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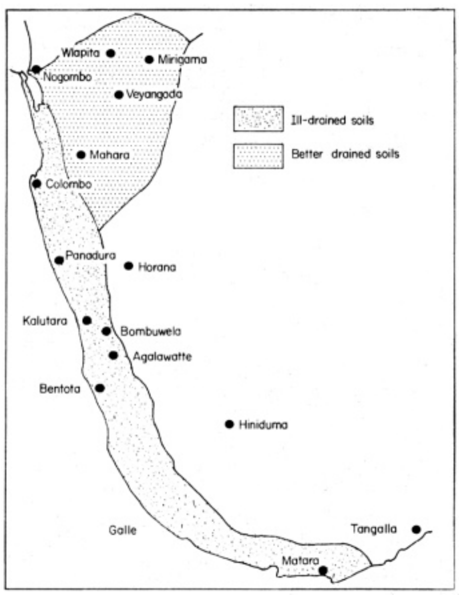
OVERALL PROGRESS

Genetic evaluation and utilization

BW 78 – a new variety for the low country wet zone

Adapted from Agricultural Newsletter No. 4, 1977, Agricultural Information Division, Department of Agriculture, 102 Union Place, Colombo 2, Sri Lanka

The so-called "miracle rices" of the "green revolution" – or the BG varieties in local parlance – are out of place in some of the ecological situations in Sri Lanka. One such area is the ill-drained belt of about 28,350 ha stretching from Negombo to midway between Matara and Tangalla, where lagoon and river basin systems of rice cultivation prevail (see map). At the mouth of the rivers and lagoons are sandbars. During the rainy season, water builds up behind the sandbars, spreads inland, and inundates the paddy fields. Floodwaters hinder cultivation until the force of the bunded waters bursts the sandbars, or until the water is pumped out. These bog soils are usually less than 1 ft below sea level. Flooding and salinity prevent cultivation of the BG varieties; only traditional types such as Dewareddisi and Pokkali can survive.



BG 78, a new rice variety developed at the Bombuwela Research Station in Sri Lanka, is suited to ill-drained soil conditions.

Even in higher reaches without continuous flooding and salinity, BG varieties have given disappointing results because of ill-drained conditions due to a surface water table and because of toxic iron deposits. During the rains, iron oxide is washed down from the surrounding red-yellow podzolic highland soils and is converted into the reduced toxic form under the ill-drained conditions. The only way to increase yields without expensive flood-control and drainage schemes is to develop more hardy varieties.

Such a variety, Bombuwela 78 or BW 78, was recently developed and released by research officers at the Bombuwela Research Station near Kalutara. BW 78 is now recommended for cultivation in the half-bogs and mineral soils found above the flood-stricken bog soils. BW 78 is also recommended for the better drained soils of the Colombo district (see map) where it might replace BG II–II in areas where the water supply is unstable and where part-time cultivators cannot give their crops high levels of management.

Paul Peiris, who bred BW 78, described it as "a rugged, rustic, rice. Not only is it resistant to poor drainage and iron toxicity, but it also shows a fair degree of field resistance to the brown planthopper, gall midge, and the leaf-rolling caterpillar, and to the paddy bug, which is the most serious pest in this region."

The paddy bug is probably discouraged from damaging the earheads because of the tough seed coat, which also discourages the paddy moth from destroying stored grain. BW 78 is also tolerant of blast and bacterial blight diseases. Its height (90 cm) and spreading growth habit permits a certain degree of flooding while discouraging excessive weed growth.

BW 78 is a 4-month variety with a white, round, samba-like grain. It is derived from a cross between H 501 (Podiwi a-8 H 5) and Selection 306, and can be cultivated both in *maha* and *yala* seasons.

A few experimental seed kits were issued to extension officers for demonstration purposes this *yala* season in Colombo, Galle, Kalutara, Matera, and Ratnapura districts. Production kits and larger stocks of seed paddy are expected to be ready for release next *maha* season.

