

Symptomatology of Tobacco Mosaic Virus (TMV) and Chilli Veinal Mottle Virus (CVMV) on six local Chilli.

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Key words: Chilli (*Capsicum annum* L.); Symptomatology; Tobacco mosaic virus (TMV); Chilli veinal mottle virus (CVMV).

RINGKASAN

Suntikan tunggal dan campuran virus-virus tobacco mosaic virus (TMV) dan chilli veinal mottle virus (CVMV) dengan cara mekanikal dilakukan ke atas anak benih enam cultivar cili yang berumur satu bulan untuk kajian simptom. Pokok kajian yang dijangkiti oleh satu isolate virus memperlihatkan simptom yang tersendiri, manakala pokok-pokok yang dijangkiti oleh kedua isolate virus memperlihatkan kedua-dua simptom isolate yang terlibat.

SUMMARY

Single and mixed inoculations of tobacco mosaic virus (TMV) and chilli veinal mottle virus (CVMV) were carried out mechanically on one month old seedlings of six local chilli cultivars to study symptomatology. Test seedlings singly infected expressed symptoms typical of the isolate whereas mixed infection resulted in plants showing combined symptoms of both isolates.

INTRODUCTION

Chilli (*Capsicum* sp.) is one of the most popular solanaceous fruit vegetables grown in Malaysia. Two species of chilli grown are *Capsicum annum* L. and *C. frutescens*. The former is cultivated mainly on the lowland, while the latter on higher altitudes.

According to the Ministry of Agriculture (Annon, 1976) the total sole crop equivalent under chilli cultivation was 931 hectares. Production of chilli cannot meet local demand and thus additional imports are necessary. Besides low acreage, production of chilli in Malaysia is also hampered by pests and diseases. Among the diseases, mosaic of chilli caused by viruses is mentioned to be common (Thompson and Johnston, 1953).

Mosaic disease of chilli was first reported in Peninsular Malaysia by Burnett (1947) and later listed by Thompson and Johnston (1953). Tobacco mosaic virus (TMV) and cucumber mosaic virus (CMV) were cited as the causal agents based on the symptoms observed, although no attempts were made to establish their presence in the infected plants (Burnett, 1947). Ong

(1975) reported that the most widespread chilli mosaic disease was that caused by chilli veinal mottle virus (CVMV) a member of the potyvirus group. Ong (1975) in his study of the symptomatology of susceptible plants to CVMV mainly described the foliar symptoms only. The object of the present study is to elaborate on the symptoms on the whole plant, except the roots, in single infections and combined infections of CVMV and TMV on six local cultivars of which five are common in Malaysia.

MATERIALS AND METHODS

The two virus isolates, TMV and CVMV, used in this study were obtained from the Malaysian Agricultural Research and Development Institute (MARDI), Serdang.

The glasshouse experiment was performed using chilli cultivar C10 obtained from MARDI and five other local chilli cultivars designated A, C, D, E and F from the Agronomy Department, Universiti Pertanian Malaysia. The six varieties were treated with four types of treatments viz.; two single virus inoculations, a mixed virus inoculation and a control. Each treatment con-

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sisted of three plants, replicated twice in a completely randomized design.

Aphids and mites were controlled by bi-weekly spraying of 0.01% a.i. of Malathion or Kelthane. At fruit maturity 0.1% a.i. Manzate-D spray was carried out biweekly to avoid anthracnose disease. Fertilization of the plant per pot was at the rate of 10 gm of Nitrophoska blue (R) for the first 2 months of growth and 15 gm for the subsequent growth duration. All plants were watered daily.

Chilli seeds were sowed on sterilised soil in a seeding box; and two weeks after germination transplanted into 10" diameter clay pots. The soil mixture used was composed of soil, peat and sand (3:2:1) to one cubic yard, to which were added 5 lb lime and 5 lb Nitrophoska blue(R) during mixing.

The virus inoculations were performed when the seedlings were 30 days old. Inocula were prepared by grinding TMV and CVMV infected leaves of chilli cultivar C10 separately in 0.5M phosphate buffer pH. 7.0 and 0.5M phosphate buffer pH. 7.0 containing 0.05M MgCl and 0.1% sodium sulphite respectively. The ratio of diseased leaves to buffer was 1:3 (W/V).

