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OVERALL PROGRESS

Genetic evaluation and utilization

Parijat, a new upland rice variety from India

H. K. Mohanty, professor of plant breeding and rice breeder, Orissa University of Agriculture and Technology (OUAT), Bhubaneswar, Orissa, India; and A. Roy, rice breeder, All India Coordinated Rice Improvement Project, Regional Research Station (OUAT), Chiplima, Orissa, India

Parijat (IET 2684) is a semidwarf rice developed from the cross TN1 /TKM 6 at the Rice Research Station, Bhubaneswar, Orissa. When direct seeded it matures in about 90 days in kharif (wet season) and in 105 days in rabi (dry season). It is suitable for upland areas of the state. Its yield performance in tests of the All India Coordinated Rice Improvement Project, as well as at the state level in 1972–75, showed its wide adaptability.

Parijat has medium slender grains and field resistance to bacterial leaf blight, bacterial leaf streak, Helminthosporium leaf spot, and the green leafhopper, and moderate resistance to the stem borer and the brown planthopper. It is superior to the upland variety Bala in its synchronized flowering and easy threshability. It has better grain quality than the upland rice variety Annapurna (Annapurna has coarse red kernels) and matures about a week earlier. On the average it produces about 3.7 t/ha, with a maximum of 8.2 t/ha under good management.

GENETIC EVALUATION & UTILIZATION

Agromomic characteristics

Rice varieties for late planting in West Bengal

N. C. Basu Raychaudhuri, Rice Research Station, Bankura, West Bengal, India

The vagaries of the southwesterly monsoon in parts of West Bengal often force resowing or delayed planting of rice. During 1975–76, 32 semidwarf high yielding rices (HYV) and 56 tall indigenous cultivars were compared in “optimum” and late plantings. Under rainfed conditions and with identical soil moisture through the growing season, tall indigenous cultivars of early and medium duration proved more tolerant of late planting than the HYV. The superior varieties were N.C. 918 and N.C. 1626 — aus (insensitive) types – and Badkalamkati-7, Jhati, Hiramoti, Churnakati, K X I-36, Basful, Asmanchak, Safadhan, Dudhkalma, Latisail, and Bankura-5-7 — aman (sensitive) types. Their superiority showed in their growth characters, complete panicle exsertion, tolerance of bacterial and virus diseases, and insignificant yield reductions. The mean grain yields were 257 g/sq m from the normal season, 26 July transplanting and 234 g/sq m and 231 g/sq m from late transplantings (10 and 23 September) of seedlings sown 21 August. Most HYV gave higher yields in early sowings, but behaved differently — with incomplete exsertion, poor growth, and severe disease, and reduced yield — in late plantings. Mean grain yields were 368 g/sq m, 172 g/sq m, and 108 g/sq m in the normal and the two late plantings, respectively. However, some short-duration HYV, e.g., Pusa 2-21, Pusa 33-30-3-3, IET 2233, IET 1444, and Ratna, performed better.

Flowering of aus rice cultivars in West Bengal, India

D. Mitra and S. Biswas, Rice Research Station, Chinsurah, West Bengal, India

Aus (early) rice cultivars — usually classified as photoperiod insensitive — were sowed 31 March at Chinsurah, India, permitting exposure to long days for nearly 6 months in the field.

Flowering (50%) time ranged from 60–66 to 123–129 days after sowing. Half of the cultivars flowered between 88 and 94 days. The cultivars collected from a particular area sometimes showed similar flowering dates; sometimes they varied widely (see table).

Collection areas and flowering times of aus rice cultivars. Rice Research Station, Chinsurah, West Bengal, India.

Collection area	Flowering time[a]		
	Early	Medium	Late
West Bengal			
West Dinajpur	4	4	1
Coochbihar	5		
Jalpaiguri	5	4	
Malda	2		
Murshidabad	20	1	
Nadia	30	26	3
24 Paraganas	2	3	
Hooghly	2	4	
Midnapore	2		
Burdwan	6	2	
Birbhum	3		
Bankura	1		1
Purulia		1	
Kashmir	5		1
Manipur			3
East Sikkim			3
Bhutan	1		
USSR	13		
Japan	7	7	4
HW	42	63	3

[a]Attainment of 50% flowering: early = 60–87 days; medium = 88–101 days; late = 102–129 days.