GENETIC EVALUATION & UTILIZATION

Disease resistance

Toward rice varieties with multiple resistance

K. I. James, rice breeder; P. A. Varkey, junior rice breeder; R. Pushpakumari, research assistant; All India Coordinated Rice Improvement Project, Rice Research Station, Pattambi, Kerala State, India

Outbreaks of brown planthoppers, grassy stunt, blast, and sheath blight on popular high yielding varieties (HYV) grown in Kerala have emphasized the importance of an alert and aggressive rice breeding program. The earlier concept in rice breeding was to produce rice varieties adapted to a particular stress condition. Consequently, varieties that were developed have built-in resistance to a single pest or disease, but have no multiple resistance to withstand varied stress conditions under which the crop is grown. To develop varieties with multiple resistance, the hybridization program at the Rice Research Station, Pattambi, was expanded. Forty-five cultures (see table) recorded resistance to one or more pests and diseases together. Most donors responsible for the resistance were IRRI lines.

Resistance ratings of varieties in Kerala, India.

Pedigree	Cultures (no.)	Rating score[a]						
		Blast	Bacterial blight	Sheath blight	Helmin-thosporium	Brown planthoppers	Grassy stunt virus	Rice tungro virus
Triveni/IR1875-78-1-3-1	1	0	2	2	2	–	1	1
Triveni/IR2071-251-1-1	2	0–3	2–3	2–4	0–2	1–2	3	3
IR1702/CH 5	1	1	2	2	0	4	1	1
Jaya/IR1820-210-2	2	0–2	1–2	2–3	2–3	3–4	7	1
12814/SI 26 (Indonesian line)	10	1–3	1–2	0	0	2–4	7	1
Jaya/IR2153-26-3-5-6	1	1	2	2	0	3	7	1
Bharathi/IR2071-625-3-4	11	1–3	2–3	1–3	0	1–2	3	3
Triveni/Mudgo	2	2–3	3–4	2–3	0	1–3	3	3
Triveni/IR2061-464-2-3	3	2–4	2–3	2–3	0	1–2	3	3
Triveni/IR1539	12	2–4	3–4	3–4	0	2	7	3

[a]Rated on a scale of 0–9: 0 = highly resistant; 9 = highly susceptible.

Brown planthopper symposium

A symposium on the brown planthopper was held during the International Rice Research Conference, 18–22 April 1977. The symposium inc1uded formal papers and planning sessions. Papers on the following topics were presented:

- The Brown Planthopper Problem
- Economic Thresholds, Nature of Damage, and Losses Caused by the Brown Planthopper
- Ecology of the Brown Planthopper in the Tropics
- Ecology of the Brown Planthopper in Temperate Regions
- Brown Planthopper Migration
- Cultural Control of the Brown Planthopper
- Biological Control of the Brown Planthopper
- Factors Governing Susceptibility and Resistance of Certain Rice Varieties to the Brown Planthopper
- Breeding for and Genetics of Resistance
- Chemical control of the Brown Planthopper
- Methodology for Studying Varietal Resistance

In addition, papers were presented on the status of varietal resistance for brown planthopper control in India, Indonesia, Japan, Korea, Philippines, Solomon Islands, Sri Lanka, Taiwan, and Thailand.

The proceedings of the symposium will be published in the future.

Seedling reaction to bacterial blight

Nirmaljit Singh and Harnam Singh, Department of Plant Pathology, Punjab Agricultural University, Ludhianal, Punjab; S. S. Saini, Regional Rice Research Station, Kapurthala, Punjab, India

One hundred and ninety cultures of rice were tested against a virulent isolate of *Xanthomonas oryzae* during Jul–August 1976. The two youngest, fully expanded leaves of each 30-day-old seedling were clipped at about 6 cm from the tip with scissors dipped in a bacterial suspension of 10^7 cells/ml of 48-hour-old culture grown on potato sucrose peptone agar. The disease reaction was determined by measuring the lesion length (cm) from the point of inoculation of 20-25 leaves at 14 days after inoculation. Cross combinations, lesion lengths, and resistance ratings are shown in the table.

Lesion lengths and bacterial blight resistance ratings of several cross combinations tested in India.

