

VIRUS DISEASES OF RICE AND LEGUMINOUS CROPS IN THAILAND

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ABSTRACT

There are five virus diseases of rice plant in Thailand; yellow orange leaf, ragged stunt, gall dwarf, transitory yellowing and grassy stunt. They are kept under control by the use of suitable insecticides and resistant varieties. Important virus diseases of soybean are caused by soybean mosaic virus and soybean crinkle leaf virus. The most important virus disease of groundnut is caused by peanut mottle virus and that of mungbean is caused by mungbean yellow mosaic virus. As for vegetable leguminous crops, asparagus bean is severely attacked by cowpea aphid-borne mosaic virus, blackeye cowpea mosaic virus and an unidentified virus which causes bunchy stunt disease.

Introduction

A number of virus diseases have been reported to cause yield losses ranging from 10 to 80% in rice and leguminous crops in Thailand. A review of the major and new virus diseases is presented including information on current research and trend of future work.

Virus diseases of rice

1 Rice yellow orange leaf virus

Rice yellow orange leaf virus (RYOLV) causes one of the most destructive and widespread virus diseases of rice in Thailand. The disease was first observed in the central rice-growing regions in 1964 (Wathanakul *et al.*, 1967). It was estimated that in the severely diseased areas rice yield was reduced to about half of the normal production. The symptoms consist of mild interveinal chlorosis, leaf mottle, dark green foliage, stunting, reduced root system, delayed flowering and reduced grain yield. Grains in fields infested with RYOLV ripen unevenly. The rice green leafhopper (*Nephotettix virescens*) is the most important and efficient vector, *N. nigropictus* and the zigzag leaf hopper (*Recilia dorsalis*) can also transmit this virus. The disease has been kept below the damaging level by controlling insect vectors and using the highly resistant variety RD 1 since 1969.

2 Rice ragged stunt virus

Rice ragged stunt virus (RRSV) causes the most destructive virus disease. The disease was reported and described in 1977 (Chettanachit *et al.*, 1978). The farmers named the disease "Rok Joo". The infected areas have expanded year by year. It is reported as the most destructive disease in the central region at present. The symptoms consist of stunting, twisted and ragged leaves, empty panicles and galls on the outer surface of the flag leaf. Rice ragged stunt virus (RRSV) is transmitted by the brown planthopper, *Nilaparvata lugens* in a persistent manner (Morinaka *et al.*, 1981). Although it is a serious disease, the disease incidence is on the decline because of the widespread use of insecticides for controlling the insect vectors and use of RD 1, RD 21 and RD 23 varieties, which are resistant. RD 9 is also resistant to this disease but it is susceptible to the dirty panicle disease.

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3 Rice gall dwarf virus

Rice gall dwarf virus (RDV) was first detected in Thailand in 1979 under the collaborative research project between the Department of Agriculture, Thailand and the Tropical Agriculture Research Center, Japan (Morinaka *et al.*, 1981). The farmers called the disease caused by this virus "Rok Hood". The disease is not considered to be a serious problem since it is found scattered sporadically in the fields. Symptoms of the diseased plants resemble those of rice ragged stunt virus disease. The plants are stunted and twisted with short dark green leaves. Vein swelling which is round like the galls appears on the outer surface of the leaf blades and sheath. The number of galls increase as the symptoms develop. The diseased plants exhibit reduced tillering and produce few panicles.

The zigzag-wing rice leafhopper *Recilia dorsalis* and the rice green leafhopper, *Nephotettix nigropictus* are able to transmit the disease in a persistent manner. The incubation period is 9-25 days in both vectors and 21-25 days in the rice plants. The disease is distributed widely throughout the Central Plain particularly in the irrigated areas where rice is grown in the dry season. Results from the rice gall dwarf disease screening tests in 1980 indicated that RD 1 is highly resistant to the vector and disease, therefore rice gall dwarf virus disease is not a serious problem at present. However, as the green leafhoppers are commonly found in the fields, there is always a potential threat that large scale epidemic could occur in the future.

4 Rice transitory yellowing virus

Rice transitory yellowing virus (RTYV) was first described in Chiengrai. The symptoms caused by the virus consist of stunting, small number of tillers, orange red discoloration of the upper leaves and yellow discoloration of the lower leaves which resemble those caused by RYOLV. The virus is transmitted effectively in a persistent manner by *Nephotettix nigropictus* and *N. cincticeps*. Rice transitory yellowing disease is not considered to be a serious problem at present.

5 Rice grassy stunt virus

A rice disease tentatively called grassy stunt was reported in 1966. (Wathanakul and Weerapat, 1967). In 1982 rice grassy stunt virus-like disease was detected in Chachoengsao (Disthaporn *et al.*, 1983). The causal agent of this disease is an unknown virus which is related to rice grassy stunt virus. Infected plants show stunting and yellowing symptoms similar to those of yellow orange leaf and rice transitory yellowing diseases. The disease can be transmitted by the brown planthopper *Nilaparvata lugens* with 38% efficiency in a persistent manner.

6 Research plans and trends of research work

Rice viruses mentioned above are introduced and disseminated in the field by insect vectors. Effective control of insect vectors should therefore reduce the spread of the diseases. In this regard, some effective insecticides are being tested for the control of insect vectors particularly in the early stage of plant growth and for emergency control in the heavily contaminated areas. Another much emphasized research project consists of the use of host resistance and many selected varieties are being recommended in the integrated control program.

Virus diseases of leguminous crops

Leguminous crops such as soybean, groundnut, mungbean and asparagus bean are major sources of protein and are cash crops in Thailand. There are two kinds of leguminous crops, leguminous vegetable and leguminous grain crops. The leguminous grain crops mostly are planted after the main field crops such as rice, corn, cotton and sorghum. Leguminous vegetable crops are planted throughout the year and the country, except garden pea which is grown in the cool season and in limited areas. There are more than seventeen virus diseases of leguminous crops in Thailand. Major virus diseases which cause serious yield losses are reported under their

hosts.

