries and on both ends of every block. Fertilizer was applied at 90:67.5:45 kg/ha (urea in 2 splits) and the rows were weeded. The levees surrounding the nursery plot were raised and plastered with mud to maintain at least 7-10 cm standing irrigation water. At the late tillering stage plants were inoculated with *S. oryzae.* Sclerotia and mycelia were prepared in an autoclaved 2:1 rice hull: rice grain mixture and spread over the center of the rows at 20 ml/row. Infection on the outer leaf sheath became visible 2 weeks after inoculation. At maturity 3 to 4 hills from the center of each row were cut down to soil level, and then 25 random tillers were graded individually on a disease index scale of 0-9, based on depth of infection and severity. The average reading from the 25 tillers was considered the index for the variety (see table). ■

Summary of results of screening rice varieties and lines against stem rot at BRRI, Joydebpur, Dacca, Bangladesh, 1978.

Season	Varieties, lines screened (no.)	Varieties and lines (no.) with disease score[a] of			
		0	0.1–3.0	3.1–6.0	6.1–9.0
Boro	78	0	19[b]	58	1
Aus	429	0	53[c]	334	42
T. aman	498	0	9[d]	428	61

[a]0 = immune, 0.1–3.0 = resistant to moderately resistant, 3.1–6.0 = intermediate, 6.1–9.0 = susceptible to highly susceptible.
[b]Includes B5441b-Kn-7-1-2-3, BG375-1(75-404), BR8, Chandrasail 1, Chainung-Sen-yu-6, DJ684D, IR32, IR944-85-1-2-1-1-2-1, IR2071-586-5-6-4, lR2451-90-4-3,IR2793-80-1, and IR3464-75-1-1.
[c]Includes B441bl26-2-3-1-9, B462B-Pn-1-3, Baspati, BR6, BR161-2B-42, BR168-2B-23, BR1031-48-1-2, C168, Chakila, Chandina, Chandrasail 1, Giza, B541b-Kn-19-3-4, IR2071-625-1, BG11-11, BG35-2, BR2-29-2-1-3, BR3-12-B-15-54, BR4-30-3-2-1, BR4-30-51-2, BR9-17-4-1, BR13-47-3, IET5107, IR2061-214-3-3-32, and IR2061-214-3-14.
[d]Includes BR4-30-3-2-1, BR52-87-1/HR90, BR52-87-1/34, IR2031-2384-1-3-2, Purbachi, Remadja, Tan I x Ta-Poo-cho-Z, Badaia chikon, and BR4.

GENETIC EVALUATION AND UTILIZATION

Insect resistance

Resistance of paddy varieties to gall midge

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Epidemics of the paddy gall midge *Orseolia oryzae* occurred in 1971, 1972, 1975, 1976, and 1978 in the rice bowl of Chattisgarh, Madhya Pradesh. Early, medium, late, and resistant groups of tall and semidwarf paddy were therefore screened for reaction to gall midge in government farms and cultivators' fields.

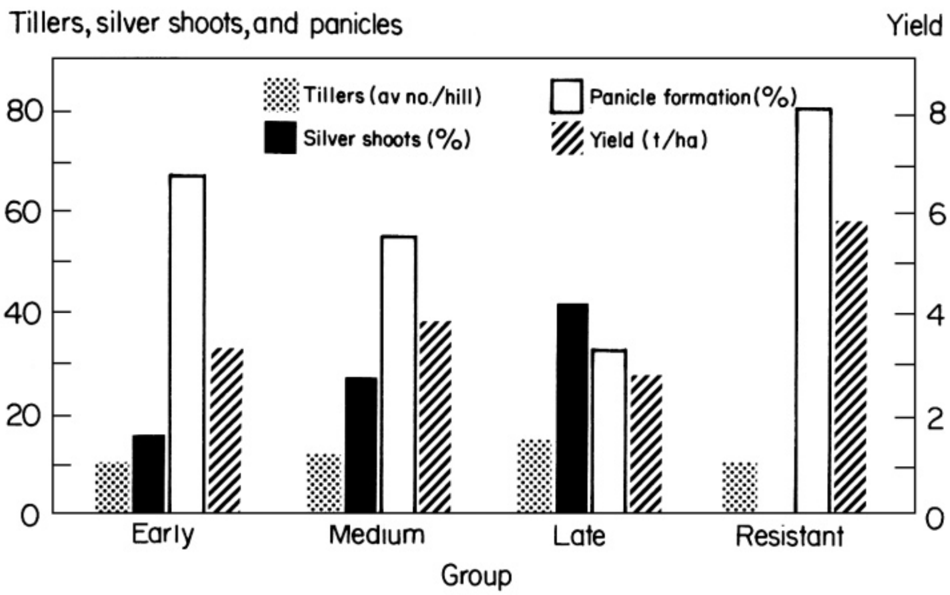
In the early group susceptibility to silver shoots ranged from 0.7 to 41%

Reaction of transplanted varieties to gall midge *Orseolia oryzae* in 1978 kharif. Raipur, India.

Designation	Tillers (av no./hill)	Panicles (%)	Silver shoots (%)	Yield (t/ha)
Early				
R155-2598	5.1	96.4	0.7	4.2
R155-355	12.2	47.4	40.9	3.6
JR16-15-1-1	7.2	75.6	3.7	2.8
JR16-15-1-1 [a]	29.7	38.9	22.3	1.5
Anjania [a]	4.3	49.6	13.4	2.3
Kaveri	6.8	72.2	14.5	3.7
Anupama	5.8	86.2	9.1	4.5
Medium				
Kranti	9.7	40.1	28.6	3.3
Garima	15.6	36.5	45.6	4.0
Pragati	14.4	44.3	35.0	4.0
Madhuri	14.1	45.7	26.1	2.4
R2270	13.1	59.8	29.2	3.1
Assamchuri	17.8	47 .0	20.4	3.9
TN1	8.7	79.5	17.6	4.5
R8-2535	12.4	73.3	6.2	6.1
Ratna	5.6	63.3	31.4	3.1

Designation	Tillers (av no./hill)	Panicles (%)	Silver shoots (%)	Yield (t/ha)
		Late		
IET56-56	18.1	40.2	52.8	4.9
Suku Gurmatiya [a]	9.0	26.7	52.8	1.6
Safari 17 [a]	4.3	39.2	31.3	0.9
Mahsuri	23.8	22.3	25.2	3.7
		Resistant		
Bangoli 2 (GMR 11)	9.8	94.9	0.1	6.1
Bangoli 3 (GMR 17)	15.8	91.1	0.0	5.0
Bangoli 5 (GMR18)	10.3	87.2	0.6	6.3
RP9-4	10.8	84.9	0.0	6.2
Bangoli 6 (GMR19)	12.0	82.8	0.2	6.3
RPW6-17	10.0	87.0	0.1	5.4
R2384	6.8	71.6	0.0	5.2
R35-2750	8.8	76.1	0.4	6.8
R35-2752	7.4	49.8	0.4	5.6

[a] Broadcast.



Performance of rices of various maturity groups in relation to gall midge.

(see table). Transplanted paddy always yielded more than broadcast paddy.

In the medium maturity group, silver shoots ranged from 6.2 to 45.6%.

Gall midge was severe in both tall and semidwarf varieties of the late maturity group.

Resistant varieties not only withstood the gall midge attacks but also performed well in panicle formation and yield.

The performance of each paddy group was determined. The average percentage of panicles decreased gradually from early to late maturity groups, but was highest in the resistant varieties (see figure). Similarly, the percentage of gall midge infestation, as indicated by silver shoots, was lower in the early group and higher in the medium and late groups. Medium-maturing varieties yielded highest. Resistant varieties performed best.

Large-scale cultivation of resistant varieties can help control gall midge and reduce the use of insecticides, which not only are costly but also perform poorly against gall midge. ■

GENETIC EVALUATION AND UTILIZATION

Drought resistance

C22, a promising rice culture for semidry tracts

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The variety C22 was evolved at the University of the Philippines at Los Baños from the cross Tjere Mas/BPI-76//Palawan/Azucena. It was received through the International Rice Testing Program, coordinated by IRRI, as one of the entries in the Third International Upland Rice Yield Nursery.

A medium-tall variety with long slender grain, C22 matures in 135 days. It was tested in yield evaluation trials for 3 consecutive years in samba season (Aug–Dec 1976–78). The popular varieties IR20 and TKM8 were also tested in the trials (see table). ■

Performance of C22 at Tirurkuppam, Tamil Nadu, India.

Variety	Mean yield (t/ha)	Increase over TKM8 (%)	1000-grain wt (g)	Grain shape
C22	3.7	49.1	22.4	Slender
IR20	2.8	12.8	20.5	Medium
TKM8	2.5	–	19.7	Medium

GENETIC EVALUATION AND UTILIZATION

Adverse soils tolerance

MR375—A salt-tolerant rice suitable for coastal saline soils

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About 4,500 ha of rice land along the coasts of Karnataka are flooded by seawater every kharif. The Agricultural Research Station (ARS) at Ankola, on the sea coast of North Kanara district, is well suited for research on coastal saline soils and on varietal improvement for salty areas. The station's soils are acidic, generally high in exchangeable sodium and hydrogen, and low in calcium content. The varieties B146 and K12 are successfully grown in wetland soils of this region during kharif. B146 was selected at Ankola from a natural bulk population of the variety Bilekagga; K12 is from Karekagga. B146 does well in less severely saline soils. K12 can withstand higher salt concentrations and is suitable for low-lying wetlands. Both are tall indica varieties with coarse grains, prominent awns, and red kernels. Although their grain quality is poor their yields are fairly high in wetland conditions.