Cross combination	Cultures tested (no.)	Av. lesion length (cm)	Rating[a]
Bas 370/Jaya	54	8.6	MS
Norin 18/Hyb 27	52	10.3	S
Mutants of Basmati 370	33	9.6	S
Bas 370/Hamsa	22	9.0	MS
Bas 370/IR127-80-1-10	5	11.2	S
IRS/Bas 370	4	9.3	S
Phulpattas 72/Mut 65	4	9.1	S
Bas 370/IR8	3	11.3	S
Hyb 27/Mut 65	2	9.8	S
Mut 52/Bas 370	1	8.4	MS
Bas 370/IR480-5	1	9.0	MS
UPR 71-12	1	3.2	MR
UPR 71-21	1	5.8	MR
UPR 70/30-4	1	5.4	MR
UPR 70/30-7	1	5.6	MR
UPR 70/30-14	1	7.4	MS
UPR 70/30-15	1	6.2	MS
UPR 70/30-25	1	3.2	MR
UPR 70/30-26	1	5.2	MR
UPR 70/30-39	1	4.4	MR
IR8	–	8.6	MS
Jaya	–	8.0	MS

[a]MR = moderately resistant (lesion length 3.2–5.8 cm); M S = moderately susceptible (6.2–9.0 cm); S = susceptible (9.1–11.3 cm).

Combined field resistance of some 1975 IRON entries to green leafhopper and stern borer at Cuttack, India

P. S. Prakasa Rao, entomologist, Central Rice Research Institute, Cuttack, India

Three hundred and thirty-six entries in the 1975 International Rice Observational Nursery (IRON) and cultures developed at the Central Rice Research Institute were subjected to severe field infestation Of the green leafhopper *Nephotettix virescens* and *N. nigropictus* and the stem borer (predominantly *Tryporyza incertulas*) by planting late in September 1975, and by installing electric lights. Most entries developed either severe hopperburn due to *Nephotettix* spp. or severe stem borer damage, or both. Only seven IRON entries and four CRRI cultures (see table) withstood both pressures well.

Entries in the 1975 International Rice Observational Nursery (IRON) and from the Central Rice Research Institute (CRRI) that had high levels of field resistance to both the green leafhopper and the stem borer.

Designation	Origin	Cross
BR 2-29-2-8-1	Bangladesh	IR8/Patnai 23
BR 20-28-2	Bangladesh	Pukhi//IR127
TG 37	Indonesia	–
Mahsuri	Malaysia	–
IR2451-20-3-2	IRRI	IR841-85/IR1529-680-3
IR1917-3-10-3	IRRI	IR20^3/*O. nivara*
IR1917-3-19-2	IRRI	IR20^3/*O. nivara*
CR 94-MR 1550 white[a]	CRRI	PTB 18/PTB 21//IR8
CR 93-MR 1624-1073-1[a]	CRRI	PTB 21/PTB 18//IR8
CR 157-41-112[a]	CRRI	Vijaya/PTB 10
CR 139-1 047[b]	CRRI	TKM 6/IR8//TKM 6

[a]Also resistant to gall midge. [b]Also resistant to bacterial blight.

Pest management and control
DISEASES

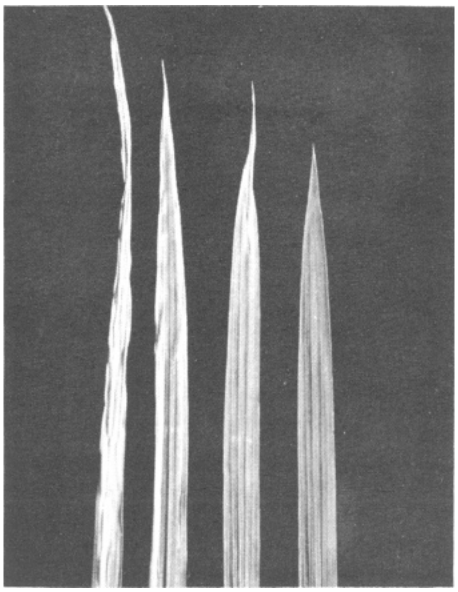
Identification of bacterial leaf blight in rice, caused by *Xanthomonas oryzae,* in America

J. C. Lozano, plant pathologist, Centro Internacional de Agricultura Tropical, Apartado Akreo 6713, Cali, Colombia, S. A.

Symptoms similar to bacterial leaf blight were observed on rice in several countries of the Caribbean zone of Latin America. Morphological and physiological characteristics of the bacterial pathogen were studied and a number of rice cultivars known to be susceptible to the disease in Asia were inoculated with the isolates.

The results clearly show that the bacterial pathogen that was isolated belongs to the species *X. oryzae.*

The symptoms observed in the field and obtained by artificial inoculation were identical with those induced by *X. oryzae.*



Reaction of the rice Bluebonnet 50 to a Panama isolate (X.O. No. 5) of *X. oryzae,* inoculated by the puncture technique at 4, 8, 12, and 15 days (left to right) after inoculation.