1 Soybean (*Glycine max*)

Soybean is widely grown as an alternative cash crop in nineteen provinces of the five Agro-Economic Zones of Thailand (Anonymous, 1984). At least eight viruses have been reported to infect field-grown soybeans in the country (Honda *et al.*, 1982; Iwaki *et al.*, 1979, 1980; Thongmeearkom *et al.*, 1982).

The most common and widely distributed virus is soybean mosaic virus (SMV) which is transmitted non persistently by several different species of aphids. It is also transmitted mechanically and through seeds. Infected plants with SMV show mosaic and rugosity symptoms. Severely affected plants are stunted and produce few seeds. It was reported that 100% infection with SMV in soybean plants caused 30–50% yield reduction (Thongmeearkom *et al.*, 1981b). SMV has a wide host range, including mainly plants in the family Leguminosae. The disease is found in Chiang Mai, Chainat, Khon Kaen, Lamphun, Loei, Nakhon Ratchasima, Nakhon Sawan, Saraburi and Sukhothai Provinces.

The other major virus is soybean crinkle leaf virus (SCV) which was reported in 1983 (Iwaki *et al.*, 1983). The virus is whitefly-borne and transmitted mechanically. Soybean plants infected with this virus show yellow netting of veins, twisting or curling of leaves, veinal enations and dark green color of the foliage. The virus has a wide range. Prior to 1984, soybean crinkle leaf disease was sporadically distributed in most soybean-growing areas, especially in Chainat, Kamphaeng Phet, Loei, Nakhon Sawan, Saraburi and Sukhothai Provinces, and there was no significant yield loss in the diseased areas. However, the disease may become destructive in the future.

Minor viruses of soybean are black gram mottle virus (BGMV), cowpea mild mottle virus (CMMV), Indonesian soybean dwarf virus, peanut mottle virus (PnMV), mungbean yellow mosaic virus (MYMV) and soybean yellow vein virus.

2 Groundnut (*Arachis hypogaea*)

Groundnut is widely grown in Kamphaeng Phet, Pichit, Phitsanulok and Tak Provinces (Anonymous, 1984). Four viruses have been found in Thailand (Choopanya *et al.*, 1980, 1983; Wongkaew and Choopanya, 1985). They are peanut mottle virus (PnMV), peanut yellow spot virus, peanut stripe virus and cowpea mild mottle virus (CMMV). PnMV the major virus of groundnut was first observed in northern Thailand in 1969. It was detected in all the groundnut-growing areas throughout the country. This virus is transmitted by sap inoculation and by aphids, *Aphis craccivora* in a non persistent manner. Groundnut plants infected with PnMV show mosaic, ringspot and rugosity symptoms. Severely affected plants show stunting, abnormal pods and small seeds.

3 Mungbean (*Vigna radiata*)

Mungbean is normally grown as a major crop in Kamphaeng Phet, Lop Buri, Nakhon Sawan, Phitsanulok, Pichit, Saraburi, Tak and Uthai Thani Provinces (Anonymous, 1984). There are two kinds of viruses affecting field-grown mungbean, i.e. mungbean yellow mosaic virus (MYMV) (Honda *et al.*, 1983) and black gram mottle virus (BGMV) (Honda *et al.*, 1982). MYMV the major virus of mungbean was first detected in northern Thailand in 1977 (Thongmeearkom *et al.*, 1981a). The disease occurred intensively in Kamphaeng Phet and sporadically in five other adjacent provinces.

MYMV is transmitted by mechanical transmission and by white flies, *Bemisia tabaci*. Infected plants show symptoms consisting of vein yellowing, yellow mosaic, and downward curling of leaf. The host range of MYMV is restricted to plants in the family Leguminosae. There is no economic yield loss reported in this disease.

4 Asparagus bean (*Vigna sesquipedalis*)

There are several leguminous vegetable crops grown in Thailand, some of them are popular among the farmers, namely asparagus bean (*Vigna sesquipedalis*), garden pea (*Pisum sativum*) and common bean (*Phaseolus vulgaris*). The asparagus bean is grown for green pods throughout the country. It is ranked as one of the economic leguminous vegetable crops. There are three virus diseases affecting asparagus bean; yellow mosaic disease caused by cowpea aphid-borne mosaic virus (Jarupat, 1975), mosaic disease by blackeye cowpea mosaic virus (Tsuchizaki *et al.*, 1984) and bunchy stunt disease caused by an unidentified virus (Pholouyporn, 1981). Only bunchy stunt disease has been surveyed for disease intensity and distribution during 1973-1977. The results showed that it is an endemic disease and the average disease intensity amounted to about 8-10% of the total crop. Bunchy stunt virus is transmitted by grafting and by aphids *Aphis craccivora* in a persistent manner. Infected plants show symptoms consisting of a reduction in the size of leaves, shortened internodes, bunchy top and lack of flowers. Host range of this disease is limited to plants in the family Leguminosae.

5 Activities and future work plans

Leguminous virus diseases can be controlled by timely spraying the plants with insecticides and selecting healthy seeds for farmer use. Screening for efficient insect vector control which can be carried out for emergency use is not the ultimate control strategy. A breeding program has been recently initiated to develop resistant varieties for selected viruses and selected crops such as soybean mosaic virus on soybean.

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Discussion

Makkouk, K.M. (ICARDA): Is mungbean yellow mosaic virus different from bean yellow mosaic virus?

Answer: Honda, Y. (Japan): The two viruses are different as mungbean yellow mosaic virus is a geminivirus and bean yellow mosaic virus is a potyvirus.