VIRUS DISEASES OF RICE AND LEGUMINOUS CROPS IN MALAYSIA

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ABSTRACT

Recent developments in virus diseases of rice and legumes in Peninsular Malaysia are outlined. Results of diagnostic studies are highlighted. Information on virus vectors, seed-borne viruses and virus resistant materials is still limited. Epidemiological aspects, including the role of alternate or volunteer hosts, have not been sufficiently examined. Control measures for prevalent viruses and prevention of entry of foreign viruses need greater effort.

Introduction

Rice cultivation in Peninsular Malaysia accounts for a total area of about 380,000 ha. Depending on the availability of irrigation systems, one or more croppings are planned each year. Unlike rice which is mainly grown as a sole crop, food legumes are usually planted in rotation or mixed cropping patterns. It is difficult to estimate the extent of leguminous crops grown in the country as their cultivation fluctuates from time to time. Currently, grain legumes such as soybean and mungbean, probably only exist in small experimental plantings. Groundnut and vegetable legumes like yardlong bean, French bean and peas, in total at most cover about 6,000 ha. In contrast it is interesting to note that the extent of leguminous cover crops grown in the plantations, especially rubber and oil palm, far exceeds that all of food and feed legumes.

Rice virus diseases

At present, four virus diseases, viz. Penyakit merah, ragged stunt, grassy stunt and gall dwarf, and two mycoplasma diseases viz. orange leaf and yellow dwarf, are recognized in local rice crops. The causal agents are related or similar to those recorded elsewhere (Table 1) (Singh *et al.*, 1970; Habibuddin, 1978; Habibuddin *et al.,* 1978; Ong and Omura, 1982; Habibuddin and Ong, 1984). The vectors involved are also practically the same (Ling *et al.,* 1983). Except for Penyakit merah (which is caused by the tungro virus), the other diseases are not considered important as their incidence is low or sporadic. According to records, although no significant increase in the extent of areas affected by Penyakit merah is observed, there appears to be some spread to new areas (Table 2) (Habibuddin, 1985).

The origin of these diseases is not known and there is limited information about their ecological relationships. At least for Penyakit merah, several weeds susceptible to the virus can also harbor the vectors. Outstanding among these is the grass species, *Echinochloa colonum* (Linn.) Link which besides being an important weed both in rice fields and upland areas, is also a propagative host of the tungro virus and the vector leafhopper, *Nephotettix nigropictus*. Similarly, another widespread grass, *Eleusine indica* Gaertn is a systemic host of the virus and a food host of the two vector species, *N. nigropictus* and *N. virescens.* It is also interesting to note that *Leersia hexandra* Swartz, a weed in rice fields can support the multiplication of the virus as well as that of *N. nigropictus* (Lee, 1977; Moody, 1977; Habibuddin, 1985). Although under local conditions it

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Table 1 Virus and mycoplasma diseases of rice in Peninsular Malaysia

Disease/virus/mycoplasma	Vector
Penyakit merah/Tungro	*Nephotettix virescens* (Dist.)
	N. nigropictus (Stal)
	Recilia dorsalis (Motsch.)
Rice gall dwarf	*Nephotettix nigropictus*
	N. virescens
	Recilia dorsalis
Ragged stunt	*Nilaparvata lugens* (Stal)
Grassy stunt	*N. lugens*
Padi jantan/Yellow dwarf	*Nephotettix virescens*
	N. nigropictus
Orange leaf	*Recilia dorsalis*

Table 2 Extent of area* affected by Penyakit Merah in Peninsular Malaysia 1979 — 1984

Year Area/State	1979 ha	1980 ha	1981 ha	1982 ha	1983 ha	1984 ha
Perak	101	0	2,297	1,941	2,723	800
Penang	101	0	2,960	69	110	334
MADA	0		5,884	5,839	9,022	495
Kedah (Excluding MADA)			1,391	1,787	750	177
Perlis (Excluding MADA)			202	7,871	218	3
Kelantan			0	0	69	155
Trengganu			0	0	0	0.4
Selangor			0	0	0	0
Total	202	0	12,734	17,507	12,892	1,964.4

Source: Crop Protection Branch, Department of Agriculture, Malyasia.
* Figures refer to affected hectarage regardless of infection intensity.