The cultural, morphological, and physiological characteristics of the bacterial pathogen isolated in America were identical with those recorded for *X. oryzae.*

When the artificial-inoculation procedures developed for testing the pathogenicity of, virulence of, and resistance to *X. oryzae* were used, symptoms developed in periods equal to those recorded for *X. oryzae* inoculated by the same procedures.

The inoculated varieties gave the same reactions as those they gave when inoculated with different Asiatic strains of *X. oryzae.*

Parasitic activity of *Trichoderma viride* on *Corticium sasakii*

A. K. Roy, Mycology Research Section, Department of Botany and Plant Pathology, Assam Agricultural University, Jorhat-785013, Assam, India

Trichoderma viride, a common soil-inhabiting fungus, completely suppressed the growth of sheath blight fungus *(Corticium sasakii)* in maize-meal sand medium. Germination of sclerotia of *C. sasakii* was completely inhibited when passed through a culture of *T. viride* with luxuriant sporulation. However, the efficacy of *T. viride* was reduced when the spores were diluted in water suspension; reduction was greatest in the higher dilution (17 × 10^4 conidia/ml). The efficacy of *T. viride* in suppressing *C. sasakii* was attributable to direct competition, although occasionally *T. viride* also parasitized the hyphae of *C. sasakii.* Production of an antibiotic substance by *T. viride* was not observed.

When the culture of *T. viride* was incorporated into sterilized soil along with *C. sasakii* (both cultures grown in 4% maize-meal sand medium), sheath blight infection on Pusa 2-21 was reduced to a certain extent (73% of the plants were infected vs. 100% in the inoculated control). But when the aerial parts of the plants were sprayed with *T. viride* spores either twice or four times and then inoculated with *C. sasakii,* the disease could not be checked.

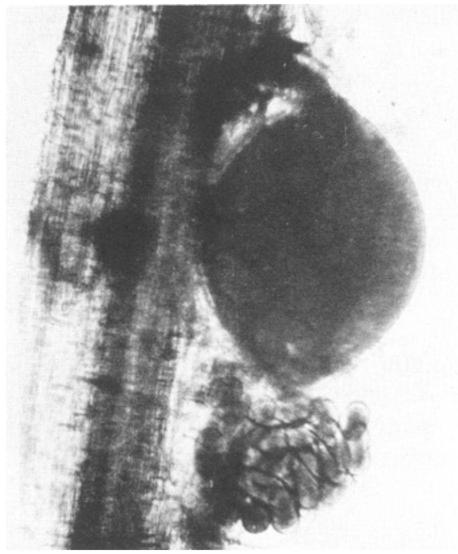
Leaf chlorosis due to infestation by a new cyst nematode

Y. Seshagiri Rao and A Jayaprakash, Central Rice Research Institute, Cuttack 753 006, India

Cyst nematodes of the genus *Heterodera* have reportedly attacked upland rice in Japan and lowland rice in the Ivory Coast. The parasite causes browning, reduction of root hairs, and retardation of physiological functioning of roots. The chief foliar symptoms are retarded plant growth, depleted vigor, and leaf chlorosis.

Recent surveys for parasitic nematodes of rice and rice soils in the Indian northeastern states, Orissa and Kerala showed *H. oryzae* prevalent in Orissa, and Assam. In the upland rice areas on the Rice Research Farms at Pattambi and Mannuty in Kerala, standing rice crops at 50-70 days of age suffered from leaf chlorosis. Examination of roots showed the presence of cyst nematode, blackening of roots, and loss of root hairs. The nematode cysts resembled *H. elachista* in shape but differed in the structure of vulval cone. Each contained an egg sac attached to its vulva (see figure). Because the second-stage juveniles differed in dimension from those of *H. oryzae,* the cyst nematode may be considered a new species.

Greenhouse tests in which rice varieties IR8 and the cultivar CRM 13-3241 (an irradiated culture of the cross NSJ 200/Padma) were inoculated with infective juveniles of the new cyst nematode confirmed the pathogenicity of the nematode. Typical symptoms of leaf chlorosis and root browning occurred 15 days after infestation of the root by the nematode. Analysis of chlorophyll in leaves of healthy and infected plants of CRM 13-3241 at 15, 25, and 35 days after inoculation showed reduction by 20.9%, 58.6%, and 74.2%, respectively. Affected plants flowered 10 days earlier and had reduced grain weight. The nematode completed its life cycle from 27 to 32 days after inoculation and the eggs from egg sac or cyst readily hatched in water. Further work on the identification of the new nematode, evaluation of damage and yield losses, and development of control measures is in progress.