To improve its grain quality and plant type, K12 was crossed with IR8 in 1970. The progeny, now stabilized, are being tested in yield trials to determine their suitability for inland and coastal saline soils, and in adverse soils at the UAS experimental station at Hiriyur and at Ankola. Eighteen selected K12/IR8 lines (designated "MR") and 10 other standard salt-tolerant varieties were tested in wetland soils at the Ankola ARS. The entries were grown in a randomized block design with 4 replications, fertilized at 40-40-40 kg NPK/ha. The net plot size per entry was 4 m^2, spaced at 20 × 15 cm and seeded at 75 kg/ha.

MR375 yielded highest, 1.8 t/ha, followed by Dasal and Gettu (1.5 t/ha) (see table). MR375, a semitall variety with stiff straw and medium-slender grains, matures in about 125 days. Its yields did not differ significantly at the 1 % level from those of Dasal and Gettu, the standard salt-tolerant varieties. The next best culture, C7 (1.3 t/ha), is a semidwarf with fine grains, similar to those of Sona, and tight panicles. In. experiments at the Hiriyur ARS in inland saline soils, C7 was tolerant of inland salinity, although its yields were inconsistent. The performance of the salt-tolerant SR26B in wetland at the Ankola ARS was not encouraging. With suitable agronomic practices MR375 should yield at least 2 t/ha in wetland. ■

Results of salt tolerance variety trial at the Agricultural Research Station, Ankola, Karnataka, India, 1978 wet season.

Designation	Yield (t/ha)	Plant ht (cm)	Panicles (no./m^2)	Maturity (days)
MR261	0.6	78	146	134
MR339	0.6	63	103	114
MR340	0.9	61	123	115
MR341	0.6	62	133	114
MR342	0.9	65	136	114
MR375	1.8*	93	113	123
MR343	1.2	99	146	115
MR338	0.8	70	123	114
MR346	0.9	73	99	123
KI42	0.4	79	146	117
MR358	1.0	66	136	114
MR359	1.2*	84	146	139
MR361	0.7	111	160	140
MR362	0.8	75	120	117
MR363	0.7	91	126	132
K125	1.2*	66	99	112
MR376	0.8	67	126	111
MR377	0.4	57	89	123
Dasal	1.5*	86	113	133
Gettu	1.5*	90	118	133
Madhu	1.2*	74	116	113
IR2070-4-14	0.3	70	120	118
C7	1.3	71	106	118
Mangala	0.4	66	140	98
IET2254	1.0	65	113	123
Arya	0.7	113	146	124
F test	**			
CD (0.05)	0.4			
CV %	28.6			

* = differs significantly (P=0.05) from the highest yielding check (Arya); ** =significant at 1% Level; CD = critical difference at 5% level.

GENETIC EVALUATION AND UTILIZATION

Deep water

Root and soil parasitic nematodes of deepwater rice areas in Bangladesh

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Parasitic nematodes were surveyed in nine deepwater rice areas of Bangladesh in collaboration with members of the ODM-funded Deepwater Rice Pest Management Team, BRRI. Samples of soil and water, and of plant material, were collected at 65 sites randomly selected from farmers' fields from 19 June to 9 August 1978. Nematodes were extracted from the culms, panicles, roots, soil, and floodwater, and identified at IRRI.

Seventy-two percent of the sites were infested with plant parasitic nematodes. Several nematodes, in addition to the ufra nematode *Ditylenchus angustus* (which causes the most damage to deepwater rice), were extracted from the roots and soil. Until this study, those sites of infestation had been studied in less detail than the aerial parts of the deepwater plant. The following types of nematodes were found:

Type	Sites (%) with infestation
Meloidogyne graminicola	30
Hirschmanniella oryzae	52
Tylenchorhynchus martini	16

Unidentified species of *Longidorus* and *Xiphinema* were also occasionally found.

All three known nematode parasites of rice — *M. graminicola, H. oryzae,* and *T. martini* — probably cause significant yield reductions in deepwater rice in Bangladesh. *M. graminicola* root-knot nematode probably causes the most damage to the aman crop. Typical field symptoms are yellowing and stunting, associated with the presence of *M. graminicola* females within roots and with some galling. *M. graminicola* can obviously tolerate flooding — large numbers of it were found in roots submerged in water as deep as 1.5 m, which was expected to reach more than 4-m depth later. The soil temperatures at the sites ranged from 31 to 36°C. The main *M. graminicola* damage appeared to be reduction in the ability of the deepwater rice plant to elongate so that it could not keep pace with the rising floodwater. In some situations, that could result in the complete drowning out of the crop. ■

Synergy between benomyl and carbofuran in the control of ufra

P. G. Cox, plant pathologist, and L. Rahman, scientific officer, BRRI/ODA Deep-water Rice Pest Management Project, Bangladesh Rice Research Institute, Joydebpur, Dacca, Bangladesh

Ufra (caused by the stem nematode *Ditylenchus angustus* Filipjev) is a serious disease of deepwater rice in southern Bangladesh. During 1978, an experiment on its chemical control when symptoms appear in the vegetative phase was laid out at a study site in Comilla District. A treated plot was arranged on each edge of a square untreated control plot to form a cross. All plots were 5 m x 5 m. The design reduced edge effects between treated plots as no two were contiguous along a boundary. Patchiness in disease distribution was also reduced as each treated plot was equidistant from the control and was surrounded by an untreated area. Four treatments were allocated randomly to the outer plots (see table). There were three replications in different fields. All were harvested in November.

Chemicals were applied in mid-August (soon after the appearance of chlorosis and distortion of the young leaves) and just before panicle initiation in early October. Carbofuran, a granular insecticide, was applied to the flood-water (about 0.5 m deep) as Furadan 3G at 2 kg/m^2. Benomyl, a systemic fungicide, was applied to the foliage with a knapsack sprayer as Benlate 50 WP at 12.5 g/25 m^2. Since it is easier to detect synergy between two chemicals when the marginal physical product of one of them approaches zero, a high rate of carbofuran was necessary.

The analysis of variance indicates a significant difference between treatment effects ($p<0.01$). Two applications of benomyl did not give a significant yield improvement. The three other treatment means were significantly different from the mean of the control plot ($p<0.05$). The significant difference between F + B and B + F may be explained either by the diminishing effect of carbofuran or an augmented effect of benomyl, as the time of application was postponed. There is evidence of a synergistic interaction between carbofuran and benomyl in the control of ufra. Although two applications of benomyl were less effective than two applications of carbofuran, carbofuran was less effective than benomyl after an initial carbofuran application. ■

Yield of rough rice at three sites with chemical treatment with carbofuran (F) and benomyl (B) after the appearance of symptoms of ufra attack in the vegetative phase.

Treatment[a]	Yield of rough rice (t/ha at 14% moisture)				
	Block 1	Block 2	Block 3	Treatment totals	Treatment means[b]
F + B	1.54	1.53	1.86	4.93	1.64 ± 0.13 a
F + F	1.38	1.40	0.90	3.68	1.23 ± 0.13 ab
B + F	1.11	1.32	0.94	3.37	1.12 ± 0.13 bc
B + B	0.98	0.67	0.73	2.38	0.79 ± 0.13 cd
Control	0.45	0.96	0.61	2.02	0.67 ± 0.13 d
Block totals	5.46	5.88	5.04	16.38	1.09

[a]The first letter of each treatment represents application in mid-August; the second letter, application in early October.
[b]Any two means having a common letter are not significantly different at the 5% level.

Pest management and control DISEASES

Efficiency of granular herbicides and cultural methods in rice weed control

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Granular forms of 2 esters (isopropyl and ethyl of 2,4-D at 1.0 and 1.5 kg a.i./ha were compared for efficiency in weed control with butachlor (G) at 2 kg/ha, nitrofen (G) at 2.0 kg/ha, propanil at 3.0 liters + 2,4-D Na salt at 0.8 kg a.i./ha, two hand weedings, a weed-free check, and an unweeded control in 1978 kharif. The weed flora in the experimental field included *Echinochloa colonum, Cynodon dactylon, Cyperus* spp., *Fimbristylis* spp., *Ammania baccifera, Ludwigia* spp., *Eclipta alba, Monochoria vaginalis, Potamogeton,* and *Anagallis arvensis.* The butachlor treatment had the lowest weed count, followed by 2,4-D EE at 1.5 kg/ha. The dry weight of weeds was lowest with 2,4-D IPE at 1.5 kg/ha — statistically the same level as that with 2,4-D IPE at 1.0, 2,4-D EE at 1.5 and

1.0, and nitrofen at 2.0 kg/ha. For early-maturing varieties such as Pusa 33-30, yields were highest with 2,4-D IPE at 1.0 kg/ha, followed by yield with nitrofen. These treatments were statistically similar to the weed-free check and two hand weedings. ■

Leaf scald disease of rice in Sierra Leone

S. A. Raymundo, pathologist. Rice Research Station, Rokupr, Sierra Leone, West Africa

Although leaf scald disease of rice incited by *Rhynchosporium oryzae* has long been present in West Africa, precise information about its economic significance is meager or entirely lacking.