Table 3 Species composition of green leafhoppers in Peninsular Malaysia

State	P.W.		Kedah/Perlis		Krian		Kelantan		Trengganu	
Year	N.v.	N.n.	N.v.	N.n.	N.v.	N.n.	N.v.	N.n.	N.v.	N.n.
1968			60—70	30—40	97	7				
1974	52	48	30—40	60—70						
1976	65	35								
1980	80	20								
1981	90	10	57—98	2—43						
1982	79	21	98	2			44	56	14—94	5—96
1983	97		>90		>80					
1984	96		>90		>80		>90			

N.v. = *Nephotettix virescens*
N.n. = *Nephotettix nigropictus*
P.W. = Province Wellesley

is speculated that volunteer or ratoon rice plants play a major role in the disease cycle, alternative means of survival or perennation of the virus and vector in weeds may be important under certain conditions. However, the recent increase in incidence of Penyakit merah presumably arose from factors and practices which favor a sustained high level of vector populations and activities. Vector population monitoring showed a higher level in the drier season than in the wetter one. In general there is also a change in the pattern of species composition over the years. From an almost equal proportion the trend appears to be towards a higher population of *N. virescens* than *N. nigropictus* (Table 3).

As a means of control, attempts are now being made to introduce a definite fallow period and systematic staggered planting (Nozaki *et al.,* 1984). The initial observation, however, showed that unexpected prolonged rains can affect the desired outcome. Resistant varieties have been used to reduce the yield loss due to the disease but their grain quality appears to be a setback. Control of the vectors using chemicals is possible but for a variety of reasons this method is unattractive to the rice growers (Habibuddin, 1985).

Legume virus diseases

Nearly 400 leguminous species in 90 genera are present in Malaysia. Virus infections have been associated with at least 14 of them which include crops, weeds and wild plants. The viruses isolated or suspected are peanut mottle (=groundnut mosaic), blackeye cowpea mosaic, cowpea stunt, cowpea mild mottle, bean yellow mosaic, bean common mosaic, soybean mosaic and clitoria yellow vein (Singh, 1980; Abu Kassim a, b, 1984; Iwaki, 1984; Noraini, 1984) (Table 4). Although other insects, such as whiteflies (Aleyrodidae), lygaeid plant bugs (Lygaeidae) and beetles (Coleoptera), are believed to be involved in virus transmission, only aphids have been confirmed so far, viz. *Aphis craccivora* Koch, *A. gossypii* Glov., *A. spiraecola* Patch, *Hysteroneura setariae* (Thomas), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulz) and *Rhopalosiphum maidis* (Fitch) (Ong and Ting, 1977; Tsuchizaki, *et al.,* 1984).

Certain viruses are evidently seed-borne viz. long bean mosaic (Ong and Ting, 1977) and blackeye cowpea mosaic in *V. sesquipedalis* and calopogonium mosaic in *Cassia occidentalis* L. (Abu Kassim, 1984a). Although peanut mottle is known to be seed-transmissible elsewhere, tests with the local groundnut mosaic isolate have not revealed this property. Seeds of several cultivated legumes especially yardlong bean, Franch bean and peas, are constantly imported into the country. Indications are that certain viruses have been inadvertently introduced through them. Therefore there is always a risk of other viruses appearing in the crops.

Most farmers allocate only small plots of land (averaging less than 1 ha) to food legumes. They often grow a variety of crops throughout the year with no definite sequence or pattern. Leguminous cover crops or weeds are commonly found in the vicinity. Plants such as *Calopogonium* spp., *Centrosema pubescens, Crotalaria* spp. and *Cassia* spp. are already known to be hosts of several viruses. Since the Malaysian equatorial climate permits plant survival throughout the year, a reservoir of vectors and viruses is probably easily established. Sources of vectors and inocula outside the crop are therefore believed to play a major role in the disease cycle. In any case, spread of viruses through the field appears very rapidly for certain crops such as groundnut and yardlong bean. It is not unusual to find whole fields completely infected. Interestingly, in some crops such as French bean, soybean and mungbean, infections appear to be restricted even if these crops are susceptible to viruses in the vicinity or if infected plants are already present within the crop. It also remains to be seen whether other viruses especially cucumber mosaic and tomato spotted wilt, prevalent in non legumes will also pose a problem to legume crops.

About 25 local and foreign (USA, Indonesia, India and Philippines) groundnut accessions screened against groundnut mosaic virus gave infection rates of above 50%. The same isolate has also been tested on more than 30 soybean entries including those shown to have resistance against peanut mottle strains elsewhere, but none seems to have any differential reactions.