Cyst of Heterodera *sp in situ on root of IR8.*

Effect of Hinosan and foliar micronutrient sprays on brown-spot disease of rice

Sp. Sundaram and N. N. Prasad, Microbiology Laboratory, Agriculture College, Annamalai University, Annamalainagar, Tamil Nadu, India

The effectiveness of two foliar micronutrient sprays and of Hinosan (O-ethyl S, S. diphenyl phosphoro-dithioate) against brown spot of rice caused by *Helminthosporium oryzae* Breda de Haan was tested in a field trial during *samba* season (Sept. 1976 – Jan. 1977).

A 1% solution of "733," 1% and 1.5% solutions of "755," and 0.08% solution of Hinosan were used. "F33" contained (by weight) Cu, 10%; $MG(OH)_2$, NH_3, KBr, S, Ca, and catalysts 30%; Zn, 2.5%; Mn, 2.5%; Bo 2.5%; and traces of Mb, Vn, Co, and Ni. "F55" is like "F33," except that its Cu content is 20%. The solutions were sprayed 65, 85, and 105 days after seeding. All treatments reduced disease incidence. Hinosan and "F55" at 1.5% reduced leaf and grain infections. Increased grain yield was recorded for Hinosan- and "F55" -treated plots.

Isolation of the brown leaf spot pathogen of rice from soil

Sp. Sundaram, S. Kannaiyan, and N. N. Prasad, Microbiology Laboratory, Agriculture College, Annamalai University, Annamalainagar 6081 01, Tamil Nadu, India

In an experiment to standardize the isolation from soil of the brown leaf spot pathogen of rice *Helminthosporium oryzae* Breda de Haan, the pathogen was isolated in Czapek-Dox-Agar and rice agar media. The systemic fungicide Benlate was incorporated in the media at 100, 250, and 500 ppm. The pathogen was recovered from both media, but more from the rice agar medium (see table).

Isolation of *H. oryzae* from soil, Tamil Nadu, India.

Medium	Benlate (ppm)		
	100	250	500
Czapek-Dox-Agar	1.41 [a]	1.92	2.48
Rice agar	2.14	2.13	3.34

[a] Colonies (x 10^3)/g of soil (wet wt).

Seasonal variation of rice reactions to blast in Taiwan

W. L. Chang, L. C. Chen, and S. C. Yang, Chiayi Agricultural Experiment Station, TARI, Chiayi, Taiwan

Blast caused by *Pyricularia oryzae* is one major disease of rice in Taiwan. Until recently, it was more commonly observed during the cool first-crop season and it tended to cause more damage on ponlai

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.

Rice reactions to blast at Chiayi nursery, 1976.

Crop season	Plant type	Leaf blast				Neck blast			
		Resistant		Susceptible		Resistant		Susceptible	
		(no.)	(%)	(no.)	(%)	(no.)	(%)	(no.)	(%)
First	Ponlai	21	22.3	94	11.7	35	31.3	77	68.7
	Indica	42	11.8	12	22.2	45	84.9	8	15.1
Second	Ponlai	18	14.9	103	85.1	15	62.0	46	38.0
	Indica	13	24.1	41	75.9	16	30.2	37	69.8

rices. But now blast is often found in the second crop of the hot season, and indica rices are as susceptible as the ponlais. In the 1976 uniform blast nursery conducted at the Chiayi Station, 27 of 121 elite ponlais (22%) and 42 of 54 modern indicas (78%) in the first crop showed resistance to leaf blast, while 35 ponlais (31%) and 45 indicas (85%) were resistant to neck blast. In the second crop, however, entries resistant to blast decreased sharply with the exception of ponlais that were resistant to neck blast. Only 18 ponlais (1 5%) and 13 indicas (24%) remained resistant to leaf blast, while 75 ponlais (62%) and 16 indicas (30%) were resistant to neck blast. These reactions indicate that rice varieties, particularly indicas, may tend to become more susceptible to blast under the environmental conditions of the second crop. Further observation on the seasonal change of rice reactions to blast appears necessary.