Determination of the adaptation of rice genotypes to water deeper than 30 cm – a new formula

A story carrying the above title on page 10 of IRRN 1:2 (DECEMBER 1976) contained an error. Its first paragraph should end as follows:

A scale for interpreting the values classifies the genotypes into four groups: very high (F_D 160 or above), high (F_D 140–159), moderate (F_D 120–139), and low (F_D below 120) adaptation to increasing water depths (see table).

GENETIC EVALUATION & UTILIZATION

Disease resistance

Varietal resistance to ufra disease in Burma

Tin Sein, Plant Pathology Department, Agricultural Research Institute, Rangoon, Burma

Ufra disease caused by the nematode *Ditylenchus angustus* will spread if normal and diseased rice plants are grown in the same paddy water. In three rainy seasons, 1972–74, seedlings of 151 varieties and 76 crosses were grown in 1-sq-m plots; when they were 1 month old, four to six diseased C4-63 plants were introduced into each plot. One month later the seedlings were transplanted to an isolated field. The percentage of fertile tillers at flowering time was recorded.

Sixty varieties and 12 crosses died, including C4-63, IR5, IR24, and many Burmese varieties common to the Irrawaddy Delta. More than 72% of the tillers of 8 varieties and 5 crosses flowered in one season but fewer in the other two seasons. Only the variety B-69-1 (Tha-baung-mee-gok), a selection from the indigenous rice of Tha-baung, a town in Irrawaddy Delta, showed more than 72% fertile tillers in all three seasons.

When 15 randomly selected hills each of diseased (inoculated) and of healthy B-69-1 rice were observed in 1974, the symptoms on diseased plants showed that B-69-1 is only tolerant. But the variety is useful, along with other control measures such as stubble-burning, clean cultivation, roguing, and flood control, for reducing the nematode population.

Breakdown at low temperature of IR20 resistance to tungro virus

G. Mohana Rao and A. Anjaneyulu, Central Rice Research Institute, Cuttack-753006, India

A reselection of the cultivar IR20 has been found to be highly resistant in the field to the Cuttack isolate of the rice tungro virus in kharif during the last 4 years. In monthly plantings for 2½ years, IR20 maintained its resistance during monsoon (July–October) and summer (March–June) seasons, but not during winter (November–February). Average maximum and minimum temperatures were 28.5 and 15.8°C during the 1974–75 winter season, and 28.6 and 15.2°C during the 1975–76 winter. Infected plants were a richer green than healthy plants, and were stunted during the summer and monsoon seasons. During winter, the older leaves of infected plants were orange, while newly emerging leaves exhibited chlorosis. Infected plants were severely stunted, and showed symptoms more or less like those of susceptible TN1. Healthy plants in the same season had no discoloration. Symptom severity increased in December and January.

As many as 14.2% of the leafhoppers could become viruliferous during winter, as against 0.9% during summer and 2.1% during monsoon (average of 2 years).

Symptomatological polymorphism of a rice variety under differential climatic conditions may pose a problem, especially in identification of strains of rice tungro virus at several sites of the International Rice Tungro Nursery.

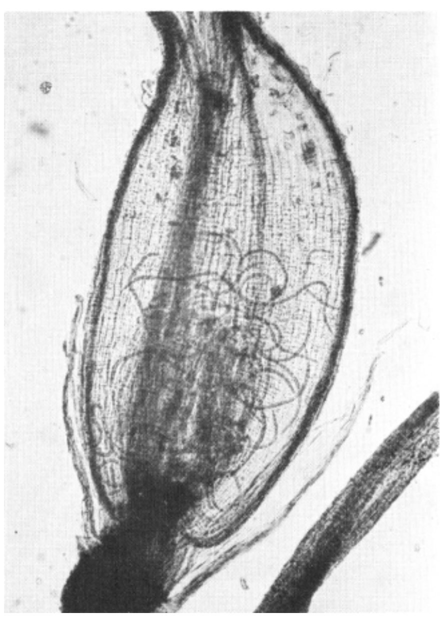
GENETIC EVALUATION & UTILIZATION

Insect resistance

Rice varieties and the white-tip nematode

G. Rajendran, T. S. Muthukrishnan, and M. Balasubramanian, Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore-3, India

