to measure resistance is based on a comparison of the amount of disease on IR24. The effect of *Xa-4* on the individual race was estimated by the formula

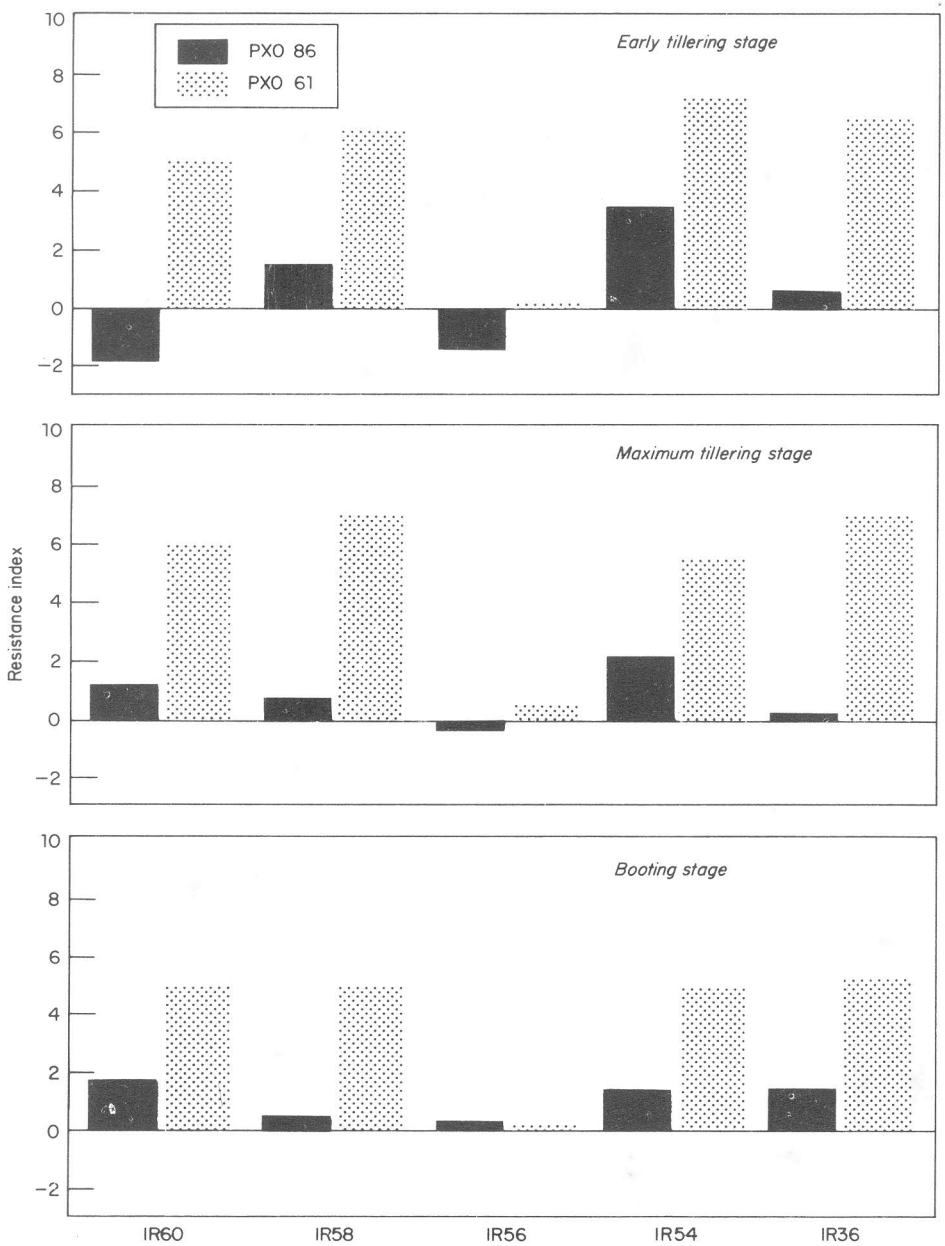
$$RI = \frac{\text{DL of IR24} - \text{DL of IR cultivar}}{100}$$

DL = disease level (% hill infection, % leaf infection, % lesion area)
A zero RI means that resistance equals that of IR24.

A wide range of hill and leaf infection with the two races was observed (see table). Infection with the virulent race was higher than with the avirulent race at both maximum tillering and booting. Based on hill infection, the RI of varieties infected with the avirulent race increased as the plants matured (see figure). The RI of varieties infected with the virulent race also increased.

The data seem to suggest that these varieties possess a distinct background resistance that increased as the plant matured. Using hill and leaf infection as parameters, such background resistance may not be shown at early tillering.

Because difference in disease level induced by PXO 61 and PXO 86 is related to the effect of *Xa-4*, the DL of a test variety not matched by PXO 86 is a measure of background resistance. Although the measurement is indirect, differences at different growth stages were clear. Perhaps this background resistance slows down epidemics in farmers' fields in the Philippines, even though the race 2 population is increasing with an increase in hectarage planted to varieties with similar genetic backgrounds. Background resistance could be an attribute of the durability of resistance of IR cultivars carrying the *Xa-4* gene. □



Relative resistance index, based on hill infection, of selected IR varieties to races 1 (PXO 61) and 2 (PXO 86) of *Xanthomonas campestris* pv. *oryzae* as compared to that of IR24, the susceptible variety, at 3 growth stages, IRRI, 1986 dry season. + = more resistant than IR24, - = more susceptible than IR24.