Pest management and control

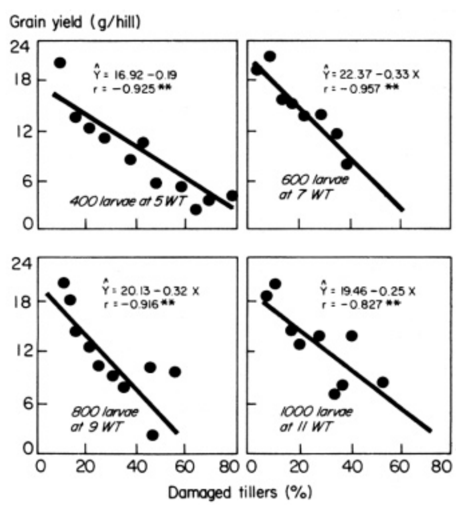
INSECTS

Relation between damage by rice stem borer *Tryporyza incertulas* and yield of rice variety Pelita I-1

J. Soejitno, Entomology Department, Central Research Institute for Agriculture, Bogor, Indonesia

The yellow rice borer *Tryporyza incertulas* is a pest of major importance in Indonesia. Insecticide application is based primarily upon the rice plant stages. To be economically justified, such applications should be based on insect population density.

A study was conducted to determine the relationship between percentage of tillers damaged by *T. incertulas* and grain yield. The experiment was conducted in a screenhouse with four 2- × 2-m plots. Rice variety Pelita I-1 was grown at a planting distance of 20 × 20 cm. Plots were artificially infected with newly hatched *T. incertulas* larvae at 5, 7, 9, or 11 weeks after transplanting. Deadhearts were counted weekly. Data on whiteheads and grain yield were based upon hill units.



Rice grain yield of Pelita I-1 related to the tillers that were damaged by the larvae of yellow stem borer T. incertulas. (WT = weeks after transplanting)

Data on damage and grain yield indicated that the relation between stem borer damage and rice yield is linear rather than exponential (see figure).

Damage in plots infected at 7 and 9 weeks after transplanting may cause higher yield reduction than damage at 5 or 11 weeks. Infection at 5 weeks after transplanting was assumed to stimulate formation of new tillers, while infection at 11 weeks after transplanting led to high larval mortality caused by plant vigor. The relation between damaged tillers (at 3 weeks after infection) and grain yield reduction indicated that each percentage unit of plant damage caused about 1 percent reduction in yield.

Yield losses and economic injury levels of rice insect pests in South Sulawesi, Indonesia

Summary of a seminar presented by P. van Halteren at the Research Institute at Maros, Indonesia, April, 1977

Rice yield losses due to insects were assessed in South Sulawesi. When crops are not protected, rice insects (excluding the rice seedbug) reduce the potential yield of varieties such as Pelita I-1, C4-63, IR5, IR20, IR26, SPR 6726-76-2-3, and B462c-Pn-1-3 by from 1 to 3 t/ha, or an average of about 30%.

When the insect pests *Hydrellia philippina, Cnaphalocrosis medinalis, Nymphula stagnalis, Spodoptera* spp., and grasshoppers attack rice during the first 4 weeks, yields may be cut by from 5 to 10%. *Cnaphalocrosis* attacks in the flag leaf stage might also cut yields by from 5 to 10%.

Artificial defoliation produced the greatest loss at about 7 to 10 weeks after transplanting, during the periods of panicle initiation and formation.

Measuring the effect of stem borers during the vegetative stage was complicated; deadheart percentages seemed to be a poor indication of damage and the data were inconclusive. During the reproductive stage, yield losses due to stem borers varied from 0.9 to 2.1% per unit percent of whitehead, or an average of 1.2%.

Studies of yield loss from the rice bug resulted in the regression line $y = 11.34 \log x - 7.34$ ($r = 0.676$ and $n = 36$), indicating that yield loss can be expected at a certain population density. Chemical treatment seems justified if from 1 to 2 bugs/sq m are found.

Root-zone placement of carbofuran for insect control in rice

S. Y. Choi, College of Agriculture, Seoul National University, Suweon, Korea, and J. K. Ryu, H. R. Lee, and Y. H. Song, Institute of Agricultural Sciences, Office of Rural Development, Suweon, Korea

A root-zone liquid-insecticide injector designed at IRRI was tested in 1976 experiments at Suweon and at Honam. Its effectiveness was compared with that of root-zone applications of encapsulated carbofuran and with broadcast applications. At Suweon, capsules applied to the root zone most effectively controlled the striped stem borer *Chilo suppressalis* and the small brown planthopper *Laodelphax striatellus*. One application with the injector at transplanting was equal to two broadcast applications.

