

## 2. VIRUS DISEASES OF FOOD CROPS IN INDONESIA AND THEIR CONTROL

Ida Nyoman OKA\*

### Introduction

Toward the year 2000 food production in Indonesia should be doubled, just to maintain the present rate of consumption, to meet the demand of around 250 million people<sup>10)</sup>.

The introduction of modern agricultural technology since 1969 such as high inputs of fertilizers, the increase of pesticides, the use of good seeds of high yielding varieties, good management practices, better irrigation and processing is eminently successful in boosting up the production of wet land paddy by about one million ton per year (Table 1).

**Table 1. Production of wet land and dry land paddy (ton)  
in Indonesia, 1968-1973<sup>\*)</sup>**

Year	Wet land	Dry land	Total
1968	20 080 093	2 354 954	22 435 047
1969	21 474 285	2 081 562	23 555 847
1970	23 148 517	2 120 721	25 269 238
1971	24 307 806	2 084 369	26 392 175
1972	23 401 626	1 949 484	25 351 110
1973	25 901 823	2 189 026	26 120 849

<sup>\*)</sup> Statistical Pocketbook Indonesia, 1974-1975.

However, the new technology also brings along various problems such as increased attack of insects and diseases.

Virus diseases are also becoming increasingly important during the last decade. A brief report dealing with virus diseases of rice and some of the leguminous crops in Indonesia will be discussed in this paper.

### Virus/mycoplasma diseases of rice

Four virus/mycoplasma diseases of rice have been reported to occur in Indonesia. There are tungro, grassy stunt, yellow dwarf and orange leaf (15; 12; 23). At present tungro and grassy stunt are economically the most important.

**Tungro** Tungro disease was recorded for the first time in Java in 1968<sup>10)</sup>. In 1962 a disease showing tungro symptoms (local: "Penyakit habang"), was reported to occur only sporadically in South Kalimantan. However, from 1969 until 1971 the disease had reached epidemic proportions in the provinces of South Kalimantan, South Sumatra, and Lampung. The acreages damaged by the disease were estimated about 10,000 ha, 7,000 ha and 3,000 ha, respectively<sup>10, 11)</sup>. Rice varieties severely affected by the disease in South Kalimantan were Lemo, Cempaka, Lalantik Bamban, Randah Padang, Kencana Hantasan,

\* Chief, Division of Insect Pests and Diseases, Central Research Institute for Agriculture, Merdeka 99, Bogor, Indonesia

Karangdukuh, and Sijam Panangah. It was suggested to plant high yielding tolerant varieties such as C4-63 and IR5 and some resistant local varieties such as Ketumping, Ketan, Pirukat, Benih Kuning, Pengambau and Randah Palas<sup>12)</sup>.

In South Sumatra and Lampung the local varieties Kwatik, Ketan Cebol, Ketan Laler, Ketan Laron, and Senggoto were susceptible. Varieties showing resistant reaction to the disease were IR5, C4-63, Dewi Ratih and some local varieties such as Gembira, Syntha and Dara<sup>14)</sup>.

In October 1972 an outbreak of the same "Penyakit habang" (local term "Cella pance") was reported in South Sulawesi affecting an area of about 1,000 ha planted with C4-63, Pelita I/1, Pelita I/2 and some other local varieties<sup>22)</sup>. In 1973 dry season the affected area had increased to about 5,000 ha<sup>23)</sup>. Laboratory experiments carried out in Bogor and microplot inoculation tests conducted in South Kalimantan and South Sulawesi, showed that both "Penyakit habang" and "Cella pance" were similar in nature to tungro disease in other countries<sup>25)</sup>. In the areas where the disease reached epidemic proportions the population of the green leafhopper, *Nephotettix virescens*, was estimated at around 25 to 50 individuals per 25 times net sweeping<sup>21)</sup>. In 1972-1974 rice seasons in South Sulawesi the disease damaged around 50,000 ha of rice field<sup>26)</sup>.

Since then the disease was diminishing considerably, probably due to drastic changes of the susceptible Pelita with IR20, C4-63, and Bengawan which are tolerant to the disease<sup>26)</sup>.