From 1974 to the present the author has worked with the disease in farmers' fields and experimental plots. The following are general conclusions:

1. The disease is most severe in the uplands. Yield reductions from 9 to 12% were estimated from preliminary studies.
2. Severe infection (more than 25% leaf area desiccation) can occur in wet season paddy or irrigated rice. The disease appears insignificant on dry season crops.
3. Visible infection usually appears after the end of tillering. However, the disease has also been found in seedling nurseries.
4. Narrow-leaf varieties like ROK 3, PN 623-3, ADNY 8, and ROK 8 are less affected than broad-leaf varieties like IRAT 8, Moroberekan, LAC 23, and ROK 16.
5. Broadleaf varieties that retain water droplets on the leaf surface are more susceptible to the disease.
6. The disease is more severe on fertilized than unfertilized plots. This susceptibility under varying soil fertility levels was particularly striking in Sierra Leone's "On Farm Trials" network where upland plots received 60 kg N/ha, 40 kg P/ha, and 40 kg K/ha.

At the Rokupr Rice Research Station, studies on yield loss, epidemiology, plant canopy characteristics, spacing, and fertility levels in relation to disease severity, are in progress. Additionally, varietal screening for total performance including resistance to scald is continuing. ■

Rice diseases during kharif in Karnataka, India

S. Sanne Cowda, pathologist (AICRIP), The University of Agricultural Sciences, Regional Research Station, V. C. Farm, Mandya, Karnataka, India

Rice blast caused by *Pyricularia oryzae* occurs every year in the main rice-growing areas of Karnataka state. Neck blast is usually more damaging than leaf blast. Out of 683 NSN entries screened for blast, only 35 were resistant at Ponnampet during 1978 kharif: IET6586, IET6731, IET6814, IET6868, IET6873, IET6876, IET6877, IET6880, IET6881, IET6882, IET6883, IET6884, IET6894, IET6899, IET6900, IET6907, IET6914, IET6916, IET6950, IET6951, IET6952, IET4554, IET5905, IET5909, IET5910, IET5911, IET6046, IET6260, IET4699, IET5735, IET6312, IET6663, IET6665, IET6667, and IET6669.

Brown leaf spot *(Helminthosporium oryzae),* the next most important disease, occurs throughout the state.

Udbatta disease *(Ephelis oryzae)* has increased in recent years. Severe infection of high yielding dwarf varieties caused considerable yield loss.

The problems of grain discoloration increased after the introduction of high yielding varieties. The discolored grains are associated with organisms like *P. oryzae, Trichoconis oryzae, and Dreschlera oryzae.*

Leaf scald due to *Rhynchosporium oryzae* has been observed in the past 7 to 8 years on high yielding varieties.

Other erratic and minor diseases like bacterial leaf blight *(Xanthomanas oryzae),* false-smut *(Ustilaginoidea virens),* sheath blight *(Corticium sasakii),* and sheath rot *(Acrocylindrium oryzae)* have also been observed. ■

Acquisition of rice tungro virus through parafilm membrane by *Nephotettix virescens* (Distant)

P. Q. Cabauatan and K. C. Ling, International Rice Research Institute, Philippines

The ability of 547 adult *Nephotettix virescens* to acquire the tungro virus from diseased leaves covered with parafilm was tested. After an acquisition access time of 1 to 4 days, 56 to 75% of the insects became infective on TNl seedlings (see table). In general, the percentage of infective insects increases as the acquisition access time lengthens from 1 to 4 days. But in this test it decreased on the third and fourth day because the diseased leaves became necrotic from continuous insect feeding, and started to decay. The parafilm membrane did not hinder acquisition feeding by the insect. The method may therefore be used for developing a bioassay of the virus. ■

Percentage of infective *N. virescens* after acquisition feeding on tungro-diseased leaves covered with parafilm. IRRI, 1979.

Acquisition access time (days)	Insects tested (no.)	Infective insects (%)
1	221	56
2	197	75
3	89	74
4	40	68

Field efficacy of stable bleaching powder to control bacterial blight of rice

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In a field trial during 1977 and 1978 kharif, stable bleaching powder (SBP) was tested for the control of bacterial blight of rice. Seedlings of Jaya were inoculated with a virulent isolate of *Xanthomonas oryzae* (Uyeda and Ishiyama) Dowson by the clipping method 3 weeks after transplanting. Three 15 kg/ha applications of SBP were spread on fields having 4.5 to 5.0 cm of standing water to provide 10 ppm chlorine. The first application was made 72 hours before inoculation and subsequent applications were at fort-nightly intervals. Disease incidence was recorded 2 weeks after the last application; the other observations were made at harvest (see table).

Application of SBP reduced disease incidence and percentage of chaffy grains. It increased the number of panicle-bearing tillers and total yield over that in the inoculated control. However, differences among various treatments were not significant. SBP is cheaper than other spray chemicals. One or two 15 kg/ha applications during the rainy season, when it is difficult to spray the crop, may help prevent a secondary spread of the pathogen. ■

Effect of soil-applied stable bleaching powder in controlling bacterial blight of rice, av for 2 years, Ludhiana. India. 1977–78.

Applications (no.)	Disease incidence (%)	Yield (t/ha)	Wt (g) of 1000 healthy grains	Chaffiness (%)	Tillers (no./m^2)	
					With panicles	Without panicles
1	50.8	5.6	28.2	25.8	220.5	68.5
2	49.9	5.6	28.8	25.8	223.0	56.5
3	49.6	5.7	28.9	25.6	234.0	52.0
Control (inoculated)	58.9	5.0	28.8	32.7	215.5	73.5
Control (uninoculated)	9.4	6.4	29.3	15.9	272.0	45.0

A survey of South Arcot District in Tamil Nadu for diseases of rice

S. Srinivasan, Paddy Experiment Station, Aduthurai, Tamil Nadu, India

The rice crop on about 230 ha in 8 villages (Vaniyampalayam, Sundaripalayam, V. Akaram, Kurunthipadi, Pennadam, Mazhikaikottam, Eraiyur, and Erappavur) in South Arcot district of Tamil Nadu was surveyed for rice diseases on 13 and 14 December 1978. Rice tungro virus disease had the highest incidence, followed by sheath rot and narrow brown leaf spot (see table). ■

Disease incidence on 4 varieties of rice, Tamil Nadu, India, 1978.

Variety	Tungro (%)	Brown spot (%)	Sheath rot (%)	Narrow brown leaf spot (%)
IR20	56.3	–	43.2	29.6
BCP 1	17.9	–	11.6	3.4
Co 40	90.7	81.5	31.9	5.9
Ponni	35.2	–	17.4	–

Pest management and control INSECTS

Yield loss due to rice tungro virus

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During 1978 kuruvai and samba, a severe incidence of rice tungro virus was observed in Thanjavur district of Tamil Nadu. A study to estimate yield loss caused by the virus was undertaken. The test variety was the highly susceptible ADT 31. Yields from 100 hills that showed disease symptoms at 15, 30, 45, and 60 days after transplanting were recorded. The yield from 100 healthy hills was also recorded (see table).

During the year severe tungro disease reduced the yield from some of the PES fields to only 450–700 kg/ha. ■

Yield losses caused by rice tungo virus, Thaniavur district. India. 1978.

Time (DT)[a] when disease symptoms were observed	Grain yield (g/100 hills)	Yield loss (%)
Diseased plants		
15	8.8	98.5
30	14.8	97.2
45	369.6	30.4
60	490.2	7.5
Healthy plants		
	529.7	

[a] Days after transplanting.

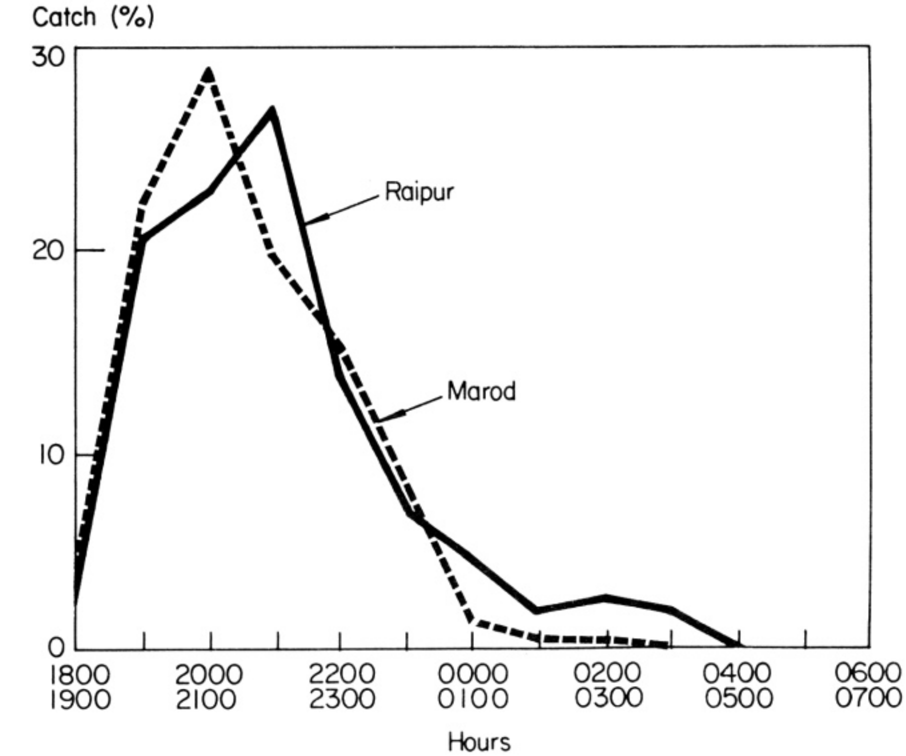
Attraction of gall midge to lights

S. K. Shrivastava, P. D. Deshmukh, D. J. Pophali, G. A. Gangrade, U. K. Kaushik, B. C. Shukla, and G. L. Patidar. Operational Research Project on Integrated Control of Rice Pests, College of Agriculture, Raipur, Madhya Pradesh, India

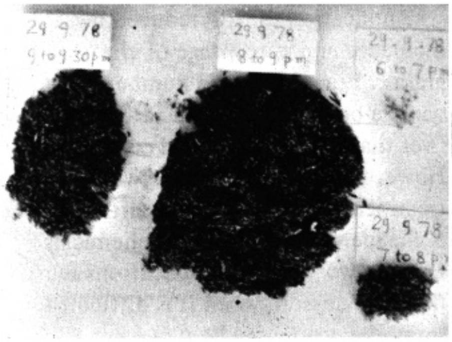
A 1978 epidemic of *Orseolia oryzae* on kharif paddy in Chattisgarh region, Madhya Pradesh, is suspected to have been caused by the fact that the summer paddy crop (Jan–Jun) was linked with the kharif season, so gall midge is carried over. About 8% of the tillers of the preceding summer paddy crop harbored gall midge.