Root-zone and paddy-water applications of insecticide to control insects of rice. Variety Palkweng.[a] Honam Crops Experiment Station, Korea, 1976.

Treatment[b]	Rate (kg a.i./ha) of application	Deadhearts at 55 DT	Insects (no./40 hills) Small brown planthoppers at 30 DT	Insects (no./40 hills) Green leafhoppers[c] at 40 DT	Yield (t/ha)
Carbofuran					
Capsules	1.0 x 1	0.6 a	2 a	16 ab	5.350 a
	2.0 x 1	0.3 a	1 a	2 a	5.673 a
Liquid injector	1.0 x 1	8.6 bc	72 ab	50 abc	4.130 bc
	2.0 x 1	4.6 ab	14 ab	15 ab	4.339 b
Broadcast	0.9 x 2	16.7 cd	65 ab	64 abc	4.050 bcd
	0.9 x 4	8.1 ab	52 ab	33 abc	4.473 b
Diazinon					
Broadcast	0.9 x 2	16.9 d	101 ab	74 bc	3.555 cd
	0.9 x 4	5.0 ab	156 b	60 abc	3.757 bcd
Control		19.3 d	114 ab	80 c	3.356 d

[a]Japonica-type variety susceptible to common rice insect pests in Korea. Within a column, means that are followed by a common letter are not significantly different at the 5% level. DT days after transplanting. [b]First application, 2 days after transplanting. [c]*Nephotettix cincticeps.*

At Honam, capsules also were the most effective. One application of carbofuran by injector was equal to four broadcast applications (see table).

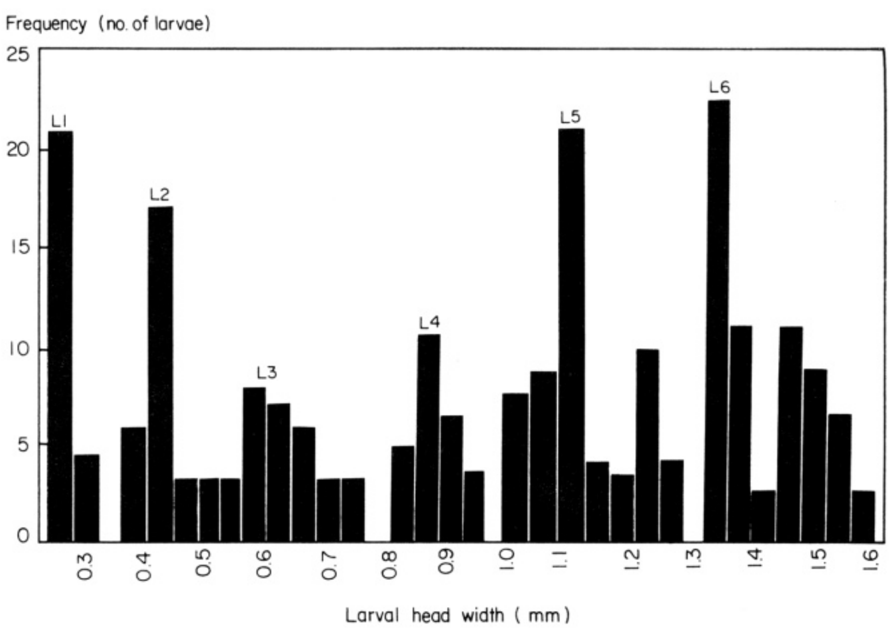
Number and duration of larval instars of striped rice borer *Chilo suppressalis* in the laboratory

J. Soejitno, Entomology Department, Central Research Institute for Agriculture, Bogor, Indonesia

The larval instars of *C. suppressalis* were studied in the laboratory at CRIA, Bogor. Larvae were reared on 5- to 7-day-old seedlings of IR5. Twenty-five larvae were sampled at 3-day intervals during larval development and the width of their head capsules was measured under the microscope. Daily observations were also made of individually reared larvae to determine the time of molting and duration of each instar.

