CHARACTERISTICS OF RICE RAGGED STUNT IN THAILAND

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ABSTRACT

Rice ragged stunt (RRS) disease was first observed in Thailand in 1978. The causal agent is a virus with polyhedral particles 60 nm in diameter which is transmitted by the brown planthopper, *Nilaparvata lugens* and *N. bakeri* in a persistent manner without transovarial passage. Wild rice (*Oryza* sp.) is the host plant affected by the disease.

The cultivation of the rice variety RD 7 in 1980 contributed to the remarkable spread of RRS disease. The damaged area covered 33,279 ha in the Central Plain of the country. After the release of the two new varieties RD 21 and RD 23 the disease occurrence was significantly reduced. Use of resistant varieties is one of the most practical methods of control of the disease.

Introduction

Rice ragged stunt disease which is caused by the rice ragged stunt virus (RRSV) transmitted by the brown planthopper, *Nilaparvata lugens* (Stal), was first recorded in Indonesia in 1977 (Hibino, 1979) and is a serious disease of rice in tropical Asia. In the same year RRSV symptoms were observed in paddy rice in Thailand (Weerapat and Pongprasert, 1978) and subsequent transmission studies confirmed its presence (Chettanachit *et al.,* 1978). Thai farmers named the disease "Joo" which means "Short".

The disease symptoms found in Thailand consist of typical stunting and reduction of tillering. Leaves are green serrated or ragged; flag leaves are small and often twisted or malformed and vein swellings appear on the leaf sheaths, leaf blades, and culms; nodal panicles are produced at later stages of growth. The disease symptoms occurring in the field display a complex and varied pattern depending on the stage of plant growth. Hibino *et al.* (1977) and Ling *et al.,* (1978) reported that symptoms often became masked, with the plant showing only stunting or vein-swelling on the leaf sheaths, depending on the rice varieties and stages of plant growth.

Transmission

The results obtained from transmission tests of rice ragged stung virus (RRSV) were similar to those reported in Indonesia and the Philippines. The virus could not be transmitted through seed and soil. Transmission tests by insects commonly found in paddy fields namely *Nilaparvata lugens* Stal, *Nephotettix virescens* Distant, *Nephotettix nigropictus* Stal, *Recilia dorsalis* Motschulsky, and *Sogatella furcifera* Horvath, showed that only the brown planthopper, *Nilaparvata lugens* Stal could transmit the disease in a persistent manner without transovarial passage (Putta *et al.,* 1980). *Nilaparvata bakeri* was also able to transmit the virus (Morinaka *et al.,* 1981).

RRSV was transmitted by the brown planthopper in a persistent manner with a 8-day incubation period on the average. The insects retained their infectivity after molting. Later stage of nymphs (4th and 5th instars) acquired the virus better than younger stages or the adults. The viruliferous insects transmitted the disease after an inoculation access period as short as 1 hr (Putta *et al.,* 1980; Morinaka *et al.,* 1981).

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Causal agent (electron microscopy)

A sample of infected plants collected from a farmer field was examined under electron microscopy by Dr. Y. Saito at the Institute for Plant Virus Research, Japan. Electron micrographs of ultrathin sections of infected leaf tissues revealed the presence of abundant pohyhedral particles of virus about 60 nm in diameter in the phloem cells. The same investigation was also performed at the rice Pathology Section, Thailand by dip preparation from vein-swelling portions and infected leaf tissues. The spherical particles of virus in the range of 50–70 nm in diameter were detected by electron microscopy, but no particles were observed in the preparations of healthy leaves (Chettanachit *et al.,* 1978).

Varietal resistance tests

Resistance of breeding lines to ragged stunt (RS) and yellow orange leaf (YOL) diseases was tested. Eight lines from the Rice Division were tested in August 1979 and 2 lines selected at Suphanburi Rice Experiment Station were tested in January 1981. Three virulifeous insects of RS and 2 viruliferous insects of YOL were allowed to feed on a seedling in a test tube for 1 day. The results are shown in Table 1 and Table 2. The results indicated that most of the lines were resistant to RS but not to YOL. The 2 lines selected at Suphanburi Rice Experiment Station

Table 1 Resistance to rice ragged stunt and rice yellow orange leaf disease of eight breeding lines from the Rice Division. (Derived from Morinaka, T., *et al.,* 1981)

Breeding lines tested	Ragged stunt infected plants tested plants (%)	Yellow orange leaf infected plants tested plants (%)
Irrad KTH 17 (KTH'65-G_2U-31)	9/47(19)	4/48(8)
KTH 17/LY 34 (BKN 6003-242)	8/44(18)	39/48(81)
GR201/PN16 (BKN58-4-315)	9/49(18)	35/45(78)
Lon Krok/NMS-A (BKN6321-46-3)	2/35(6)	32/40(80)
LY2B-72 (SPT'58-9-330)	3/43(8)	19/35(54)
Pin Gae Bow27/JLll (SPT6217-297)	8/37(17)	40/49(82)
Khao Tak Oo/KTH (BKN6113-79)	12/45(27)	39/42(93)
Leuang Kawn (SRRC'70-11-32)	5/45(11)	38/42(91)
TN1 (control)	22/47(47)	47/50(94)