It was interesting to note that IR5 in South Kalimantan was more resistant than C4-63, Pelita I/1 and Pelita I/2 under field conditions. In South Sulawesi, however, C4-63 was somewhat more resistant than IR5, Pelita I/1 and Pelita I/2<sup>21)</sup>. This suggests that there might be two different strains of the pathogen involved.

**Grassy stunt** Grassy stunt virus symptoms on rice was observed for the first time at Muara, Bogor in 1967<sup>15)</sup>. Throughout West Java the disease occurred only sporadically in that same year. However, the disease had become increasingly important in Central Java since 1969, 1970 and 1971, successively. In 1971 more than 8,000 ha of rice fields were affected by the disease in Tegal and Klaten areas<sup>26)</sup>. This may include direct injury by the brown planthopper. Drastic increase of the grassy stunt virus was closely associated with high density of brown planthopper population, *Nilaparvata lugens* Stål<sup>16)</sup>. Transmission studies carried out at the Central Research Institute for Agriculture in Bogor using *Nilaparvata lugens* as vector confirmed that the disease was caused by the grassy stunt virus<sup>3, 21)</sup>.

In the province of East Java (Banyuwangi area) the disease has caused damage from year to year since 1969. In 1974 not less than 1,000 ha of rice field were severely affected by the disease<sup>26)</sup>. It was found that the disease also caused considerable damage in West Java and North Sumatra. Rapid spread of the disease was associated with considerable increase of brown planthopper population which damaged more than 344,000 ha rice field in the rice centers of the country<sup>1)</sup>. Tantera<sup>25)</sup> tested the reaction of 358 local varieties against the disease and found that all of them were susceptible. The high yielding varieties IR5, IR8, IR20, IR22, IR24, Pelita I/1, Pelita I/2, C4-63 Gb and Sigadis were also susceptible. Outbreak of the disease was probably associated with planting large areas with the highly susceptible Pelita-I variety, increased use of nitrogenous fertilizers and growing rice continuously throughout the year.

Dr. Mochida and his coworkers<sup>10, 11)</sup> have been surveying the distribution of grassy stunt and its insect vector, brown planthopper, mainly in Java and Bali since the wet season 1974/75. Though grassy stunt is frequently observed within the outbreak areas of the brown planthopper, according to them, the rice fields severely damaged by grassy stunt were not always the rice fields with high population densities of the vector insect at the time of survey. They also showed in the open field that the resistant cultivars

such as IR 26, 28, 30, 32, and 34 to brown planthopper reduced the population of the vector insect considerably. Though IR26 is not resistant to grassy stunt, it is considered to be one of excellent cultivars for farmers in brown planthopper outbreak areas in Java and Bali.

**Yellow dwarf** The disease was noted as early as 1967 in Java. The disease was successfully transmitted experimentally by using *Nephotettix virescens*<sup>25)</sup> on the test plants FK-135 and T (N)1. Further laboratory transmission experiments of the disease by using *Nephotettix nigropictus* proved the persistent type of the disease agent. The insect remain infective until it died. The disease symptoms on infected plants appeared 33 to 43 days after infection. Therefore, under field condition the disease symptom will appear on later stage of the rice growth, particularly in ratooning plants.

**Orange leaf** The disease was first noted in the dry season of 1972. Transmission studies of the disease by using *Recillia dorsalis* indicated that the disease was very similar to the orange leaf disease found in Taiwan, Thailand, and the Philippines and other countries<sup>25)</sup>.

Although both the yellow dwarf and the orange diseases are of minor importance at present still they are potentially dangerous to our rice crop.

Therefore, further investigation on the ecology, its vector relationship and search for sources of resistance to the disease are necessary.

### Virus disease of some leguminous crops

Legume plants i.e. soybean, (*Glycine max*), peanuts (*Arachis hypogea*) and mungbean (*Phaseolus radiatus*), are very important secondary crops in Indonesia as main source of plant protein, vitamins and essential minerals for the people's diet. Therefore, these crops also receive priority in the second five year development program.