Data on the larval head width, plotted as frequency distributions, showed six distinct peaks (see figure), which indicated six larval instars (Ll-L6). The major part of the larval population molted six times (65%) and only a minor part molted five (1 9%) or seven times (16%). The larval instars of *C. suppressalis* can be estimated by measuring head capsule width.

The mean value of the head width of instars L1, L2, L3, L4, L5, and L6 was 0.28 mm, 0.39 mm, 0.58 mm, 0.84 mm, 1.11 mm, and 1.46 mm, respectively. The mean duration of the larval instars varied from 5 to 6 days and the average larval stadium was 31 days.



Frequency distribution of larval head width of Chilo suppressalis *reared on IR5 rice seedlings.*

Seedling root-coat treatment with carbofuran

J. N. Seiber, visiting scientist; E. A. Heinrichs, entomologist; and S. A. Valencia, research aide, Entomology Department, International Rice Research Institute

Soaking rice seedlings in a solution of carbofuran and water gives some early protection against such pests as whorl maggot and green leafhopper. The addition of perlite, a porous volcanic mineral soil conditioner, to the soaking solution extends the period of protection. Suspended perlite coats the seedling roots and acts as a reservoir for further

Effect of two methods of carbofuran application on mortality of brown planthopper (BPH) and green leafhopper (BLH). Variety TN1, IRRI greenhouse, 1977.

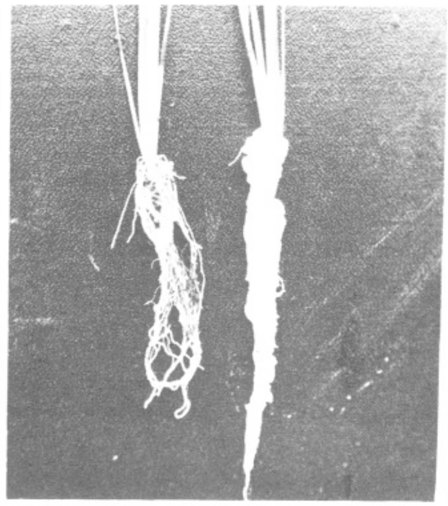
Treatment	Mortality[a] (%) 1 DAT[b]		5 DAT		12 DAT		20 DAT		30 DAT		50 DAT	
	BPH	GLH	BPH	GLH	BPH	GLH	BPH	GLH	BPH	GLH	BPH	GLH
Perlite root coat	100	100	100	100	100	100	98	100	82	100	18	100
Gelatin capsule root zone	12	20	93	100	100	100	100	100	100	100	100	100

[a]Mortality recorded at 24 hours after insects were placed on plants. Values adjusted using Abbott's Formula. [b]DAT = days after treatment, or when insects were placed on plants.

uptake of the systemic insecticide after transplanting.

The perlite root-coat was compared with the root-zone treatment using gelatin capsules. The root-coat treatment consisted of 5 g perlite and 0.5 g of Furadan 2F in 100 ml of water — sufficient to soak about 100 seedlings overnight; the root-zone treatment involved 2 kg a.i./ha of Furadan in gelatin capsules, placed in the rice root-zone at transplanting in the greenhouse.

Ten adult brown planthoppers *Nilaparvata lugens* and 10 green leafhoppers *Nephotettix virescens* were caged on the plants at intervals after transplanting. The root-coat caused high initial mortality in both pests, but maintained good control of brown planthoppers through 30 days after treatment (DAT) and of green leafhoppers through 50 DAT. The root-zone placement achieved 100% mortality for both pests about 5 DAT. Control lasted through 50 DAT. Analysis of plant leaves showed that the two treatments gave roughly equivalent and high carbofuran residues at 20 DAT; the residues from the root-zone treatment remained high in leaves at 50 DAT while those from the root-coat treatment declined to one-tenth the values measured at 20 DAT. Residues in the stems were much lower than those in the leaves, but they followed the same trends.



Rice seedling dipped in water (left), and in perlite-water suspension (right).

The new root-coat technique requires less insecticide and considerably less labor than does the capsule method. While its residual effectiveness is not as long-lasting as that of the capsule method, pest control under greenhouse conditions is immediate and apparently of sufficient duration to protect plants during the critical few weeks after transplanting. Field tests are now in progress to verify this. Because of the possible hazard to persons handling seedlings treated in this manner, the new method would appear to be most suited to areas where seedlings are transplanted by machine.

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

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