DISTRIBUTION, INFECTION AND SYMPTOMATOLOGY OF VIRUS-LIKE DISEASES OF CUCURBITS IN THE VISAYAS

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ABSTRACT

Surveys in different localities of Bohol, Cebu, Leyte and Samar revealed that 13 virus-like diseases infect cucurbits, namely: ampalaya and patola abnormality (APA), ampalaya leaf curl (ALC), ampalaya little leaf (ALL), ampalaya mosaic (AM), chayote little leaf (CLL), cucumber mosaic (CM), patola little leaf (PLL), squash mosaic (SM), squash leaf curl (SLC), squash yellow mosaic (SYM), upo mosaic (UM), watermelon mosaic (WM), and watermelon leaf curl (WLC). The infection of these diseases ranged from <1-100%, with no discrete pattern of infection observed. Of these 13 virus-like diseases, ALL, SM, and UM were commonly observed and showed a significantly higher percentage infection in the four provinces; however, CM showed the highest average infection of 80% in Bohol. Likewise, Leyte was observed to have the most varied kinds of virus-like diseases in cucurbits as compared to Bohol, Cebu, and Samar, in descending order. Symptoms of the disease varied from yellow and green mosaic, yellowing, chlorotic flecks, vein clearing, mottling to malformation of leaves.

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KEY WORDS: *Cucurbitaceae*. Disease distribution. Symptomatology. Virus-like diseases. Visayas.

INTRODUCTION

The cucurbits (*Cucurbitaceae*) compose a large group of vegetables including "ampalaya" (*Momordica charantia* Linn.), "chayote" (*Sechium edule* (Jacq.) Sw.), cucumber (*Cucumis sativus*), "patola" (*Luffa cylindrica* Linn.), squash (*Cucurbita maxima*), "upo" (*Lagenaria leucantha* (Duch.) Ruxby), and watermelon (*Citrullus maxima* Duch). Like many other cultivated plants, cucurbits are constantly subjected to devastating maladies

like insect pests and diseases. Some of the most damaging pathogens are viral diseases which often reduce the quantity and quality of crop yield.

Except for the report of their occurrence in the Philippines by Protacio and Pama-Pacumbaba (1970) and Talens (1979), studies on viral diseases of cucurbits in the Visayas are lacking. This paper presents the survey results in terms of distribution, infection and symptomatology of virus-like diseases of cucurbits in the Visayas.

MATERIALS AND METHODS

Field visits in selected areas in Bohol, Cebu, Leyte and Samar were made to ascertain the incidence of virus diseases of cucurbits. Surveys were made in backyard gardens and in commercial plantations. Areas manifesting the disease were revisited to determine the extent of disease distribution. The percentage infection of the disease per unit area observed on cucurbits was recorded to evaluate disease incidence.

Disease identification was done through symptomatology and host association. Symptom description was verified based on artificially inoculated plants.

RESULTS AND DISCUSSION

Disease distribution and infection

Cucurbit virus-like diseases were observed only in backyard gardens and small fields in the places visited with an infection that ranged from <1 to 100% (Tables 1-4).

In the province of Bohol (Table 1), 10 virus-like diseases were observed, namely: ampalaya leaf curl (ALC), ampalaya little leaf (ALL), ampalaya mosaic (AM), chayote little leaf (CLL), cucumber mosaic (CM), patola little leaf (PLL), squash mosaic (SM), upo mosaic (UM), watermelon leaf curl (WLC), and watermelon mosaic (WM). The SM was observed to be prevalent in all the places surveyed in Bohol, while ALL had significant higher infection in the localities. Likewise, Cebu province was infested with only five virus-like diseases like AM, CLL, SM, squash leaf curl (SLC), and UM (Table 2).

Table 3 shows the percentage infection of the virus-like diseases of cucurbits in Leyte.Eleven virus-like diseases afflicted cucurbits in the

province, namely: ampalaya and patola abnormality (APA), ALC, ALL, AM, CM, PLL, SM, SLC, SYM, UM, and WM. Like in Bohol, SM was prevalent with a relatively high disease infection (17%). In Samar, four virus-like diseases were found like ALL, PLL, SM and UM (Table 4). In some localities, virus diseases, *i.e.* SM and UM, reached up to 100% infection which implies that the disease is a major problem in the area.