As it is true with rice, the leguminous crops also are subjected to attack by various insects and diseases. There are around 20 species of insect pests associated with soybean alone in Indonesia<sup>6,4,29)</sup>.

Virus/mycoplasma associated with the leguminous crops are undoubtedly very important in limiting its production output. Iwaki<sup>9)</sup> made extensive studies on viruses attacking the crops. He found that the diseases showed various kinds of symptoms such as witches' broom, phyllody, small leaf, mosaic leaf malformation, stunt and dwarf.

On soybean Roehan et al<sup>17)</sup> identified soybean stunt virus transmitted by juice inoculation and by aphids *Aphis craccivora* and *Aphis glycines*. In addition Iwaki reported bean yellow mosaic virus (transmitted by juice inoculation and by some aphids, but not seed borne), and soybean dwarf virus (transmissible through grafting and by *Aphis glycines*).

On mungbean, Iwaki<sup>9)</sup> identified two viruses i.e. mungbean mosaic virus and bean yellow mosaic virus, while on peanut he found peanut mottle virus. Both viruses were transmissible by mechanical inoculation and by *Aphis craccivora* and *Aphis glycines*. Peanut mosaic virus was first reported by Thung<sup>28)</sup> and Bergman<sup>2)</sup>, which was transmitted by *Orosius argentatus*. Peanut crinkle leaf virus was reported by Thung and Tojib in 1953<sup>27)</sup>.

Harjono<sup>7)</sup> discovered two diseases on cowpea namely mosaic virus and witches' broom. The mosaic virus was transmissible by aphids.

Iwaki et al<sup>8)</sup> studied the virus of cowpea. The virus is easily transmitted by juice and by *Aphis craccivora*, but it is not transmissible through seeds. He identified the virus as cowpea Aphid—borne Mosaic Virus.

Iwaki<sup>9)</sup> also discovered cowpea stunt virus on cowpea, which caused reduced size of leaves, shortened internodes and excessive development of auxiliary buds making the plants look bushy. He found that the virus was transmitted by *Aphis craccivora*.

Witches' broom is considered one of the most important virus/mycoplasma diseases of legume crops in the country. Accurate data on yield losses of the crop due to the disease is not available as yet, however, its geographical distribution is very wide and very often it occurs in epidemic proportions, where diseased plants will produce no yield. Moreover, it has a wide host range among legume plants.

### The control of virus diseases of food crops

In view of the large acreage where food crops are being planted and their relative low value, the most feasible and economical method of pest control would be through varietal resistance.

The breeding for multiple disease and insect resistance is becoming an important objective in Indonesia. At CRIA entomologists, plant pathologists and breeders are actively cooperating to implement the program<sup>5)</sup>. Among 667 lines/varieties of rice tested in South Kalimantan and 3,073 in South Sulawesi (Bogor lines, IRRI lines, local varieties) for tungro resistance, a few indicated MR and R reaction. These are: IR20, C4-63, BPI-76, E 666, RD2, Mala, Ratna, Bg 11-11, Triweni, Pankhari 203, Latisail Aman, Habigany DW8, Ptb 18, Ptb 21, Gam Pai, Malakit Sungsong, 10266, 10531 and 11254.

Test for resistance to grassy stunt virus was conducted in the laboratory in 1972<sup>25)</sup>. Several lines are very promising (Table 2) and further testing is being conducted under