The crude sap was then applied separately on the adaxial surfaces of carborundum dusted leaves of the seedlings. In the mixed infection study equal volumes of TMV and CVMV inocula were mixed and applied in the same manner. The leaves were rinsed with water immediately after inoculation.

RESULTS AND DISCUSSION

The results of the symptomatology studies are summarised in Table 1(a) and 1(b).

Foliar Symptoms

Leaves of CVMV and TMV infected plants exhibited varying degrees of vein clearing, mottling and chlorosis (Plate 1). However, CVMV infected plants did not develop leaf puckering and veinal necrosis and they also showed various types of leaf distortions including; leaf epinasty, leaf narrowing, filiform leaves and irregularly shaped leaves. Ong (1975) also reported leaf distortions of CVMV infected plants. Mixed infection of CVMV and TMV on chilli plants shows combined symptoms characteristic of both CVMV and TMV (Plate 1).

Stem Symptoms

Mottling, swelling and lesions were three types of stem symptoms observed in this study.

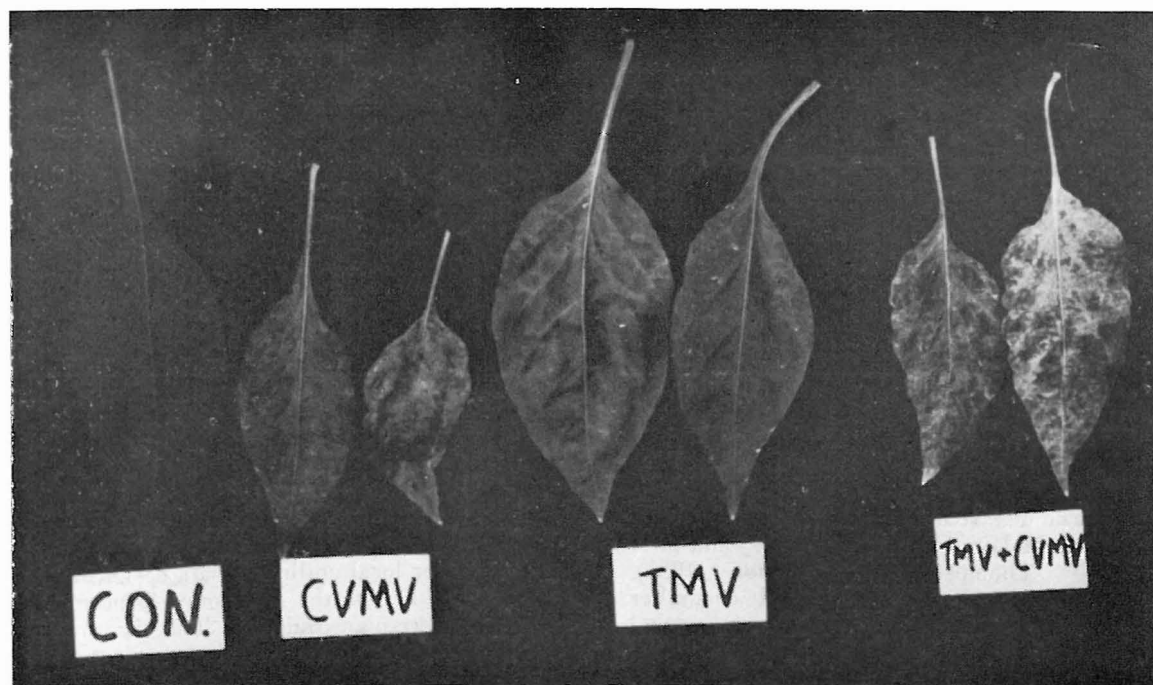


Plate 1: Foliar symptom showing varying degrees of chlorotic mottling induced by single and mixed virus infection.

SYMPTOMATOLOGY OF TMV AND CVMV ON LOCAL CHILLI

TABLE 1(a)

Summary of the Symptomatology Studies – Symptoms are listed in order of their appearance.