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Neck blast (Bl) in newly released upland rice varieties in Brazil

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Upland rice varieties Rio Paranaiba (IAC47/63-83), Araguaia (IAC47/TOS2578/7-4-2-3-B_2), and Cabaçu (mutant of IRAT79) were released to the Cerrado Region in Brazil. They were evaluated in consecutive years 1984-85, 1985-86, and 1986-87 in Goiania with local check IAC47.

Neck Bl increased and grain yield decreased for all varieties tested (see table). The increase in all cultivars was independent of the degree of resistance.

Disease and yield were significantly different between IAC47 and the improved varieties. The newly released upland varieties had higher neck Bl resistance, and yielded more. □

Neck Bl incidence[a] and grain yield of newly released upland rice cultivars and local check IAC47.[b] Goiania, GO, Brazil, 1986-87.

Growing season[c]	IAC47		Rio Paranaiba		Araguaia		Cabaçu		Year mean	
	Neck Bl	Grain yield (t/ha)	Neck Bl	Grain yield (t/ha)	Neck Bl	Grain yield (t/ha)	Neck Bl	Grain yield (t/ha)	Neck Bl	Grain yield (t/ha)
1984-85 (6)	3.2	2.6	1.3	3.4	1.1	2.8	1.2	2.9	1.7 c	2.9 a
1985-86 (4)	3.9	1.3	3.0	2.0	2.7	2.1	2.9	1.9	3.9 b	1.8 b
1986-87 (4)	8.7	0.8	5.6	1.6	5.1	1.6	5.4	1.3	6.2 a	1.3 c
Cultivar mean	6.2 a	1.6 b	3.2 b	2.4 a	2.9 b	2.2 a	3.1 b	2.1 a		

[a]Disease evaluation scale 1 to 9, *Standard evaluation system for rice.* [b]Means were compared using Tukey's test at 5% level of significance. abc show differences among year means; ABC show differences among cultivar means. [c]Figures in parentheses = number of trials.

Maintenance of virulence in *Xanthomonas campestris* pv. *oryzae* cultures

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The loss of virulence in phytopathogenic bacterial cultures maintained on culture medium is a common phenomenon. In the absence of lyophilization facilities, cultures of *Xanthomonas campestris* pv. *oryzae*, the pathogen of bacterial blight, not only decline in virulence but occasionally even lose viability within a year of maintenance on a culture medium under refrigeration. We evaluated the suitability of sterile distilled water columns, top layered with liquid paraffin, for long-term maintenance of the bacterium.

A distilled water column 2.5 cm high in round-bottomed, screw-capped test tube (about 7.5 cm high, 1.5 cm outer diameter) was provided with a 0.5-cm-thick top layer of medical grade liquid paraffin and autoclaved at 15 lb pressure for 30 min. Bacterial growth from nutrient agar slant 48 h old was transferred aseptically to the column and stored at 10 °C.

In Oct 1980, cultures of three virulent grades—highly, moderately, and weakly virulent—were preserved by this technique. An identical set was maintained under refrigeration on culture medium (modified Wakimoto's medium: 5 g peptone, 20 g sucrose, 0.5 g $Ca(NO_3)_2 \cdot 4\ H_2O$, 0.5 g $FeSO_4 \cdot 7H_2O$, 2 g $Na_2HPO_4 \cdot 2H_2O$; 20 g agar, 1000 ml distilled water, pH adjusted to 6.8), with subculturing at 6-mo intervals.

The viability of the preserved cultures was tested. With a wire-loop, a minute amount of the bacterial mass available as sediment at the bottom of the water columns was transferred to medium slants and incubated at 27 °C. An aqueous suspension of 48-h-old fresh culture at about 10^9 cells/ml served as inoculum.

About 20 fully developed young leaves of TN1 rice plants at the maximum tillering stage were inoculated by leaf tip cutting. Virulence was determined by average lesion length measured 15 d after inoculation. The cultures were graded weakly (0.1-5.0 cm), moderately (5.1-12.0 cm), or highly (>12.0 cm) virulent.

Cultures preserved in the water column and those maintained on culture medium were tested for viability and virulence at 1, 3, and 6 yr.

Each culture in a water column was still viable in the last test in 1986, with no appreciable decline in initial virulence. In the cultures maintained on culture medium, the moderately and weakly virulent types survived to the last test, but 2 of the 3 highly virulent cultures lost viability within 1 yr.

The pathogenicity test further revealed a gradual loss of virulence in highly and moderately virulent cultures. In the last test, three cultures (one highly virulent and two moderately virulent) became avirulent; the rest reacted as weakly virulent.

Sterile distilled water columns top layered with liquid paraffin served as a remarkably suitable and effective medium for long-term maintenance of *X. c.* pv. *oryzae* cultures. The preserved cultures not only remained viable, but retained their original pathological characteristics for several years. This inexpensive and easily manageable device could be a reliable base for maintaining the bacterium in its virulent form in laboratories lacking lyophilization facilities. □

Leaf blast (Bl) outbreak at Faizabad, India

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Severe leaf Bl caused by *Pyricularia oryzae* had not been observed around Faizabad, specifically Masodha and Sohawal block, for 10 yr. During the 1986 wet season (Jun-Dec) at C. R. S. Masodha, it appeared only on N22 at the milk stage, and only on the upper and flag leaves; the neck was not affected. During the 1987 wet season, N22 and Bagri showed severe infection in early Aug at tillering; plants were completely killed by the second week of Aug.

Under upland rainfed conditions in trials at C. R. S. Masodha, where disease pressure was highest, some newly developed lines showed high resistance to leaf Bl; indigenous varieties were