A 100-watt electric bulb was fitted at 2-m height near farmhouse walls at both Raipur and Marod. Swarms of gall midge adults attracted to the lights were then caught by hand net. Times of peak catches at both locations were similar. At Marod 2.1% were caught from 1800 to 1900 hours, 22.5% from 1900 to 2000, 29.8% from 2000 to 2100, 27.5% from 2100 to 2200, and 15.5% from 2200 to 2300 (Fig. 1). The majority (87.4%) of the flies were attracted between 1900 to 2300. After that, the catches declined to 8.3% just before midnight. Thus 97.8% of the flies were attracted and caught before midnight.

Peculiarly, at midnight of 29 September, 98% of the flies were attracted between 2000 and 2100 hours. That night 877,500 flies were collected (Fig. 2). Catches declined the next day. Weather conditions (evening temperature



Hourly attraction of gall midge to electric bulb, Tamil Nadu, India.



Hourly collection of gall midge by light. Tamil Nadu, India.

and humidity) caused the wide fluctuations in fly attraction. The sex ratio of males to females was about 1:7.

Electric lights were a powerful attraction for gall midge and may be useful in integrated control. But unlike ordinary lamps and the Petromax lamp, they do not kill the flies. Electric lights designed to kill flies would greatly reduce the gall midge population.■

Fumigation effect of certain granular insecticides against the brown planthopper

P. R. M. Rao and P. S. Prakasa Rao, Central Rice Research Institute (CRRI), Cuttack, Orissa, India

Certain insecticides used either as foliar spray or as paddy water application act as fumigants, and, at least initially, give considerable control. This finding may be significant for brown planthopper (BPH) control because most of the adults and nymphs stay at the base of the rice plants. When applied to paddy water or as foliar spray, insecticides that have high fumigant action may be more effective in the field, considering that the thick rice canopy forms an air cover for this special microhabitat.

Sixteen commercial granular insecticides at 1.5 kg a.i./ha in wet and dry forms were tested against BPH adults. Dry granules and granules moistened with water were tested separately in an experiment replicated three times. The required amount of each insecticide

Evaluation of insecticides applied at 1.5 kg a.i./ha in wet and dry forms for their effectiveness as fumigants against brown planthopper adults.[a] 11–14 Apr 1977, CRRI, India.

Insecticide	Corrected mortality (%) of insects exposed			
	12 h		24 h	
	Dry form	Wet form	Dry form	Wet form
Phorate	100	100	100	100
AC92, 100 (Counter)	100	100	100	100
BPMC	50	100	100	100
MIX	30	10	77	70
Disulfoton	73	30	100	60
Endosulfan + BPMC	40	30	70	57
Fenthion	0	17	13	40
Fensulfothion	0	10	0	13
Quinalphos	0	3	7	10
Carbofuran	0	0	33	0
Chlordimeform	20	0	37	0
Monocrotophos	0	0	0	0
Lindane	0	0	0	0
Fenitrothion	0	10	10	23
SAN 197	13	3	27	23
SAN 1551	0	0	10	23
Control	0	0	0	0

[a] Max temp = 34.4°C, min temp = 22.2°C, mean max temp = 33.7°C, mean min temp = 24.3°C, mean RH = 74%.

(calculated on the basis of the diameter of the chimney used in the investigations) was kept in small cups, over which a fine wire mesh (36 gauze) was placed to prevent BPH from coming in direct contact with the chemicals. The small cups were kept near the base of potted plants of TN1 and a chimney covered both the plant and the cups. Ten adult insects were simultaneously released in each treatment. The upper end of the chimney was covered with fine nylon netting. Mortality was recorded at 12 and 24 hours after insect release.

Disulfoton and MIPC were effective fumigants in both dry and wet forms (see table). Application of their granular forms to paddy water can give good field control of BPH. ■

Ovicidal action of insecticides on brown planthopper eggs

P. R. M. Rao and P. S. Prakasa Rao, Central Rice Research Institute (CRRI), Cuttack, Orissa, India

The brown planthopper (BPH) is an important rice pest, particularly of high yielding varieties. Because the insect thrusts its eggs into the tissues of rice leaf sheaths, insecticidal contact is difficult. Satisfactory control can be achieved only by spraying a persistent insecticide with ovicidal action.

Laboratory experiments to determine the effectiveness of various insecticides and treatments against BPH eggs laid in the leaf sheath were conducted at CRRI (see table).

Five gravid females were caged overnight on potted plants of TN1 for oviposition. Aqueous solutions of 11 commercial insecticidal preparations were applied as foliar sprays at 0.05% concentration. Sixteen granular insecticides were broadcast at 2.0 kg a.i./ha (calculated by taking the diameter of the pot) on the soil surface of the pot to simulate paddy water application. Sixteen granular insecticides were dropped directly in holes made near the rice plants to simulate root-zone placement. Each rice plant had 1-, 3-, and 5-day-old BPH eggs. The control was an untreated plant with BPH eggs. The experiment was replicated three times. The treated plants were observed for ovicidal action (hatching or nonhatching of eggs) for 10 days.

Carbofuran applied by any method, carbaryl as foliar spray, and BPMC and MIPC applied into standing paddy water or placed in the root zone caused the ultimate death of all eggs before normal hatching. But quinalphos as a foliar spray inhibited normal hatching of 5-day-old eggs only. ■

Effects of insecticides applied as foliar spray, paddy water broadcast application, and into the root zone on hatching of 1-, 3-, and 5-day-dd brown planthopper eggs. Central Rice Research Institute, Cuttack, India, 11–20 April 1977.

Insecticide	Hatching[a] of eggs as affected by								
	Foliar spray (0.05%)			Application at 2 kg a.i/ha into					
				Standing (paddy) water			Root zone		
	1	3	5	1	3	5	1	3	5
Carbofuran	A	A	A	A	A	A	A	A	A
Carbaryl	A	A	A	A	A	A	A	A	A
Quinalphos	H	H	A	H	H	H	H	H	H
Chlorpyrifos	H	H	H	H	H	H	H	H	H
Monocrotophos	H	H	H	H	H	H	H	H	H
Chlordimeform	H	H	H	H	H	H	H	H	H
Endrin	H	H	H	H	H	H	H	H	H
Phosphamidon	H	H	H	H	H	H	H	H	H
Dimethoate	–	–	–	H	H	H	H	H	H
BPMC	–	–	–	A	A	A	A	A	A
MIPC	–	–	–	A	A	A	A	A	A
Ac, 92, 100	–	–	–	H	H	H	H	H	H
Fensulfothion	–	–	–	H	H	H	H	H	H
Carbaryl + lindane	–	–	–	H	H	H	H	H	H
Mephosfolan	–	–	–	H	H	H	H	H	H
Endosulfan	H	H	H	H	H	H	H	H	H
Lindane	–	–	–	H	H	H	H	H	H
Chlorfenvinphos	–	–	–	H	H	H	H	H	H
Diazinon	H	H	H	H	H	H	H	H	H
Phorate	–	–	–	H	H	H	H	H	H

[a] A = abnormal hatching, H = normal hatching, – = not tested; max temp, 34.4°C, min temp, 22.2°C; mean max temp, 33.7°C, mean min temp, 24.3°C, mean RH, 74%.
Abnormal: Fully developed eggs with eye spots, 6 days after oviposition, pierced through the leaf sheath. At this stage, they are dying. In normal hatching, 1st-instar nymphs emerged 6 days after oviposition.

Soil-incorporated carbofuran for control of rice whorl maggots and "early" stem borers

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Rice seedling damage caused by the rice whorl maggot *Hydrellia* sp. during the first month after transplanting has increased steadily in the Philippines in the past 10 years. Most insecticidal sprays only partially control the pest. Granular forms of carbofuran or diazinon control the insect reasonably well where water management is good but control it poorly where rains wash the granules off the paddy. Soaking of seedling roots in solutions of granular or flowable (F) carbofuran is effective for 20 to 25 days after transplanting, but is time-consuming and messy. With F the method may be risky for those handling the solution.