Rice yield losses of up to 60% are attributable to the rice white-tip caused by the nematode *Aphelenchoides besseyi* in the State of Tamil Nadu, India. One hundred and one rice cultivars were screened under natural conditions in the field from July 1973 to July 1976. The number of chaffy spikelets per panicle was recorded as an indication of nematode damage. Entries with less than 5% infestation and other selected entries are shown in the table.



The white-tip nematode causes rice yield loss of up to 60% in Tamil Nadu, India.

Rice panicle infestation by white-tip nematode. Tamil Nadu, India, 1973–76.

Rice cultivar	Chaffy spikelets (%/panicle)
Co 13	1
Rohini	1
T 292	1
RP 113-31	1
Ratna	2
T 228	2
Triveni	2
TKM 7	2
T 482	2
ASD 14	2
Yamuna	2
Padma	2
IR5	2
SR 26B	3
Cul-7711	3
Vijaya	3
Sona	3
Soorya	3
IR30	3
Krishna	4
Bala	4
CR 12-178	4
IR8	12
IR26	14
TN1	30
GEB 24	50
TKM 6	55

Reactions of IRRI strains to gall midge at Chiplima, India

A. Roy, rioe breeder; P. K. Misra, junior rice breeder; U. K. Nanda, junior entomologist; and N. Shi, entomologist, Regional Research Station, Orissa University of Agriculture and Technology, Chiplima, Sambalpur, Orissa, India

Eight advanced International Rice Research Institute (IRRI) rice strains and 64 strains of Indian origin were subjected to a gall-midge resistance varietal trial at the Regional Research Station of Orissa University of Agriculture and Technology during 1975 and 1976 in the main crop season (May to November). The silver shoot count revealed that none of the IRRI lines had absolute resistance, but when compared with the susceptible check Jaya, each showed a certain degree of resistance (see table).

Yields and silver shoot (ss) count of IRRI cultivars, 1975 and 1976 main crop seasons. Chiplima, India.

Cultivar	Ss (no./sq m)		Yield (kg/ha)	
	1975	1976	1975	1976
IR2071-621-2-3	29	0	1749	3030
IR2071-636-5-2-6	14	0	2726	2479
IR2070-414-3-9	16	28	720	3305
IR2070-439-6-5	2	25	1955	3030
IR2070-464-1-3-6	5	11	4012	2823
IR2070-471-2-5	50	0	1749	2410
IR2071-213-6-6	108	77	1235	2617
IR2071-486-9-2	13	11	3292	2823
RPW 6-13 (Resistant check)	5	56	1646	1377
Jaya (Susceptible check)	163	95	1235	413

GENETIC EVALUATION & UTILIZATION

Drought tolerance

Upland rice varieties for drought-prone areas of West Bengal, India

N. C. Basu Raychaudhuri, Rice Research Station, Bankura; and S. Bakshi, Zonal Drought Resistant Paddy Research Station, Purulia, West Bengal, India

Rice that depends solely on rainfall occupies about 69% of the rice land in Bankura district and 86% in Purulia district in West Bengal, India. Short and badly distributed rainfall, undulating land, and poor soil-moisture retention are chiefly responsible for frequent drought. In 1976 rice experienced its most severe drought of recent times.

Seed is usually sown with the onset of the southwest monsoon in June (monsoon lasts until September), and seedlings are transplanted in July or August. Short-duration varieties are grown in the uplands and the long-duration varieties elsewhere. Tall indigenous types withstand drought stress more or less in the uplands, but are usually poor yielders; many recent high yielding varieties are drought susceptible.