Table 2 Resistance to rice ragged stunt and rice yellow orange leaf diseases of two breeding lines selected at Suphanburi rice Experiment Station (tested in January, 1981) (Derived from Morinaka, T., *et al.,* 1981)

Breeding lines tested	Ragged stunt infected plants tested plants (%)	Yellow orange leaf infected plants tested plants (%)
SPR7419-86-2-5	2/20(10)	19/20(95)
SPRLR76002-168-1-1	2/20(10)	19/20(95)
RD9 (Control)	2/20(10)	19/20(95)
RD7 (Control)	17/20(85)	17/20(85)
TN1 (Control)	12/20(60)	19/20(95)

showed resistance to RS but were highly susceptible to YOL. They were later adopted as new varieties, namely RD 21 and RD 23 (Morinaka *et al.,* 1981).

In 1984, 123 lines from the Rice Division were routinely tested against RS. There were 10 breeding lines showing moderate resistance to the disease as follows: Kao Long, Nang Kew, Kew Yai, Plai Gnam, SPRLR 75055, SPRLR 75007, Niew Ubon, URP 79-14, IR 25560-132-2-3 and BR 161-2B-25.

Host range

Several species of plants such as *Echinochloa celonum, E. crusgalli, Ischarmum rugosum, Panicum repens, Malvastrum coromandelianum, Panicum cambogiense, Pennisetum pedicellatum,* maize (*Zea mays*), wheat (*Triticum sativum*), oat (*Avena sativa*), barley (*Hordeum vulgare*), and wild rice (*Oryza* sp.) were tested to determine the host range of rice ragged stunt virus disease. The results indicated that maize (*Zea mays*) showed stunting with twisted leaves, but that the disease could not be positively inoculated back to rice plants. Wild rice (*Oryza* sp.) showed also typical symptoms of RSV disease which could be transmitted back to rice plants by the brown planthopper. This experiment indicates that only wild rice is the host of RRSV disease (Putta *et al.,* 1980). This finding confirmed the former report of Ling (1978) that wild rice was infected naturally in the field and showed the same symptoms of RRSV disease.

RRSV transmission tests by *Nilaparvata bakeri* were carried out. The insect nymphs were allowed feeding access on diseased rice plants for 17 hours (overnight), and were reared on a host, *Leersia hexandra,* for 7 days (incubation period). Transmission ability was tested by alternately putting the insect for 16 hours on a test rice plant and 8 hours on *Leersia hexandra*. *N. bakeri* would die if fed only on rice plants. The report indicated that *N. bakeri* was able to transmit RRSV (Morinaka *et al.,* 1981).

Disease distribution

The data of the Agricultural Extension Department, Thailand indicate that RRSV incidence was observed in 8 provinces in the Central Plain, the major rice-growing area, in 1977. The occurrence was recorded in 26 provinces in 1980. During October 1979 to August 1980 the total affected area covered 33,279 ha (Disthaporn, 1980). In the same year some 9,000 ha of deep water rice in Ayuthaya province were infected by this virus. Surveys of deepwater rice in the Central Plain of Thailand in 1981 revealed widespread infection with yield losses estimated at 40% in some fields (Catling *et al.,* 1982).

In the rainy season of 1980, the well-known rice variety RD 7 was severely damaged by RRSV in several regions of the Center. Yield losses at Suphanburi Rice Experiment Station (SPT) were estimated at 70%. Among the RD varieties, RD 9 was resistant to the brown planthopper and seemed to be resistant to the disease. However the variety is not popular with the farmers since it is very susceptible to the dirty panicle disease. In 1981 the candidate breeding lines SPR 419-86-2-5 and SPRLR 76002181-1-1 were selected naturally by chance during severe infestation with RRSV at SPT in 1980. These lines were later released as RD 21 and RD 23, respectively for the farmers in areas with severe incidence of the disease. Two years later, these varieties were widely grown over most of the disease areas. It is believed that due to the wide use of disease resistant varieties, the RRSV disease incidence was significantly decreased. This assumption was confirmed by the recent data from the Department of Agriculture Extension (DOAE) showing that the occurrence of RRSV disease (based on the areas where the use of chemicals had been promoted by government aid) involved 33,279 ha in 1980, 18,267 ha in 1981, 15,647 ha in 1982, 2,948 ha in 1983, 1,440 ha in 1984 and 1,003 ha in 1985, as shown in Figure 1.