IRRI field trials in the 1977 wet season with soil-incorporated granular carbofuran gave excellent control of all insects, except brown planthopper (BPH), on the susceptible varieties IR22 and TN1 for as long as 50 days after transplanting. Control of BPH lasted 25 days.

BAEX extension specialists implemented evaluation trials with different rates of soil-incorporated granular carbofuran in farmers' fields in the 1978 wet season. They used BPI Ri-4, a new 113-day Bureau of Plant Industry rice variety (selection MRC603-303, from the cross C12// Sigadis/TN1///IR424 (Masagana 99 Group II).

BPI Ri-4 is resistant to BPH biotype 1, appears to have field resistance to biotype 2, and is moderately resistant to stem borers. Current Masagana 99 crop protection recommendations do not include insecticide control for either "early" or "late" stem borers. BPH, a minor problem in the Philippines in 1978, was serious in 1977.

The average yields from 43 irrigated rice farms in 20 provinces are shown in the table.

Soil-incorporated granular carbofuran of as little as 0.5 kg a.i./ha returned high profits from the control of early season insect pests, primarily the whorl maggot and stem borers, on farms.

The Philippines may recommend soil incorporation of granular carbofuran for the Masagana 99 national rice production program for the 1979 wet season (beginning in May). ■

Average yields from 43 irrigated farmers' fields in 20 provinces, Philippines, 1978 wet season.

Insecticide rate[a] (kg a.i./ha)	Yield (t/ha)	Yield increase (t/ha)	Value of increase at US$0.15/kg	Cost of US$ granular carbofuran	Increase in profit (US$/ha)
0	4.0	–	–	–	–
0.5	4.7	0.7	105	15	90
0.75	5.0	1.0	150	22	128
1.00	5.1	1.1	165	30	135

[a] Other Masagana 99 insect control recommendations: 5 kg $ZnSO_4$/ha, MTMC spray at 0.75 kg a.i./ha applied to all treatments 50 days after transplanting.

Evaluation of systemic effect of insecticides against brown planthopper

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Of about 100 species of insect pests that attack rice in India, the brown planthopper (BPH) is the major one in many states. BPH epidemics have become frequent since about 1970. Chemical control measures are not satisfactory because the nymphs and adults remain at the base of the rice plant and the thick plant canopy forms an air cover, preventing the insecticidal spray from reaching them. To overcome this limitation studies were conducted to identify insecticides capable of killing the insect even if they are superficially applied on the crop foliage.

Aqueous solutions of 14 commercial insecticide preparations were applied as 0.05% sprays on the upper foliage of 1-month-old potted plants of TN1. The plants' basal 15-cm portions were covered with masks. The insecticides were sprayed with a fine atomizer until the runoff stage. The sprayed plants were kept in open air for 24 hours. Then the treated foliage was cut off and the plants were enclosed in cages. Ten healthy BPH adults were confined on each plant. Mortality was recorded at 12 and 24 hours after the insects' exposure to the treated plants. The experiment was replicated three times.

Chlorpyrifos had the highest systemic effect, followed by carbofuran, quinalphos, methamidophos, dicrotophos, and phosphamidon (see table). The insecticides would be promising where the dense rice canopy prevents superficial insecticidal sprays from reaching the basal plant parts, where nymphs and adults remain. ■

Evaluation of systemic effect of some candidate insecticides applied as 0.05% foliar sprays against brown planthopper adults.[a] 11–13 April 1977, Central Rice Research Institute, India.

Insecticide	Corrected mortality[b] (%) 12 hours	24 hours
Chlorpyrifos	100	100
Phosphamidon	33	63
Carbofuran	77	77
Carbaryl	40	40
Dicrotophos	50	63
Monocrotophos	33	53
Quinalphos	47	67
Dimethoate	23	43
Methamidophos	50	67
SAN 197	0	30
Vamidothion	0	0
Dichlorvos	0	0
Control	0	0

[a]Max temp = 34.4°C, min temp = 22.2°C, mean max temp = 33.7°C, mean min temp = 24.3°C, mean relative humidity = 74%. [b] Treated foliage portion cut off 24 hours after insects were exposed to treatment.

Emergence of rice leaf butterfly as a rice pest in Manipur, India

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Until 1973, the rice leaf butterfly *Melonitis leda ismene* Cramer was unknown to farmers of Manipur state. The first extensive infestation of the insect in the state was in 1973 kharif in Imphal, the central district, on a few new high-yielding and two local varieties (see table). The pest was noticed in the field in early August at the maximum tillering stage of the main second crop and infestation continued until late November when the crop was almost mature. Horned caterpillars of the butterfly fed on the tender foliage in late morning and early evening, and sometimes caused severe defoliation. Fields planted to second crops with ensured water supply were

Infestation of rice leaf butterfly on rice. Centra district, Imphal, Manipur, India

Variety	Location	Area infested[a] (ha)	Time	Plant parts infested
IR8	Changangei	4.05	Aug	Leaves
IR24	Kakching, Yurembam, Tabungkhok	81.00	Jul–Aug	Leaves
Ratna	Kakching	16.20	Jul–Aug	Leaves
Jaya	Changangei, Thoubal	4.05	Aug	Leaves
Moirangphou (local variety)	Kakching	40.50	Aug	Leaves, stem
Phourel (local variety)	Thoubal	6.07	Aug	Leaves, stem

[a]Converted from acres.

attacked more heavily than first-crop fields. Rice fields under shifting cultivation on hill slopes were not infested.

A study was made in 1973 kharif to determine the extent of infestation and the "hot spots" in Imphal, where most rice cultivation is confined.

The pest is well established in the major rice belt of Manipur, extending south to the Bishenpur block and north to Kangpokpi. Observations during the past 4 to 5 years confirm that the pest is building up in the state, necessitating regular chemical control as that for yellow stem borer and gall midge.

Further buildup of the pest cannot be ruled out, considering the changed agricultural strategy in Manipur brought about by the introduction of more high-yielding varieties, the extension of areas under such varieties, heavier fertilizer applications, and increased cropping intensity. Along with the rice caseworm *Nymphula depunctalis,* leaf butterfly is fast emerging as a pest at early growth stages of the second paddy crop — the bulk of rice production in the state. ■

Chemical control of the brown planthopper

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A study to determine suitable pesticides for control of the brown planthopper (BPH) was conducted in our field in kharif 1978.

The trial was laid out in a randomized block design, replicated four times. The insecticides fenitrothion, monocrotophos, ethion, and quinalphos at 0.05% concentration were compared with an untreated control. They were sprayed at crop growth stages from the nursery to the hard dough stage. The BPH on five randomly selected hills per replication were counted before and periodically after each spraying.

All the insecticidal sprays significantly reduced BPH infestation and increased yields over that of the control (see table). Treatments with ethion were most effective, followed by those with monocrotophos and fenitrothion. ■

Brown planthopper incidence and rice yields on plots treated with various chemicals. Mangalore, India.

Treatment[a]	BPH (mean no./ 5 hills)	Mean yield (kg/plot)
Fenitrothion	27.2	2.0
Monocrotophos	15.2	2.3
Ethion	8.0	3.0
Quinalphos	35.2	1.8
Control	67.5	0.9
CD at 0.5%	12.57	0.22

[a]All treatments applied at 0.05%.

Hopperburn by the orange-headed leafhopper in Bangladesh

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In Bangladesh, hopperburn caused by the brown planthopper, whitebacked planthopper, and green leafhopper was previously reported. This is the first report on hopperburn caused by the orange-headed leafhopper (OHLH) *Thaia oryzivora* Ghauri.

Ghauri (1962) described the new genus *Thaia* and the new species *Thaia oryzivora* on paddy in Thailand. Smaller than *Nephotettix* spp., OHLH can be easily identified by its orange-colored head and subhyaline fore wings. This leafhopper was first recorded in Bangladesh — on wheat in 1964 and on rice in 1968 — by H. Z. Alam. Ahmed and Samad (1972) regarded the insect as a pest of economic importance in Bangladesh. It usually feeds on the undersurface of leaves, causing necrotic lesions around feeding sites. The badly affected leaves show white scars or irregular lines on the upper surfaces. Adults and nymphs produce similar damage. Alam and Alam (1977) reported that the insect breeds actively in October and November and again in February and March, producing high populations during those periods.

Hopperburn occurred the last week of March in areas with controlled irrigation in the Dacca area. There was standing water in the fields and rice growth was luxuriant. Hopperburn occurred from flowering to the hard dough stage in IR8, especially that planted in November or early December. It did not occur on BR3, BR6, and Pajam II. Although OHLH caused negligible hopperburn, it is a potential pest of rice in Bangladesh. ■

Chironomid fauna of Korea and their role in the rice agroemsystem

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Chironomids are the most numerous insects in the rice paddy ecosystem in Korea. However, the significance of chironomid fauna in the ecosystem is not known.

