RICE IMPROVEMENT IN CHINA AND OTHER ASIAN COUNTRIES

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BROWN PLANTHOPPER SURVEY TECHNIQUE

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IR26 and IR28, which were resistant to the brown planthopper (BPH) *Nilaparvata lugens*, were found susceptible to biotype 2 of the insect after four or five cropping seasons in many places in Indonesia. Natural selection for the new biotypes capable of attacking resistant varieties is rapid. The shift to biotype 2 was confirmed only after the pest had spread over wide areas and had caused appreciable yield losses. IR26 and IR28 are still widely planted and run great risks of attack by biotype 2. Replacing them with IR32 and IR36, which are resistant to biotype 2 in those sites, is effective, but the advantage might last for only a few years. Therefore, a field technique for early detection of new BPH biotypes has been developed. It is carried out twice a year -- in the wet and dry seasons -- at about 1,200 sites throughout the main rice areas. Biotype identification is important in determining the distribution of seeds of IR32, IR36, and other varieties resistant to BPH biotype 2. Replacing the varieties that become susceptible with resistant ones before the pest has had the chance to spread significantly reduces yield losses. So far there is no evidence of the field development of a BPH biotype capable of attacking IR32 and IR36.

There is a wide gap in the production in farmers' fields and that on demonstration and research farms. Farmers' rice yields average 2.7 t/ha; those on demonstration plots, 3 to 4 t/ha; and those on research farms, 6 t/ha (Anon. 1979). A main reason for the gap is inadequate pest control in farmers' fields, particularly for the brown planthopper (BPH) *Nilaparvata lugens.* The BPH was previously a minor rice pest, but since 1973 it has caused significant yield losses. The yield losses varied

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considerably in 1973, but the average loss in outbreak areas was estimated as 46%. Included in the estimate are losses caused by the BPH-vectored grassy stunt virus (GSV) and ragged stunt virus (RSV) diseases (Soenardi 1976).

The first reported breakdown of the BPH resistance of IR26 was in the Philippines and the Solomon Islands (Anon. 1975, Stapley 1975).

The use of resistant varieties as the only BPH control measure appeared successful for only 4 or 5 cropping seasons in Indonesia. By the end of 1976 IR26 had become susceptible to BPH in North Sumatra (Mochida et al 1977). In Banyuwangi (eastern Java) and in southern Bali, IR28 as well as IR26 became susceptible to BPH (Oka 1977b). Both varieties have the single dominant gene *Bph 1* for resistance. The BPH field population at those locations is rapidly selecting for a different biotype -- similar to that designated as biotype 2 at IRRI -- that attacks both IR26 and IR28 (Oka 1977a). The shift of the field population to biotype 2 was confirmed after the pest spread rapidly over wide areas and reduced yields appreciably. IR32 and IR36, which are resistant to biotype 2, were introduced in those areas. But this new genetic environ-ment might again select the BPH population to a third biotype that could render IR32 and IR36 susceptible in a few seasons.

Both IR26 and IR28 are still widely planted throughout Indonesia, so the risk of their attack by biotype 2 -- either developing on the crop or migrating from other areas -- is great.

Therefore, early detection of the development of new BPH biotypes *is essential* so that varieties that have "broken down" can be replaced with resistant varieties *before the insect spreads over wide areas.*

In August 1977 BPH biotype detection was initiated at about 200 sites throughout Indonesia's main rice-growing areas. The biotype detection program, part of the general surveillance program of rice pests, is meant to be continuously carried out during each wet and dry season (Oka 1978a).

Responsibility for the planning and execution of the all-Indonesia surveillance program rests with the Directorate of Food Crop Protection, working in close cooperation with the Central Research Institute for Agriculture (CRIA), several universities, and the provincial and district extension services. Surveillance is particularly concentrated in the major rice regions. In 1978, field work was carried out by about 600

agricultural high school graduates assigned to the program. Each enumerator is responsible for 6,000 to 10,000 ha. The areas are divided into 4 or 5 subsections, 1,500 to 2,000 ha each. Rice pests in each subsection are surveyed once a week.