A number of suitable upland rice varieties from the International Rice Upland Rice Nursery in 1976 at Bankura and Purulia were identified. Seeds of 185 types were drilled at two sites in June 1976. Twenty-five local entries were added at Bankura. Growth, effect of drought stress, and other factors were recorded periodically during frequent, prolonged periods of rainless days. About 50% of the entries were credited with acceptable tolerance for drought. Some promising types are listed in the table.

Promising upland rice varieties for drought-prone areas of West Bengal, India.

Name	Source	Duration (days)	Yield (t/ha)
Se. 322 B.19	Senegal	91	4.44
IRAT 10	Ivory Coast	92	4.10
IET 1444	India	105	3.88
B.9c-Md-3-3	Indonesia	105	3.84
Brown Gora	India	92	3.60
DV 110	Bangladesh	106	3.50
DZ 41		91	3.48
ARC 7060	India	92	3.28
IET 3226		100	3.23
C22	IRRI	118	3.20
B.541 c/km/19/3/4	Indonesia	118	3.20
Se. 319 G.	Senegal	89	3.19
IR2035-227-1	IRRI	119	3.08
Aus 8	Bangladesh	114	3.00

GENETIC EVALUATION & UTILIZATION

Adverse soils

Breeding for adverse-soils tolerance

F. N. Ponnamperuma, principal soil chemist, and H. Ikehashi, plant breeder, International Rice Research Institute

In densely populated South and Southeast Asia, 100 M ha suited to rice lie idle largely because of soil toxicities (Table 1). Also, on about 50 M ha of cultivated land, deficiencies of zinc, phosphorus, or iron, or excesses of iron, aluminum, or manganese limit rice yields.

In 1976 the International Rice Research Institute screened cultivars from its germ plasm bank, evaluated promising lines, and tested the progeny from its hybridization program for tolerance of adverse soil conditions (Table 2).

Table 1. Problem rice soils (current and potential) of South and Southeast Asia.

Kind of soil	Extent (M ha)
Saline soils	62.5
Alkali soils	2.2
Acid sulfate soils	9.8
Organic soils	29.0

Table 2. Rice cultivars screened for adverse-soil tolerance. IRRI, 1976.

Source	Rice cultivars (no.) screened for					
	Salinity	Alkalinity	Iron toxicity	Organic soils	Zinc deficiency	Phosphorus deficiency
Germ plasm bank	1446	1338	12	0	5918	1134
General breeding program	1020	2397	108	195	850	330
Specific hybrids	2059	676	0	0	0	0
Total	4525	4411	120	195	6768	1464

Four IR4630 and IR4763 lines showed high salt tolerance; IR30, IR32, IR36, and 13 advanced breeding lines had moderate tolerance. IR4227-28-3 and IR4227-104-3 revealed high tolerance for alkalinity and 52 advanced breeding lines showed moderate tolerance. lR20, IR34, BG90-2, and several elite lines tolerated zinc deficiency. IR20, IR29, IR32, and many elite lines from the crosses IR2031, IR2070, IR2071, and IR2153 manifested tolerance for iron toxicity. IR28, IR29,1R30, IR34, IR1514A-E666, and several IR2061 lines tolerated phosphorus deficiency.

Several IR varieties and many IRRI elite lines with good agronomic characteristics and resistance to diseases and insects showed tolerance to adverse soils even though no conscious effort had been made to achieve it.