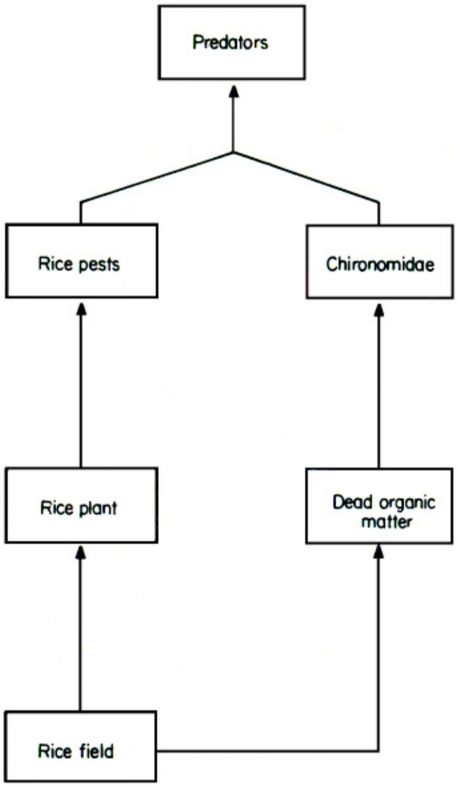
In the summer 1975, Yasumatsu and Chang collected chironomids in the rice paddies of Suweon, Korea. Hashimoto identified the specimens as follows:

1. *Smittia* sp.
2. *Mesosmittia* (?) sp.
3. *Chironomus nipponensis* Tokunaga
4. *Chironomus plumosus* Linnaeus
5. *Syncricotopus rufiventris* (Meigen)
6. *Cricotopus trifasciatus* Panzer
7. *Harnischia* sp.
8. *Orthocladius suspensus* Tokunaga
9. *Eukiefeeriella* sp.

The only chironomid species previously reported from Korea is *Chironomus oryzae* Matzumura. But it was not identified by a specialist. We believe that the species identified as *Chironomus oryzae* is *C. plumosus.* More material is still under taxonomic study by Hashimoto, and more species will later be added to the list.

Most species of chironomids breed in dead organic matter and the adults emerge in large numbers. Predators, such as spiders and damselflies, feed on them and also on pests that breed on the rice plant (see figure).

Chironomids are significant to the agrosystem. Throughout the vast rice areas of Asia they serve as an alternative food of predators and thus help conserve predators when rice pests are scarce. Chironomids are often more abundant and easily captured than rice pests.



Relationship of predator to chironomids and rice pests in the rice ecosystem.

Because predators tend to capture them rather than the other insects, the beneficial effects of predators is reduced. In some fields, spiders have no effect on the pest population when the chironomid population is high.

Any field research on rice pests and predators that ignores chironomids is unrealistic and may give unreliable information on the development of integrated rice pest control. With Thai entomologists, Yasumatsu and Hashimoto are making an extensive survey of the chironomid fauna in the rice paddies of Thailand. ■

Occurrence of *Sogutodes oryzicola* (Muir) in upland rice in Goias, Brasil

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During 1977–78 a preliminary survey of insect pests of upland rice in the experimental fields of the National Rice and Beans Research Center in Goiania revealed diverse species of leafhoppers and planthoppers in the cultivar IAC47. The insect that occurred most frequently was *Sogatodes oryzicola* (Fulgoroidea – Delphacidae) (see table). This insect, a vector of the virus disease hoja blanca, is an important rice pest in Latin American countries. It was first reported in Brazil at Resende, Rio de Janeiro, as *Sogatodes brazilensis.* In 1965, R. G. Fennah considered it as a synonym of *S. oryzicola.* The host species or the latter has, however, not been reported. Thus. this note is the first report of *S. oryzicola* as a rice pest in Brazil. Compared with the various leafhoppers and planthoppers counted on the cultivar IAC47,

Percentage incidence of Sogatodes oryzicola in a leafhopper and planthopper population established on the cultivar IAC47, Brazil, 1977–78.

Collection time (days after sowing)	*S. oryzicola* (%) Adults	Nymphs	Total
45	17	2	19
58	18	60	78
80	25	68	93
104	9	90	99
130	48	49	97

S. oryzicola had a high population.

Hoja blanca disease has not yet been reported in Brazil, but because a vector exists, appropriate measures should be considered to prevent the introduction and spread of a potential cause of large crop losses. ■

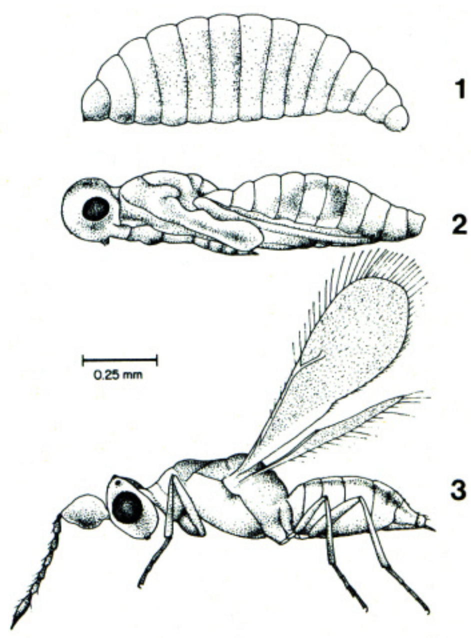
Tetrastichus sp. (Hymenoptera: Eulophidae), a new parasitoid-predator of the brown planthopper

Girish Chandra, postdoctoral fellow, Entomology Department, International Rice Research Institute

During investigations on mymarid egg parasitoids, larvae of *Tetrastichus* sp. were often found preying on eggs of brown and whitebacked planthoppers at IRRI. The hymenopteran had never been known to attack the eggs of rice hoppers, but further investigations revealed its remarkable parasitic and predatory habits.

Adults are about 1.2 mm long, yellow with brown spots, and have 4-segmented tarsi and greatly enlarged antennal scapes (see figure). They parasitize brown planthopper eggs inside which the first-instar larva develops by feeding on the egg contents. Parasitized host eggs are indistinguishable from those parasitized by mymarids — both turn yellow. Unlike mymarids, which complete their entire life cycle in one host egg, *Tetrastichus* larvae that have consumed the host egg contents emerge and behave like predators by feeding on several additional host eggs before pupating in the leaf sheath tissue. Young larvae are colorless with a yellow-pigmented alimentary canal and sharp mandibles. As they feed, their gut turns reddish and increases greatly in size. The pupa is naked, white with bright red eyes and ocelli, and has a yellow mass in the middle of the abdomen (see figure). Adults emerge after a pupal period of 4 days.

The field population of this parasitoid-predator does not appear high compared with that of the mymarid and trichogrammatid parasitoids. The larvae may still contribute to significant pest mortality because each normally destroys several host eggs before pupating. ■



Tetrastichus sp.: 1) full-grown larva, 2) pupa, 3) adult (female).

Four methods of insecticide application for control of rice stem borers

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Four methods of applying insecticides recommended for control of rice stem borers were compared. There were seven treatments and four replications in a randomized complete block design. Plots measuring 2.5 × 5.5 m were planted to variety RD1. Insecticides carbofuran 3% G, triazophos 5% G, FMC 35001 40% EC, and monocrotophos 56% WSC were broadcast, used as root soaking treatment, and applied as, seedbed and foliar spray.

Broadcast carbofuran and triazophos at 1 kg a.i./ha and foliar sprays of FMC 35001 and monocrotophos were highly effective (see table). Yields were lower where triazophos was broadcast. Foliar sprays of FMC 3500 1 and monocrotophos were more economical than broadcast carbofuran. Root soaking and seedbed applications were not significantly different from the check. ■

Comparison of 4 methods of insecticide application for control of rice stem borers at the Khonkaen Rice Experiment Station, Thailand, 1978.[a]

Treatment	Insecticide	Deadhearts (%)[b]	Yield (t/ha)
Broadcast[c]	Triazophos 5% G	0.67 a	1.5 bc
Broadcast[c]	Carbofuran 3% G	0.87 a	3.0 a
Foliar spray[d]	FMC 35001 40% EC	3.56 a	2.6 ab
Foliar spray[d]	Monocrotophos 56% WSC	4.53 ab	2.2 abc
Root soak[e]	Carbofuran 3% G	10.83 bc	1.5 bc
Foliar spray[f]	Monocrotophos 56% WSC	11.29 bc	1.8 bc
Root soak[g]	Carbofuran 3% G	12.03 c	1.4 bc
Seedbed[h]	Carbofuran 3% G	13.18 c	1.7 bc
Control	–	13.32 c	1.1 c
Seedbed[i]	Carbofuran 3% G	15.21 c	1.0 c

[a]In a column any 2 means followed by the same letter are not significantly different at the 5% level.
[b]Counted at 40 days after transplanting (DT). Percentage of deadhearts from other counts was too small to estimate.
[c]Applied at 1 kg a.i./ha every 20, 40, and 60 DT.
[d]Sprayed at 1 kg a.i./ha every 20, 40, and 60 DT.
[e]Applied at 10,000 ppm 2 days before transplanting (DBT).
[f]Sprayed twice at 1 kg a.i./ha when the infestation was more than 5%.
[g]Applied at 5000 ppm 2 DBT.
[h]Applied at 2 kg a.i./ha 20 days after seeding (DS).
[i]Applied at 4 kg a.i./ha 20 DS.

Control of the rice bug by ultra-low-volume (ULV) spraying

Stephen R. Pickin, research fellow, and E. A. Heinrichs, entomologist, Entomology Department, International Rice Research Institute

A water-based ULV spray of either gamma BHC or dichlorvos, applied once at flowering with a hand-held battery operated spinning disk sprayer, effectively reduced populations of the rice bug *Leptocorisa* sp. through the heading stage (see table). This reduction was not reflected in a significant gain in grain weight, number of grains per panicle, or a reduction in unfilled grains. But the significant reduction in the percentage of bug-damaged grains increased the quality of milled rice from grade two to one (as specified by the National Grains Authority of the Philippines).