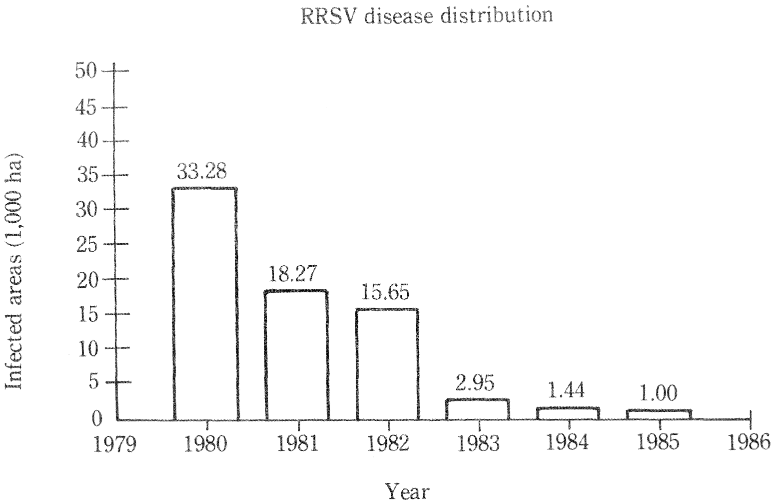

Fig. 1 Areas infected with RRSV disease, based on the areas where the use of chemicals was promoted by government aid.

References

1) Catling, H. D., Boonyaviwatana, S. and Arayarungsarit, L. (1982): Incidence of ragged stunt in floating rice in Thailand. Int. Rice Res. Newsl., 7(3), 11.
2) Chettanachit, D. Putta, M. and Disthaporn, S. (1978): Rice ragged stunt in Thailand. Int. Rice Res. Newsl. 3(4), 14-15.
3) Disthaporn, S. (1980): Recent distribution and current research of major rice diseases in Thailand. Paper presented at the 2nd Southeast Asian Symposium on plant diseases in the tropics, October 20-26, 1980 Bangkok, Thailand.
4) Hibino, H., Roechan, M., Sudarisman, S. and Tantera, D. M. (1977): A virus of rice (kerdil hampa) transmitted by brown planthopper, *Nilaparvata lugens* Stal., in Indonesia. Contr. Centr. Res. Inst. Agric. Bogor, No. 35, 1-15.
5) Hibino, H. (1979): Rice ragged stunt, a new virus disease occurring in Tropical Asia. Rev. Plan Protect. Res., 12, 98-110.
6) Ling, K. C., Tiongco, E. R. and Aguiero, V. M. (1978): Rice ragged stunt, new virus disease. Plant Dis. Reptr., 62, 701-705.
7) Morinaka, T., Putta, M., Chettanachit, D., Parejarearn, A., Patirupanusara, T. and Disthaporn, S. (1981): Studies on rice virus diseases in Thailand. The report of TARC. Min. of Agric., Forest and Fish., Japan and DOA. Min. of Agri. and Coop., Thailand. 108pp.
8) Putta, M., Chettanachit, D., Morinaka, T., Parejarearn, A. and Disthaporn, S. (1980): Rice ragged stunt virus disease in Thailand. Paper presented at the 2nd Southeast Asian symposium on plant diseases in the tropics, October 20-26, 1980, Bangkok, Thailand.
9) Weerapat, P. and Pongpasert (1978): Ragged stunt disease in Thailand. Int. Rice Res. Newsl., 3(1), 11-12.

Discussion

Morinaka, T. (Japan): I believe that the decrease in the incidence of ragged stunt disease in Thailand can be attributed to the introduction of RD21 and RD23 which are resistant to the disease. Which of the two varieties do you recommend to the farmers in relation to yield and quality?

Answer: Both varieties give a good performance with regard to resistance to rice ragged stunt insect resistance, yield and quality. However these varieties are susceptible to the yellow orange leaf virus (tungro virus) and to blast. Therefore, we recommend to the farmers to cultivate heterogeneous varieties, namely 2-3 instead of a single variety.

Hibino, Y. (IRRI): 1. You described the presence of a yellow discoloration on the leaves of rice plants infected with rice ragged stunt virus. Were these plants infected with a new strain of grassy stunt virus or tungro? 2. How is the reaction of the ragged stunt resistant varieties RD21 and RD23 to the vector (brown planthopper)? Are these varieties resistant to the virus?

Answer: 1. We consider that we were dealing with a severe strain of rice ragged stunt virus as the tungro virus was not recovered. The symptoms observed may be interpreted as being caused by a severe strain of the virus on specific varieties. 2. The varieties appear to be more resistant to the vector than to the virus, based on transmission tests.

Kishimoto, R. (Japan): You mentioned that the infestation with ragged stunt had decreased considerably during the peiod 1980-1985. Is the decrease related to the decrease of the vector density in addition to the resistance of the varieties to the virus?

Answer: We believe that the decrease in the incidence of rice ragged stunt disease was related to the use of the resistant varieties RD21 and RD23 over wide areas. In addition the implementation of integrated pest management was associated with the proper use by the farmers of insecticides aimed at controlling the population of the vector, namely the brown planthopper. In the long run, I consider that the use of resistant varieties is the most important method of control.