Pest management and control

DISEASES

Ufra disease spread by water flow

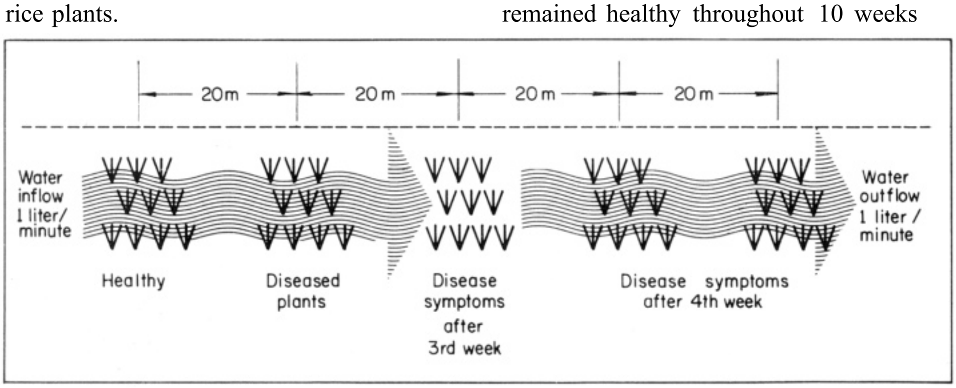
Tin Sein and Kaung Zan, Agricultural Research Institute, Rangoon, Burma

In Irrawaddy Delta, Burma, ufra disease of rice caused by the nematode *Ditylenchus angustus* is associated with lowlands onto which rivers overflow because of tidal action. Field observations showed the following sources of the disease inoculum: (1) the wild rice *Oryza perennis,* growing along banks of waterways, its roots in mud and its tops above water surface; (2) *O. meyeriana;* (3) *Leersia hexandra;* and (4) volunteer rice plants.

On a healthy rice plant grown in a pot with a diseased plant, especially in open air in the rainy season, chlorotic leaves appear in 2 weeks, suggesting that water is the agent of disease spread. The following experiment showed dispersal along currents.

In a 100-m canal, 30 cm wide and 18 cm deep (see figure), water was put in and drained at the rate of about 1 liter/ minute. One group of 10 C4-63 rice plants with ufra disease and four groups of healthy plants were placed in the canal at 20-m intervals.

The upstream group of plants remained healthy throughout 10 weeks of observation. The other originally healthy plants showed disease symptoms after the third or fourth week.



Plan of an experiment to test the transmission of ufra disease of rice through paddy water.

The studies suggest, in addition to stubble burning, the following control measures: (1) control of weeds and volunteer rice, (2) dikes and banks to prevent river overflow onto fields, and (3) clean cultivation and early roguing of diseased plants.

Possible presence of bacterial blight in Latin America

S. H. Ou, Plant Pathology Department, The International Rice Research Institute

Bacterial blight had not been previously reported in America. During my visit to rice farms in Panama on 5 and 6 August 1976 and in Ecuador on 10 and 11 August, I observed some rice showing symptoms of the disease, and several weeds with similar symptoms. On 12 August I forwarded a report of my observations to the directors general of the International Center of Tropical Agriculture (CIAT) and the International Rice Research Institute (IRRI). What follows is excerpted from the report.

On a rice farm of the Bayano project of the Panama government, CR1113, a variety newly selected from an IRRI line in Costa Rica, was about to flower. Small and large patches of blighted upper leaves, similar to those seen in bacterial blight in the early stage of an epidemic, were seen near edges of the farm. Close examination revealed the characteristic symptoms of the disease. Nearby roadside colonies of a common noxious weed *Manisuris* sp. likewise showed symptoms. Bacterial blight symptoms were also found in patches on a second farm planted to CICA 6. There *Manisuris* sp. and colonies of wild rice *Oryza latifolia* were also infected, some severely. Blighted patches were found on a third farm planted to Nilo 1; nearby *Manisuris* sp. and *O. latifolia* were infected. More disease was found on a seed-multiplication farm for possible new varieties bred locally between IR8 and Nilo 1 ; a great deal of *Manisuris* sp. nearby was severely infected, as was a weed locally called “Cabezona.” A large sage with triangular pseudostems was infected and another weed, *Bracharia* sp., also was probably infected. In the Chiriqui area 200 miles west of Panama City, rice in six large rice farms did not have bacterial blight, but many colonies of the local common weed *Panicum maximum* showed blight symptoms. If isolation and inoculation experiments confirm the observed symptoms to be those of bacterial blight of rice, the original hosts of the bacterium would appear to be the weed species. Upland rice culture probably has localized the disease; in paddy rice, water is a major agent for dissemination of the bacterium. No bacterial blight was noted on rice on many farms of the Boliche and Samborondon areas of Ecuador, but *P. maximum* grew everywhere and in most places showed symptoms typical of bacterial blight.