Virus Cultivars		Foliar Symptoms									
		Puckering	Vein Clearing	Mottling	Leaf Distortions				Veinal Necrosis	Chlorosis	IP
					E	N	F	I			
CVMV	C10	—	+	++	+	+	+	+	—	+	4
	A	—	+	+	+	+	—	+	—	+	
	C	—	+	+	+	+	—	+	—	+	
	D	—	+	++	+	+	+	+	—	+	
	E	—	+	++	+	+	—	+	—	+	
	F	—	+	++	+	+	+	+	—	+	
TMV	C10	+	+	+	—	—	—	—	+	+	2
	A	+	+	+	—	—	—	—	+	+	
	C	+	+	+	—	—	—	—	+	+	
	D	+	+	++	—	—	—	—	+	+	
	E	+	+	++	—	—	—	—	+	+	
	F	+	+	++	—	—	—	—	+	+	
CVMV and TMV	C10	+	+	+	+	+	+	+	+	+	2
	A	+	+	+	+	+	—	+	+	+	
	C	+	+	+	+	+	—	+	+	+	
	D	+	+	++	+	+	+	+	+	+	
	E	+	+	++	+	+	—	+	+	+	
	F	+	+	++	+	+	+	+	+	+	

++ : Severe Mottling
 + : Mild Mottling
 E : Leaf Epinasty
 N : Leaf Narrowing
 — : Absent

F : Filiform leaves
 I : Irregularly shaped leaves
 IP : Incubation Period (Days)
 + : Present

TABLE 1(b)

Summary of the Symptomatology Studies – Symptoms are listed in order of their appearance.

Virus	Cultivars	Stem Symptoms				Flower Distortion	Fruit Symptoms	
		Stem Mottling	Stem Swelling	Stem Lesion	ISL		a	b
CVMV	C10	+	+	—	—	+	+	—
	A	+	+	—	—	+	+	—
	C	+	+	—	—	+	+	—
	D	+	+	—	—	+	+	—
	E	+	+	—	—	+	+	—
	F	+	+	—	—	+	+	—
TMV	C10	—	—	—	—	—	—	+
	A	—	—	—	—	—	—	+
	C	—	—	—	—	—	—	+
	D	—	—	—	—	—	—	+
	E	—	—	+	+	—	—	+
	F	—	—	+	+	—	—	+
CVMV and TMV	C10	+	+	—	—	+	+	+
	A	+	+	—	—	+	+	+
	C	+	+	—	—	+	+	+
	D	+	+	—	—	+	+	+
	E	+	+	+	+	+	+	+
	F	+	+	+	+	+	+	+

a : Light green stripe and mottling
 + : Present
 — : Absent

b : Blacks marking on fully red fruits.
 ISL : Internal Stem Lesion

The first two symptoms were only found on CVMV infected plants while stem lesions occurred on TMV infected cultivars E and F only. Mixed infection produced characteristic symptoms of both viruses (Table 1(b)).

Stem swelling was one of the characteristic symptoms of CVMV. The swellings were found mainly on the mainstem ($\frac{1}{2}$ - $\frac{2}{3}$ of the total length). Some might also appeared on the upper branches (Plate 2). Plants infected with mixed viruses showed smaller swellings. The swellings were in the form of slight protrusions mainly on the upper branches of all cultivars.

Stem lesions were observed on some cultivars infected by TMV as indicated in Table 1(b)

Plate (3). Infected plants showed wilting signs followed by leaves dropping due to veinal necrosis. These plants recovered with the development of new shoots a week or two later.

Internal stem symptoms were manifest by the necrotic pitting of the pith. In cases where the necrotic stem lesions were externally severe, the whole pith also became necrotic.

Various stem necroses of pepper caused by other viruses and by TMV have been reported by other workers (Holmes, 1937; Doolittle and Zaumeyer, 1952; Miller and Thornberry, 1958; Murakishi, 1960; Greenleaf *et al.*, 1964).