By drifting fine, relatively uniform-sized droplets onto the crop, ULV spraying covers the panicles and foliage with a droplet density equivalent to the *thorough wetting* obtained with a knapsack sprayer. The volume rate of 8 liters is considerably less than the recommended 1,000 liters/ha.

Ultra-low-volume spraying of 2 insecticides against the rice bug *Leptrocorisa* sp. on irrigated lowland rice; (variety, C4-63)[a], Batangas province, Philippines, 1978 wet season.

Treatment	Bugs[b] (no./m^2)			Damaged filled grains (%)
	2 DS	5 DS	10 DS	
Dichlorvos	1.1 a	0.5 a	0.0 a	0.6 a
Gamma BHC	1.3 a	0.5 a	0.3 ab	0.6 a
Control	3.4 b	2.2 b	0.9 b	2.3 b

[a]In a column, means followed by a common letter are not significantly different at the 5% level.
[b]Sprayed at flowering at 500 g ai/ha at a volume rate of 8 liters with an ULVA 8 sprayer.
DS = days after spraying.

With the savings in labor and chemicals, ULV spraying may be a viable alternative to the knapsack sprayer, particularly for small-scale farmers who underdose by using volume rates that are too low.

IRRI is exploring the practicality of using ULV against the rice whorl maggot, stem borer, and brown planthopper. ■

Ovicidal activity of foliar sprayed insecticides on brown planthopper eggs

S. L. Valencia, research aide; E. A. Heinrichs, entomologist; C. L. Tan and C. Y. Hwang, trainees, International Rise Research Institute

Insecticides that can control the brown planthopper (BPH) have a short residual activity. Thus control is poor on nymphs that hatch a few days after insecticidal application. Timing of application would be less critical if the insecticide could kill eggs in addition to nymphs and adults.

To determine the ovicidal activity of several insecticides, BPH adults were allowed to oviposit for 24 hours on 25- to 30-day-old Taichung Native 1, a susceptible rice variety. One day after oviposition the plants were sprayed with the test insecticides at 0.75 kg a.i./ha. In a second experiment, BPH adults were allowed to oviposit for 48 hours. One day after oviposition the plants were sprayed with candidate compounds at 0.25 or 0.75 kg a.i./ha. Nymphs were removed and counted daily. At 14 days after oviposition, plants were dissected and unhatched eggs counted.

Carbofuran. azinphos ethyl, and fenitrothion had ovicidal activity (see table). There was no hatch when carbofuran was applied at 0.75 kg a.i./ha, but the hatch was high (see table) with carbofuran at 0.25 kg a.i./ha. Fenitrothion slightly reduced egg hatch at the high rate in experiment 1, but had no ovicidal activity at the lower rate in experiment 2. ■

Ovicidal activity of certain insecticides on brown planthopper eggs. IRRI, 1979.

Insecticide and formulation	Rate (kg a.i./ha)	Eggs hatched[a] (%)	Insecticide and formulation	Rate (kg a.i./ha)	Eggs hatched[a] (%)
Experiment 1			*Experiment 2*		
Perthane 45 EC	0.75	97 c	Carbofuran 12 F	0.25	98 b
Methomyl 90 WP	0.75	97 c	Permethrin 10 EC	0.25	95 b
Fenitrothion +			Miral 50 EC	0.75	93 b
BPMC 75 EC	0.75	89 c	Fenitrothion 30 EC	0.25	85 ab
Fenitrothion 30 EC	0.75	78 b	Pirimiphos		
Azinphos ethyl 40 EC	0.75	7 a	ethyl 25 EC	0.75	84 ab
Carbofuran 12 F	0.75	0 a	Propoxur 20 EC	0.75	58 a
Check		100 c	Check		95 b

[a] Means followed by a common letter are not significantly different at 5% level. Av. 4 replications, each with 2 gravid females.

Recent records of natural enemies of the brown planthopper in India

T. M. Manjunath, University of Agricultural Sciences, Regional Research Station, V. C. Farm, Mandya (Karnataka), India

Studies in and around Mandya (Karnataka) and other areas during 1977-78 revealed the presence of the following natural enemies of the rice brown planthopper *Nilaparvata lugens* Stål (Homoptera, Delphacidae):

Nymphal and adult parasites

Hymenoptera	: Dryinidae	- *Dryinus* sp.?
”	: ”	- *Haplogonatopus? orientalis* Roh.
Strepsiptera	: Elenchidae	- *Elenchus* sp.
”	: Halictophagidae	- *Halictophagus* sp.

Predators

Coleoptera	: Carabidae	- *Elaphrus charis* (Andr.)
”	: Coccinellidae	- *Coccinella repanda* Thunb.
”	: ”	- *Menochilus sexrnaculatus* (F.)
Hemiptera	: Anthocoridae	- *Orius* sp.
”	: Nabidae	- *Tropiconabis capsiformis* (Ger.)?
”	: Reduviidae	- *Polytoxus* sp.

Nymphs and adults of *N. lugens* collected from the field at V. C. Farm, Mandya, were reared and dissected in the laboratory to estimate parasitism (see table).

Of the two strepsipterans, *Elenchus* sp. was the most numerous. One parasite per host was common, but occasionally two and rarely three individuals of some species were encountered in the same host. The triungulinids of *Elenchus* emerged in quick succession from the dorsolateral region of the host's posterior segment and crawled actively on the plant surface. About 1,500 triungulinids emerged from a brachypterous female host in about a minute. Another 1,000 larvae were recovered from the same host when it was dissected. The emergence of the parasite did not result in the immediate death of the host.

The predators listed fed on brown planthopper nymphs and adults and were found to also feed on several other insect pests. Their population was low. ■

Parasitism of *Nilaparvata lugens,* Mandya, India, April 1978.

Brown planthopper	Brown planthoppers examined (no.)	Parasitism[a] (%)		
		Dryinids	Strepsipterans	Total
Brachypterous female	88	10.2	21.6	31.8
” male	25	4.0	8.0	12.0
Macropterous female	31	3.2	19.4	22.6
” male	23	8.7	8.7	17.4
Av parasitism		7.8	17.4	25.2

[a] *Echthrodelphax fairchildii* Fallen (Dryinidae), earlier reported as a parasite of *N. lugens,* also contributed to the parasitism.

Moth population fluctuation — a tool for forecasting stem borer outbreaks

Muhammad Akram Zafar and Nazir Ahmad Chaudhry, Plant Protection Institute, Faisalabad, Pakistan

Pest forecasting plays an important role in the control of impending pest outbreaks in crops. When meteorological conditions favor the development of a potent pest, scientists can forecast the outbreak and warn the farmers to use precautionary plant-protection measures.

To develop a forecasting index scientists studied the fluctuations in stem borer moth populations in Faisalabad in 1972-73. Light traps were installed at different rice-growing locations from March until November. Moths were identified and the numbers of each species were averaged as weekly totals (see table).

The data show peaks in the moth populations of *Tryporyza innotata* and *T. incertulas,* and times when moth populations became alarming.

The first generation of white and yellow borers appeared on wing when the weather was warm. Adult formation was fastest in April, and slowed to a minimum by July — probably because of hot unfavorable temperatures and the lack of host crops in the preceding months. The moth populations of white and yellow borers were alarming from the last 2 weeks of August through September because of meteorological conditions. After tile monsoon rains, the temperature favors earlier moth emergence. If temperature remains mild because of a later or prolonged monsoon, the number of moths remains critical until the first 2 weeks of October. That is especially true for *T. incertulas,* which

Fluctuations in weekly moth populations of 3 rice stem borers in Pakistan, 1972 and 1973.

Mo	Wk	Moths[a] (weekly total no.) 1972 *Tryporyza innotata*	1972 *Tryporyza incertulas*	1972 *Sesamia inferens*	1973 *Tryporyza innotata*	1973 *Tryporyza incertulas*	1973 *Sesamia inferens*
Mar	1	0	–	8	0	–	38
	2	0	0	36	0	–	49
	3	0	0	12	0	0	32
	4	75	0	16	0	0	16
Apr	1	162	12	1	75	0	7
	2	325	60	2	400	5	0
	3	1175[a]	619	0	150	12	6
	4	995	710[b]	2	108	8	4
May	1	300	655	2	441[b]	350[b]	0
	2	55	138	2	152	140	2
	3	30	72	0	50	50	3
	4	56	35	0	0	8	0
Jun	1	6	14	0	5	0	0
	2	10	5	0	12	15	3
	3	18	20	0	10	13	6
	4	5	3	0	0	5	0
Jul	1	0	1	0	2	5	0
	2	25	0	0	2	6	1
	3	20	5	0	8	5	2
	4	2	4	0	10	2	1
Aug	1	0	0	0		10	
	2	0	22	0	180	22	4
	3	16	12	3	307	63	1
	4	23	26	0	1640[b]	71	3
Sep	1	58	28	3	1200	440	3
	2	386	1080[b]	3	512	305	14
	3	420[b]	770	3	125	378	
	4	120	415	6	47	1050[b]	10
Oct	1	5	160	7	33	820	37
	2	1	80	25	5	450	41
	3	0	10	24	3	22	63
	4	0	0	18	0	0	52
Nov	1	0	0	7	0	0	22
	2	–	0	2	0	0	8
	3	–	–	0	0	0	0

[a]Vertical line indicates period when level of moth population was critical or alarming. [b]Peak level of moth population.

seems to be favored by mild, humid conditions.