Seed-borne infection and ufra disease

Tin Sein, Plant Pathology Department, Agricultural Research Institute, Rangoon, Burma

Seth observed *Ditylenchus angustus,* the nematode pathogen of ufra disease, in rice grains. Hashioka sprayed a suspension of nematodes in water onto rice seeds but the seeds did not produce diseased plants.

Studies in Burma showed that heavily infested plants produced very little seed; the panicles contained many unfilled grains. Microscopic examination showed the presence of about 15.4 nematodes in each unfilled "grain" and 5.3 in one mature grain. One mature seed carried too little inoculum to cause disease. However, large numbers of seed grown together resulted in disease when naturally infected seeds were used as the source of inoculum.

Testing some pesticides against ufra disease

Tin Sein, Plant Pathology Department, Agricultural Research Institute, Rangoon, Burma

Preliminary tests showed 4 of 47 pesticides were significantly better than a check spraying in increasing the rice yield in pots infested with the nematode *Ditylenchus angustus,* which causes ufra disease. The 4 pesticides were compared for effectiveness in further tests.

Ten heavily infested C4-63 rice plants, each in 1-kg soil in a 25-cm-diameter pot with 3 cm of water above the soil, were sprayed 3 times at weekly intervals with each pesticide suspension (33 ml, 0.21% ai.), or 0.07 g a.i. of carbofuran granules was sprinkled on the soil 3 times. One control was included with diseased plants and one with healthy plants. Four weeks after spraying, the average number of fertile tillers per pot for the various treatments were: healthy control, 6; diseased control, sprayed with water, 0; with monocrotophos, 1.8; with phenazine, 2.3; with parathion, 2.4: with carbofuran, 4.6. LSD at the 1% level was 1,702.

In another pot test of varied dosages of carbofuran granules (3% a.i.), the density of nematodes was determined by soaking 1-cm-long shoot sections, counting the nematodes in the soaking water, and calculating the number that would have been found in 1 g of shoot. There were 10 replications. With carbofuran applications of 0, 1, 2, 3, 4, and 5 g/pot, the numbers of nematodes found were 238.9, 96.0, 84.6, 34.1, 18.4, and 17.7, respectively. L.D. 50, calculated according to Bliss, was found to be 0.9825 **g** granules per pot. Assuming 1 M kg to be the weight of 1 ha of soil 15 cm deep, L.D. 50 is about 1,000 kg/ha of carbofuran granules.

The pesticides may not be economical for use against ufra disease of rice.

Pest management and control

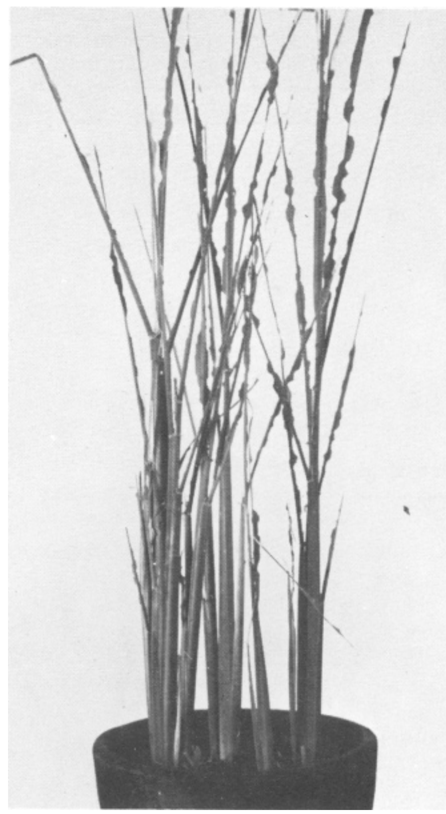
INSECTS

A new lepidopterous pest of rice

Lourdes A. Malabuyoc, research assistant, Entomology Department, International Rice Research Institute

A hairy, greenish caterpillar about 20 mm long when full grown has been observed attacking rice plants. Unchecked populations can increase rapidly and cause severe defoliation (see figure). The pest was first observed in a screenhouse at the International Rice Research Institute (IRRI) in December 1975, and later on the IRRI farm. The same insect had been reported damaging rice plants at the Maligaya Rice Research and Training Center in Nueva Ecija, Philippines, in September 1971, and in Pangasinan, Philippines. A. G. Hayes at the British Museum of Natural History identified specimens as near *Rivula atimeta* Swinhoe, 1905.