The number of survey sites has gradually increased; during the fourth survey (1979 wet season) 240 enumerators surveyed about 1,200 sites.

Each enumerator is responsible for maintaining four or five cages. BPH samples from each 1,500 to 2,000 ha area are used to infest each cage.

By late October 1977 the first distribution maps of BPH biotypes had been completed. Five subsequent detections have been conducted.

SURVEILLANCE METHODOLOGY

The differential rice varieties are TN1 (susceptible to all biotypes), Pelita I-1 (susceptible to all biotypes), IR26 and IR28 (susceptible to biotype 2 but resistant to biotypes 1 and 3), and IR32 and IR36 (susceptible to biotype 3 but resistant to biotypes 1 and 2) (Oka 1978b).

Each differential variety is seeded in double rows, spaced 4 cm. Four replicates of seeds of each differential are randomly glued between two sheets of absorbent tissue paper. Varietal names are copied opposite each row. CRIA prepares the sheets; the Directorate of Food Crop Protection distributes them throughout Indonesia. Seed preparation simplifies the work of field personnel and minimizes errors.

Field personnel place about 1 cm of field soil in plastic trays 30 x 25 x 5 cm in size. Urea is mixed with the soil at the rate of 90 kg N/ha before placing the planting sheet on the soil surface. Workers then place the plastic tray in an insect-proof cage, 30 x 30 x 25 cm. The cage, placed under direct sunlight to prevent seedling etiolation, is watered frequently. The seedlings are infested 3 to 4 days after emergence with adult BPH collected randomly from the 1,500 ha surveillance areas. About 100 to 150 adults/box are released. Assuming that half are females, they should reproduce about 2,000 nymphs/box. Each tray contains about 500 seedlings, so 4 to 5 nymphs infest each seedling.

During the first run, August 1977, only nymphs were present in many sites. Plants infested with nymphs in the second, third, or fourth instars were collected from those areas and

shaken to infest the seedlings. Later the whitebacked planthopper *Sogatella furcifera* was also found to be increasing and damaging rice at some locations. Because it is impossible for the field workers to distinguish between the nymphs of the two insects, we used only adult BPH for seedling infestation.

Workers remove the BPH predator *Cyrtorhinus lividipennis,* often found in the trays, with mouth aspirators.

Individual seedlings are scored as soon as the susceptible checks TN1 and Pelita I-1 die (1976 Standard Evaluation System for Rice score of 7-9: 7 = wilting and severe stunting, 9 = plant dead). Workers then airmail the results of the readings to the Directorate of Food Crop Protection, Jakarta, and to CRIA, Bogor, for analysis.

If TN1 and Pelita I-1 show a reading of 7 to 9 while IR26, IR28, IR32, and IR36 show low readings (2-3), then BPH biotype 1 prevails in the area. High readings on IR26, IR28, and both susceptible checks, but low readings on IR32 and IR36, suggest that biotype 2 may prevail. Biotypes may be mixed or biotype 2 may be increasing if both check varieties have high ratings (7-9), along with intermediate to high ratings (4-7) for IR26 and IR28, and low ratings for IR32 and IR36.

The first mapping showed biotype 2 to be present in northern Aceh Province, most of North Sumatra Province, two South Sumatra locations, and in West Java, eastern Java, and western Bali. No evidence of biotype 2 was found during the first and second runs for all of Central Java and most of West Java, South Sulawesi, West and South Kalimantan, or West Nusa Tenggara. But in the fourth and the fifth mapping, biotype 2 was found in almost all of East Java, Central Java, West and South Bali, and northeastern West Java. Biotype 2 was also increasingly detected in Aceh Province. There has been no indication to date of biotype 2 in South Sulawesi, South Kalimantan, and West Nusa Tenggara provinces.

Such information is passed to the mass guidance rice intensification program to guide them in distributing seed of IR32, IR36, and IR38 (which are resistant to biotype 2). Timely replacement of susceptible varieties with resistant ones will minimize yield losses.

This method may help us detect a third BPH biotype (if it develops) on IR32, IR36, and IR38, which are widely planted in rice centers infested with BPH biotype 2.

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