**Table 2. Reaction of *Oryza nivara* line to grassy stunt disease in laboratory (1972)\***

Source No.	Line	Cross	No. plant infected/ no. plant inocul.	% infection
58322	IR 1721-2-7-3-3	IR 24/3 × <i>Oryza nivara</i>	0/55	0.0
58324	IR 1721-7-1-2-2-1	do.	0/51	0.0
Check	Pelita I/1		8/60	13.3
58324	IR 1721-7-8-18-2-3	IR 24-3 × <i>Oryza nivara</i>	0/52	0.0
58350	IR 1721-11-3-7-2-1	do.	0/49	0.0
58355	IR 1721-11-4-3-3-2	do.	0/48	0.0
Check	Pelita I/1		22/46	47.8
58358	IR 1721-11-4-16-3-2	IR 24/3 × <i>Oryza nivara</i>	0/50	0.0
58368	IR 1721-11-5-31-3-2	do.	0/50	0.0
58365	IR 1721-11-4-24-2-2	do.	0/52	0.0
Check	Pelita I/1		4/56	7.1
58375	IR 1721-115-7-3-3	IR 24/3 × <i>Oryza nivara</i>	0/54	0.0
58372	IR 1721-11-5-3-2-3	do.	0/51	0.0
58333	IR 1721-7-8-11-3-2	do.	0/48	0.0
Check	Pelita I/1		9/58	15.5
58468	IR 1721-14-8-2-2-1	IR 24/3 × <i>Oryza nivara</i>	0/35	0.0
58463	IR 1721-14-6-4-3-2	do.	0/28	0.0
58436	IR 1721-13-5-8-4-1	do.	0/43	0.0
Check	Pelita I/1		8/42	19.0
58489	IR 1737-19-6-2-2	IR 24/4 × <i>Oryza nivara</i>	0/36	0.0
58435	IR 1721-2-7-2-3-3	IR 24/3 × <i>Oryza nivara</i>	0/52	0.0
58482	IR 1737-19-6-2-2	IR 24/4 × <i>Oryza nivara</i>	0/48	0.0
Check	Pelita I/1		17/130	13.0

\* Tantera (25).

field conditions.

Resistance test of varieties/lines of leguminous crops against their pest is just started. Forty six varieties/lines of soybean were tested in the greenhouse against soybean stunt virus. The varieties Taichung, Bonus and No. 1592 showed immune reaction while the varieties Davros, Ringgit, Shakti and TKS were susceptible to the virus<sup>17</sup>.

An integrated control program against the brown planthopper and grassy stunt virus of rice is being introduced in the main rice centers of the country. It consists of combinations of the following control methods:

1. Resistant varieties (IR26, 28, 30, 34)
2. Cropping system (i.e. simultaneous planting)
3. Sanitation
4. Monitoring
5. Insecticides

Ad 1. Where grassy stunt virus is serious only IR28, 30 and 34 are recommended.

Ad 2. Minimum area simultaneously planted with rice should cover a few thousand ha. Between two rice seasons there should be no rice at all or the field should be planted with crops other than rice. There exist a number of planting schemes in various parts of the country.

Ad 3. Sanitation. After harvest all stubbles should be turned (plowed) under immediately to prevent ratoon growth. This way the remaining brown planthopper would not have a place to multiply and also eliminate the source of inoculum for the grassy stunt virus.

Ad 4. To apply the insecticide more effectively the age distribution of the brown planthopper population should be examined at weekly intervals. This will be carried out by extension service people and the farmers themselves.

Ad 5. The best time for insecticide application would be when most of the insect population is still in its nymphal stage.

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### Discussion

**W. P. Ting, Malaysia:** Among the virus diseases of legumes reported in your paper, is there one that affects groundnuts which is transmitted by aphid and mechanically transmissible and also infects soybean naturally?

**Answer:** Recently Dr. Iwaki found peanut mottle virus attacking peanuts. The virus is transmissible by juice inoculation as well as by *Aphis croccivora* and *Aphis glycines*. This virus is also infecting soybean and cowpea.

**M. D. Mishra, India:** In view of what has been published regarding Penyakit Habang, what are the differences this virus has with the tungro virus? This is specially because Penyakit Habang is reported to have virion of rhabdo-virus type and tungro virus has spherical virions.

**Answer:** Laboratory and microplot inoculation tests carried out in 1971-1973 by Dr. Tantera concluded that the "Penyakit Habang" in South Kalimantan and the "Cella

Panche" in South Sulawesi, are very similar to tungro disease reported from other countries.

Electron microscopic investigations on the morphology of the virus which are underway now may clarify the morphology of the virus.