The adult moth is slightly larger than the leaf folder *Cnaphalocrosis medinalis.* It is cream colored with a tinge of very light brown at the edge of the forewings. The abdomen of the female is greenish due to the presence of eggs.



Rice plants show defoliation caused by a hairy, greenish caterpillar in IRRI Screenhouse.

The eggs, very light green, are round and laid on the leaves singly or occasionally in rows. A female can lay as many as 224 eggs. Incubation lasts 4 or 5 days. The first and second of five larval instars feed mainly on the epidermis. The third instar begins eating the leaves. About 1 month is required to complete a generation.

The pest has been most severe in the screenhouse where varieties are being screened for stem-borer resistance. However, it is common on the IRRI farm and can be considered a potentially serious pest.

Any reader with information on a similar pest should write to the Entomology Department, IRRI, P.O. Box 933, Manila, Philippines.

Brown planthopper in Borneo

D. J. McCrae, entomologist, Department of Agriculture, Brunei, Borneo

Severe hopperburn covered about 0.2 ha in some seed-multiplication plots at a Department of Agriculture rice station in Brunei, Borneo, in early January 1976. All plants in the area were killed. Large numbers of a single species of delphacid collected from the outbreak area were identified as *Nilaparvata lugens.*

Rice grown at the station receives fortnightly applications (14 kg/ha) of 3% granular carbofuran. Some affected plots had also been sprayed with methamidophos (Tamaron). The outbreak is the first recorded damage to rice by *N. lugens* in Brunei.

Pest management and control

WEEDS

Herbicides for direct-sown upland rice

M. A. Singlachar, rice agronomist, and C. Chandrashekar, research assistant, University of Agricultural Sciences, Regional Research Station, Mandya Karnataka-571405, India

In 1975 kharif, nine chemicals were tested for weed control in direct-sown upland rice. The chemicals were sprayed 4 days after the direct seeding of the cultivar IET 1444. Mixed weed seeds had been uniformly broadcast at the time of land preparation.

Of the nine herbicides (see table), AC-92553 showed the best control. The trial was conducted under the auspices of the All India Coordinated Rice Improvement Project.

Grain yield and weed control in direct-sown upland rice, 1975 kharif, Mandya, India.[a]

Herbicide	Formulation concn	Application		Weed wt (kg/15-m plot)	Grain yield (kg/ha)
		Rate (kg a.i./ha)	Time [b]		
Butralin	480 g/l	2.0	4 DS	4.0	1225
AC-92553	250 g/l	2.0	4 DS	1.2	3487
Butachlor	600 g/l	2.0	4 DS	5.9	1115
Piperophos + dimethametryn	500 g/l	2.0	4 DS	3.8	1601
Propanil	35%	3.0	18 DARE	3.4	1419
Oxadiazon	25%	1.0	4 DS	2.5	2513
Fluorodifen	30%	2.0	4 DS	2.7	0924
USB 3153	12.5%	2.0	4 DS	3.9	1662
Dinitramine	25%	2.0	4 DS	2.9	2543
Hand weeding	–	twice	20 & 40 DARE	0.6	3176
Hand weeding	–	as and when necessary		0.6	2856
Untreated control	–	–	–	6.9	1009

[a]CD (0.05): 990. [b]DS = days after seeding; DARE = days after rice emergence.