Moth populations of the pink borer *Sesamia inferens* were highest in March and October; moths also emerged in February and November in both 1972 and 1973. *S. inferens* requires comparatively lower temperature for emergence than *Tryporyza* spp. ■

Weed hosts of Diopsid (Diptera) rice stem borers in southern Nigeria

A. M. Alghali, postgraduate student (Entomology), Department of Agricultural Biology, University of Ibadan, Ibadan, Nigeria

Weeds around paddy rice fields at the International Institute of Tropical Agriculture (IITA) were sampled for eggs, larvae, pupae, and adults of *Diopsis thoracica* West. In fields with rice at the heading stage, adult flies were observed on *Paspalum orbiculare* (Gramineae), *Cynodon dactylon* (L) Pers. (Gramineae), and *Cyperus difformis* (Cyperaceae), but were more numerous on *C. difformis* From 0 to 4 eggs/leaf, laid singly at the depression of the midrib, were found on *C. difformis,* while neither eggs, larvae, nor pupae were found on the others. In harvested fields, adults were seen on 1) sprouted seedlings from shattered rice grains left in the field from the previous crop, 2) ratoon rice crop from old stubbles, and 3) *C. difformis.* A larva was found inside the stem of *C. difformis,*

Style for IRRN Contributors

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

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

and a pupa inside the leaf sheath from stubble of an unknown rice variety.

Evidence is insufficient to show that *P. orbiculare* and *C. dactylon* are alternate hosts; neither eggs, larvae, nor pupae were found on them. Possibly. the adult flies on the two weeds were only resting between flights. However. *C difformis,* found in almost all paddy rice areas around IITA, and ratoon rice plants, on which either eggs, larvae, pupae, or adults were found, could be host plants during the nonrice cropping period. ■

Soil and crop management

A convenient device for taking large undisturbed samples of paddy soil

E. T. Craswell, soil scientist, and E. G. Castillo, research aide, International Fertilizer Development Center-IRRI Cooperative Project. Los Baños, Laguna. Philippines

Soil scientists often need to take large, undisturbed cores of paddy soils for estimating bulk density or nutrient content on the basis of weight per unit area. or for conducting greenhouse experiments will undisturbed soil.

A device for this purpose was recently developed at IRRI (see figure). The dimensions can be varied according to needs; we have also used a 20- x 20- x 60-cm version. The device consists of a box-shaped structure to take undisturbed soil samples and a sliding cover to facilitale removal of the bulk sample. Both parts are made of metal strong enough to gather and support the soil sample without distorting it.

To push the soil sampler into the soil, a block of wood is placed on top of it and struck with a sledge hammer. With the samplet at the required depth (as deep as 50 cm), the soil around it is dug away and the soil core is removed. Two men can collect a large sample (13 × 40 cm) in about 20 minutes.

Following is a typical example of data from Maahas clay (Aquic Tropudalf) collected at IRRI. The means are for 3 sampling depths with bulk densities computed for 9 cores, each 20 x 20 cm at the cross section. The high coefficients of variability are probably characteristic of the field site.

Depth (cm)	H_2O Content (% Oven dry basis)	CV (%)	Bulk density (g/cc)	CV (%)
0–15	84	9	0.66	10
15–30	56	12	0.91	6
30–50	57	12	0.84	15

We have taken 256 samples as part of a series of ^{15}N balance experiments with no serious signs of wear on the soil samplers. ■

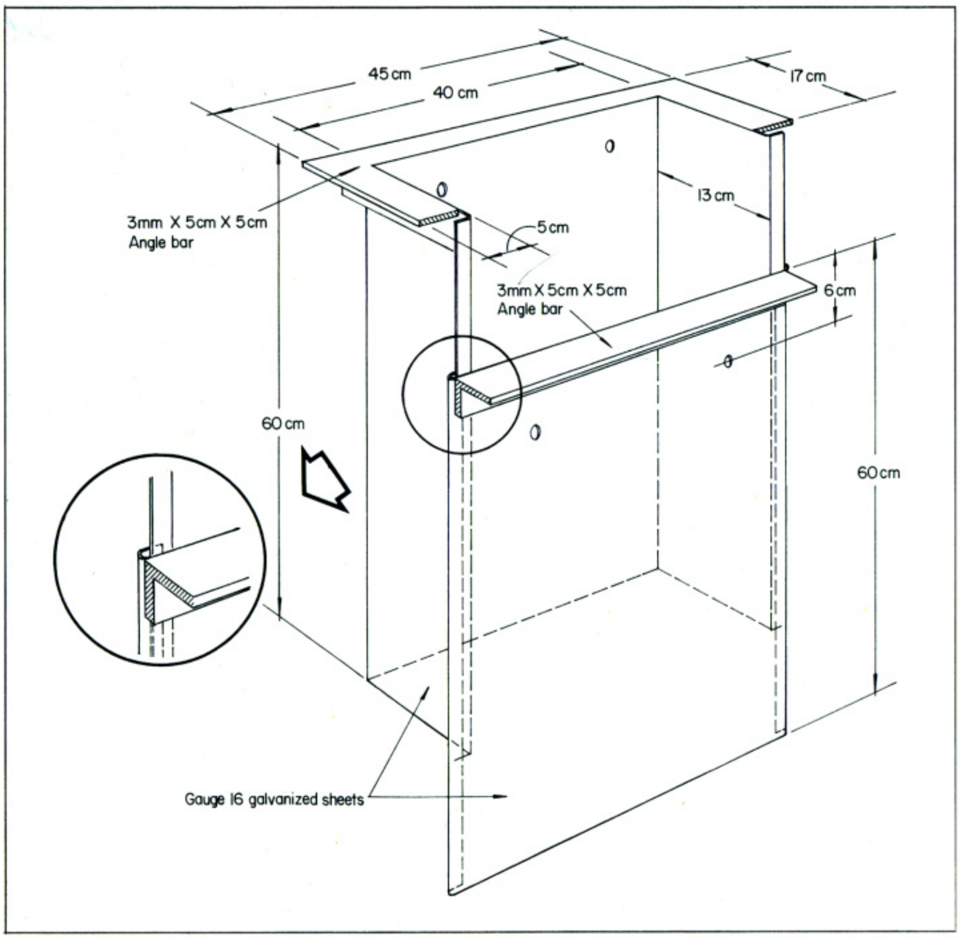

Diagram of a soil sampler designed to take large, undisturbed cores of paddy soils, IFDC – IRRI Cooperative Project.

CORRECTION

P.R. Hale. Two subterranean pests of upland rice in Papua New Guinea. IRRN 4:2 (April 1979). The correct address of P. R. Hale is Box 5144, Snowmass Village, Colorado 81615, USA.

Effect on rice crop of inoculation with blue-green algae

S. Kannaiyan, K. Govindarajan, M.D. Lewin, and G. S. Venkataraman, Plant Pathology Laboratory, Paddy Experiment Station, Tirur 602025, Chingleput Dist., Tamil Nadu, India

Field trials to assess the effect of blue-green algae (BGA) as a source of biological fertilizers for rice cultivation were conducted in a randomized block design during 1977 sornavari and samba seasons. The varieties were IR20 and ADT31. The soil was treated with BGA inoculations at 10 kg/ha and fertilizer at different levels on the seventh day after transplanting. The BGA culture had *Aulosira, Anabaena, Nostoc, Tolypothrix, Plectonema,* and *Aphanothece.* Treatments included: 1) control (no nitrogen and no BGA, 2) BGA alone, 3) 25 kg N/ha. 4) 25 kg N/ha + BGA, 5) 50 kg N/ha, 6) 50 kg N/ha + BGA, 7) 75 kg N/ha, 8) 75 kg N/ha + BGA, 9) 100 kg N/ha, 10) 100 kg N/ha + BGA. In all the treatments 50 kg K/ha and 50 kg P/ha were applied basally.

Inoculation with blue-green algae increased grain yield. At low levels of nitrogen fertilizer with algal supplement, the crop yield was comparable to that at the next higher level of nitrogen. ■

Announcements

Report of IRRI 1978 insecticide evaluation studies available

The 1978 Insecticide Evaluation Report contains 47 tables and 12 figures indicating the results of studies conducted using 64 coded and commercially available insecticides. It reports on tests conducted in the greenhouse and field against the:

- brown planthopper
- whitebacked planthopper
- green leafhopper
- whorl maggot
- striped stem borer
- leaf folder
- *Rivula* sp.

The report includes results of tests conducted to determine the effectiveness of insecticides as a contact poison. foliar spray, paddy-water application, root-zone application, and antifeedant. Relative effectiveness of various application methods and timing of insecticide application for field control of the brown planthopper are also reported.

A major portion of the report discusses the activity of various insecticides in causing resurgence of brown planthoppers and whitebacked planthoppers.

This 63-page report is available without charge by writing the Entomology Department, IRRI, P.O. Box 933, Manila. Philippines. ■

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Soils and rice	13.80	5.50	40.00	13.00	1.00	63.00	1.80
Proceedings of the workshop on the genetic conservation of rice	2.50	1.00	7.00	2.30	0.20	11.00	0.60
International bibliography of rice research for 1977	35.00	14.00	100.00	13.00	1.00	63.00	1.80
Bibliography of rice literature translations available in the IRRI Library and Documentation Center	12.50	5.00	35.00	13.00	1.00	63.00	1.80

[a] Note that these publications are offered at a 60% discount to individuals or organizations that represent developing nations. International organizations in developing nations are subject to the highly-developed-nation price.

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