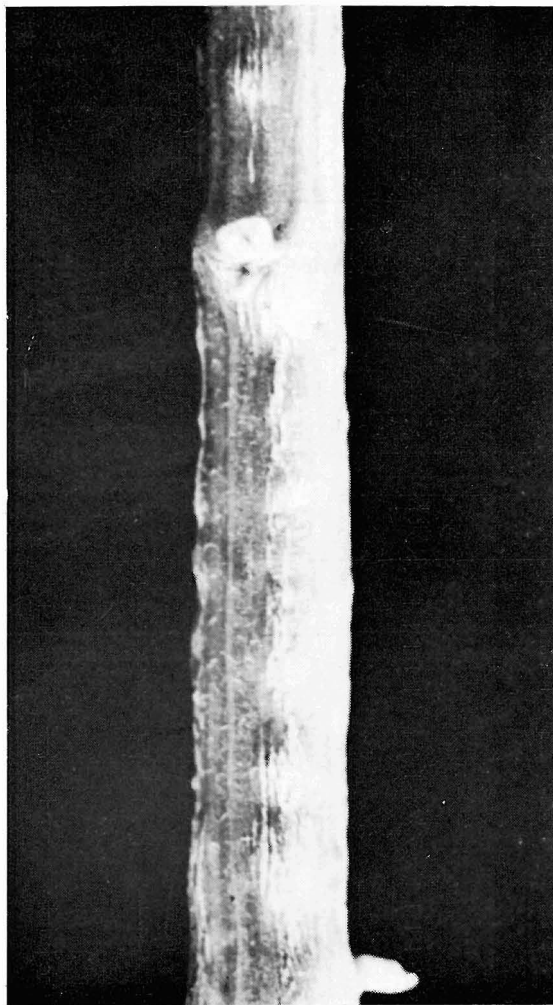


Plate 2. Stem swelling characteristics of CVMV infection on all six chilli cultivars.



Plate 3. Stem lesion characteristics of TMV infection on two chilli cultivars studied.



Plate 4: Flower distortions induced by CVMV.

Flower Symptoms

Calyx deformations and petal distortions from irregular margins, curling tips, filiform shapes, unequal lengths and incomplete numbers were observed in plants infected by CVMV or mixed infection of CVMV and TMV (Plate 4). However, infection by TMV alone did not cause flower distortion.

Fruit Symptoms

Symptoms on fruit of CVMV infected plants varied from distortions to various types of colour deviations. Fruit distortions included surface roughing, twisting and malformation of various kinds. All fruits showed colour deviations such as a light green stripe (1–2 mm wide) along their length or mottling of varying intensities. These became reddish brown or dirty brown 1–2 days before ripening but disappeared totally when the fruits were fully red.

Fruit distortions caused by TMV were similar to, but less severe, than those caused by CVMV. Half-ripe fruits possessed intermingled reddish brown and dirty glossy green colours. When fruit ripened, they showed irregular black markings (Plate 5).

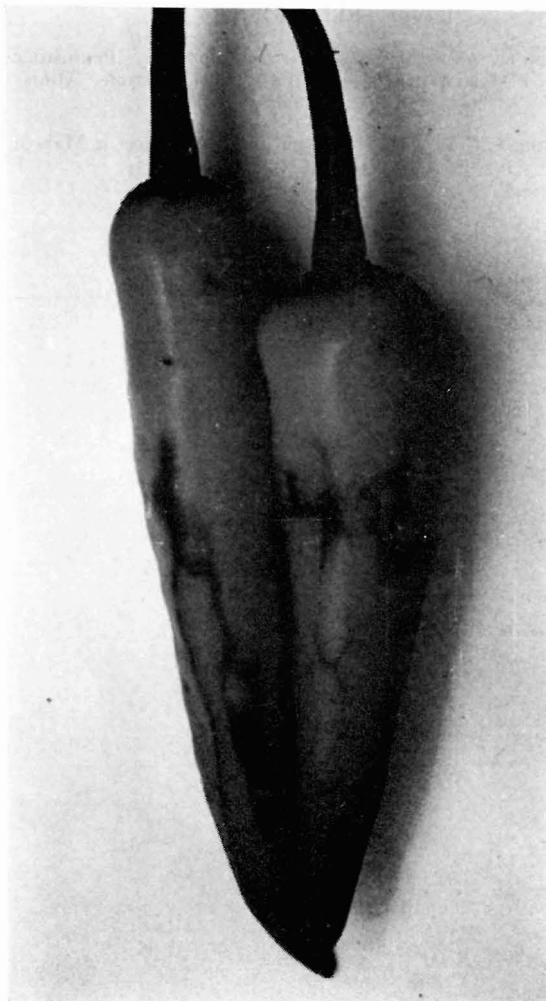


Plate 5. Irregular black markings on fully red fruits due to TMV.

CONCLUSION

The symptomatology studies showed that all cultivars infected with CVMV produced severe leaf distortions, stem mottling, stem swelling, flower distortions and colour deviations on immature fruits. In contrast, plants infected by TMV showed transient puckering symptoms on inoculated leaves, veinal necrosis, stem lesions on some cultivars and irregular black markings on ripened fruits. Mixed infected cultivars produced symptoms that were characteristic of both virus isolates.

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