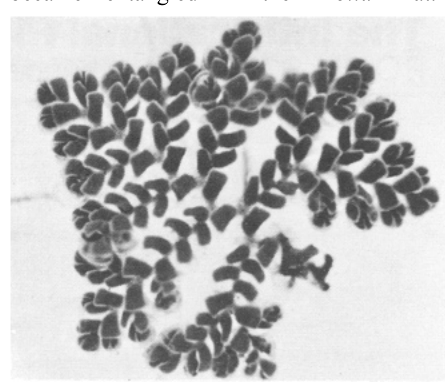
soil and crop management

The use of *Azolla pinnata* as a green manure for rice

P. K. Singh, Central Rice Research Institute, Cuttack, India

Azolla can use atmospheric nitrogen that is fixed by symbiotic blue-green algae. Observations on the use of *Azolla pinnata* in rice culture at the Central Rice Research Institute, Cuttack, India, are encouraging.

The fern multiplies rapidly except during April, May, and June. Phosphorus promotes *Azolla* growth; superphosphate is a superior phosphate source. An inoculum of 0.1 to 0.4 kg/sq m increased to 0.8 to 1.5 kg/sq m of green matter in 8 to 20 days, amounting to 30 to 50 kg N/ha. Furadan (3 kg a.i./ha) effectively controls lepidopterous and dipterous insects, which damage *Azolla* severely. Pot and field experiments showed that incorporation of 8 to 10 t/ha of fresh *Azolla* before transplanting increased rice yield as much as did 30 to 40 kg nitrogen from ammonium sulfate. Inoculation of a field with *Azolla* after rice transplanting, and the incorporation of *Azolla* after its growth stimulated rice growth. However when water level was high, rice plants became entangled in the *Azolla* mat.



Tests of a tiny water fern, Azolla, as a source of nitrogen in rice fields, are encouraging. Azolla uses nitrogen fixed by the blue-green algae Anabaena azollae.

Constraints on rice yield

A perspective study on self-sufficiency in rice production in five selected countries of West Africa

E. Lord, economist, United Nations Economic Commission for AfricalFood and Agriculture Organization Joint Agriculture Division, Addis Ababa, Ethiopia

A mid 1975 study in Gambia, Ghana, Liberia, Nigeria, and Sierra Leone sought to provide perspective on the rice situation to help the countries to increase rice production and to attain self-sufficiency. Increasing demand for commercial rice in the West African countries is due to rapid urbanization and increasing money incomes. Imports have been increasing rapidly. Much domestic rice is consumed on the farms where it is grown as noncommercial food crop. For production to increase, rice must be made a commercial crop and a marketing system must be developed.

The main conclusions are listed below.

1. Rice production will remain static as long as governments do not intervene.
2. If governments intervene and effectively attack the key constraints, production can be increased relatively quickly.
3. More emphasis should be placed on economic and social constraints and less on agronomic constraints.
4. Programs and schemes for increased rice production must offer attractive financial incentives and be socially acceptable to have significant impact.
5. Such constraints as animal pests, lack of marketing facilities, high capital cost, low profitability, and hard work can offset much of the potential gain that might result from new techno-agronomic practices and inputs.

Another project will analyze in more detail the economics of present and new technology, marketing constraints, and labor use problems, particularly the role of women in rice production.

A review of the research and methodology of the International Rice Agroeconomic Network

R. W. Herdt, Agricultural Economics Department, International Rice Research Institute

Six papers, summarizing results of experiments on farmers' fields and of coordinated farm surveys by the International Rice Agroeconomic Network (IRAEN), were presented at a November 1976 meeting in Yogyakarta, Indonesia. Twenty-six rice agronomists and economists from Bangladesh, Indonesia, Sri Lanka, Taiwan, Thailand, and the International Rice Research Institute (IRRI) discussed the studies designed to determine major biophysical constraints on rice yields, and the socioeconomic reasons for the persistence of those constraints. Methodology used by IRAEN research groups was reviewed and modified. A plan was outlined to achieve increased uniformity in methodology in the 1977 work. It is anticipated that the papers will be published by IRRI in 1977.

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.

The International Rice Research Institute
P.O. Box 933, Manila, Philippines

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