Table 4 Virus or suspected virus diseases of legumes in Peninsular Malaysia

	Disease — virus	Natural host	Other important host(s)	Transmission, vector	Seed transmission (host)
1	Bean mosaic	*Phaseolus vulgaris*			
2	* Calopogonium mosaic	*Calopogonium mucunoides*	*Cassia occidentalis, Glycine max, Phaseolus vulgaris, Pueraria phaseoloides, Calopogonium caeruleum*	Sap	30% (*Cassia occidentalis*)
3	Calopogonium mucunoides blotchy mottle — Clitoria yellow vein	*Calopogonium mucunoides*	*Pueraria phaseoloides, Desmodium ovalifolium, heterophyllum*, 2 *Centrosema pubescens, Arachis hypogaea, Vigna sesquipedalis, Cassia occidentalis, Phaseolus vulgaris*	Sap	
4	Cassia mild mosaic	*Cassia* sp.			
5	* Centrosema mosaic	*Centrosema pubescens*	*Cassia occidentalis, Glycine max, Phaseolus vulgaris, Pueraria phaseoloides, Calopogonium mucunoides, Desmodium ovalifolium*	Sap	
6	Cowpea mild mottle	*Glycine max, Arachis hypogaea*			
7	Cowpea necrotic mosaic mottle	*Vigna unguiculata*	*Cassia occidentalis, Glycine max, Phaseolus vulgaris*	Sap	
8	Cowpea stunt	*Vigna sesquipedalis*			
9	Crotalaria anagyroides mosaic	*Crotalaria anagyroides*			
10	Desmodium ovalifolium mosaic	*Desmodium ovalifolium*			

11	Groundnut mosaic — Peanut mottle	*Arachis hypogaea* *Glycine max*	*Cassia occidentalis, Calopogonium mucunoides, Stylosanthes gracilis, Crotalaria anagyroides, Indigofera hirsuta*	Sap, *Aphis gossypii, A. craccivora, Myzus persicae, Rhopalosiphum maidis, Toxoptera citricidus*	
12	Groundnut stunting sterility	*Arachis hypogaea*			
13	Longbean mosaic	*Vigna sesquipedalis*	*Calopogonium mucunoides, Pisum sativum, Phaseolus vulgaris*	Sap, *Aphis gossypii, A. craccivora, Myzus persicae, Lipaphis erysimmi*	2–50% (*Vigna sesquipedalis*)
14	Longbean mosaic-Blackeye cowpea mosaic	*Vigna sesquipedalis*	*Calopogonium mucunoides, Cassia occidentalis, Phaseolus vulgaris*	Sap, *Aphis craccivora*	+(*Vigna sesquipedalis*)
15	Longbean phyllody	*Vigna sesquipedalis*			
16	Longbean yellow mottle	*Vigna sesquipedalis*			
17	Mungbean mosaic	*Vigna radiata*		Sap	
18	Mungbean phyllody	*Vigna radiata*			
19	Mungbean yellow mottle	*Vigna radiata*			
20	Soybean chlorotic mottle — Bean yellow mosaic	*Glycine max*	*Cassia occidentalis, Phaseolus vulgaris, Crotalaria striata*	Sap	
21	Soybean phyllody	*Glycine max*			
22	Soybean rugose mosaic — Soybean mosaic	*Glycine max*	*Phaseolus vulgaris*	Sap	
23	Soybean yellow mosaic	*Glycine max*	*Arachis hypogaea, Pisum sativum, Phaseolus vulgaris*	Sap	
24	Vigna marina vein yellows	*Vigna marina*			
25	Winged bean mosaic — Bean common mosaic	*Psophocarpus tetragonolobus*	*Phaseolus vulgaris*	Sap	

* Probably similar or related.

However, expression of resistance in certain soybean varieties against the local soybean mosaic and bean yellow mosaic isolates had been observed. Similarly, based on the resistant reactions of certain cowpea lines (*V. unguiculata*) a local isolate of blackeye cowpea mosaic virus appears to be the same as the Nigerian isolate (Abu Kassim, 1984a).

Recent observations indicate that the diagnosis of virus diseases found in local legumes, especially yardlong bean, French bean and pea, are far from complete. Seed-borne viruses will have to receive much emphasis. The kind of alternate hosts and their role in the epidemiology of the diseases should be resolved if control is to be achieved. However, in the long run, resistant materials need to be identified or developed.

Conclusion

There is little doubt that virus diseases of food crops are widespread in the country. A wide range of viruses and vectors is involved but the information available is very limited. Most of the problems remain to be studied especially with respect to the epidemiology and control. Identification and use of resistant materials may be essential. As the climatic conditions are conducive to plant survival throughout the year the role of volunteer or alternate hosts in the disease cycle needs to be elucidated. Many viruses can be seed-borne in legumes and the risks associated with them are of concern.

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Discussion

Reddy, D.V.R. (ICRISAT): The groundnut mosaic you described which is transmitted by aphids and is different from groundnut mosaic transmitted by leafhoppers in Indonesia seems to resemble more peanut stripe than peanut mottle. Is there any relationship between groundnut mosaic and peanut stripe?

Answer: There are differences between groundnut mosaic and peanut mottle reported in the USA, as follows: 1. Local reactions were produced on *Chenopodium amaranticolor* by groundnut mosaic but not by peanut mottle; 2. There were no differential reactions on peanut mottle resistant accessions of soybean and peas with groundnut mosaic; 3. No local reactions were observed on bean varieties inoculated with groundnut mosaic.