In the four provinces surveyed, a total of 13 virus-like diseases were found. The average infection ranged from 1 to 80%, with no pattern observed, an indication that the incidence of virus-like diseases of cucurbits in some areas can be high. Three virus-like diseases like ALL, SM, and UM were more commonly observed and showed significantly higher percentage

Table 1. Percentage infection of virus-like diseases of cucurbits in different localities in Bohol.

	Infection (%)									
Location	ALC	ALL	AM	CLL	CM	PLL	SM	UM	WLC	WM
Alicia		60					12			
Batuan		5		5			10			
Calape							53			
Carmen							10			
Clarin	5					5	4	50		
Dagohoy						65				
Inabanga								60		
Loon						20				
Pilar		55	10							
Sagbayan		35					28			
San Miguel		85					45			
Sierra Bullones			2			4				
Tagbilaran							50		40	30
Trinidad		12	10				18			
Tubigon					80					
Ubay		40					25	30		
Average	5	42	7	5	80	24	25	47	40	30

Legend:

ALC = ampalaya leaf curl
ALL = ampalaya little leaf
AM = ampalaya mosaic
CLL = chayote little leaf
CM = cucumber mosaic
PLL = patola little leaf
SM = squash mosaic
UM = upo mosaic
WLC = watermelon leaf curl
WM = watermelon mosaic

Table 2. Percentage infection of virus-like diseases of cucurbits in different localities in Cebu.

Location	Infection (%)				
	AM	CLL	SM	SLC	UM
Arellano (BPI)	30				8
Busay			7		
Carcar		5	31	1	20
Dalaguete	13				
Guba			20		
Lahug			9		
Oslob					
Average	21	5	17	1	14

Legend:

AM = ampalaya mosaic
CLL = chayote little leaf
SM = squash mosaic
SLC = squash leaf curl
UM = upo mosaic

Table 3. Percentage infection of virus-like diseases of cucurbits in different localities in Leyte.

Location	Infection (%)										
	APA	ALC	ALL	AM	CM	PLL	SM	SLC	SYM	UM	WM
AES, Abuyog		<1	5				17				1
Albuera						40	56				
Bato							14				
Bontoc							63	8	21		
Hilongos							20	<1			
San Isidro								2			
Tacloban							57	25			
Tanauan	<1										
Tolosa							<1	<1			
Tunga							<1	<1			
Villaba							5				
ViSCA	<1	6	20	<1	58	30	51	1		69	
Average	1	3	13	1	58	35	28	6	21	69	1

Legend:

APA = ampalaya and patola abnormality
ALC = ampalaya leaf curl
ALL = ampalaya little leaf
AM = ampalaya mosaic
CM = cucumber mosaic
PLL = patola little leaf
SM = squash mosaic
SLC = squash leaf curl
SYM = squash yellow mosaic
UM = upo mosaic
WM = watermelon mosaic

Table 4. Percentage infection of virus-like diseases of cucurbits in various localities in Samar.

Location	Infection (%)			
	ALL	PLL	SM	UM
Samar				
Calbayog	50	46		
Catbalogan		36		
Northern				
Catarman	65		47	
Gamay	15		29	
Lavezares	59	52	100	
Eastern				
Borongan			17	40
Gen. MacArthur	27		50	
Oras		25	44	
Taft	63			100
Average	46	40	48	70

Legend:
ALL = ampalaya little leaf
PLL = patola little leaf
SM = squash mosaic
UM = upo mosaic

infection compared to other virus-like diseases infecting cucurbits in different localities within the four provinces. However, considering the average percentage infection of cucurbit virus-like diseases per province, CM showed the highest infection of 80% in Bohol. Likewise, Leyte was observed to have the most varied kinds of virus-like diseases in cucurbits as compared to Bohol, Cebu and Samar, in descending order. The great difference in the percentage infection observed could be due to the insect vector population density which varied from one area to another.

The results provide basic knowledge on the seriousness of the cucurbit virus-like diseases in the Visayas. Although some virus-like diseases of cucurbits are not that intense in some localities in the Visayas, it could be a major pathological problem in the near future.

Symptomatology

Ampalaya mosaic. The symptoms of ampalaya mosaic (Fig. 1A) observed began with chlorotic flecks and vein clearing on the infected leaves. Chlorotic

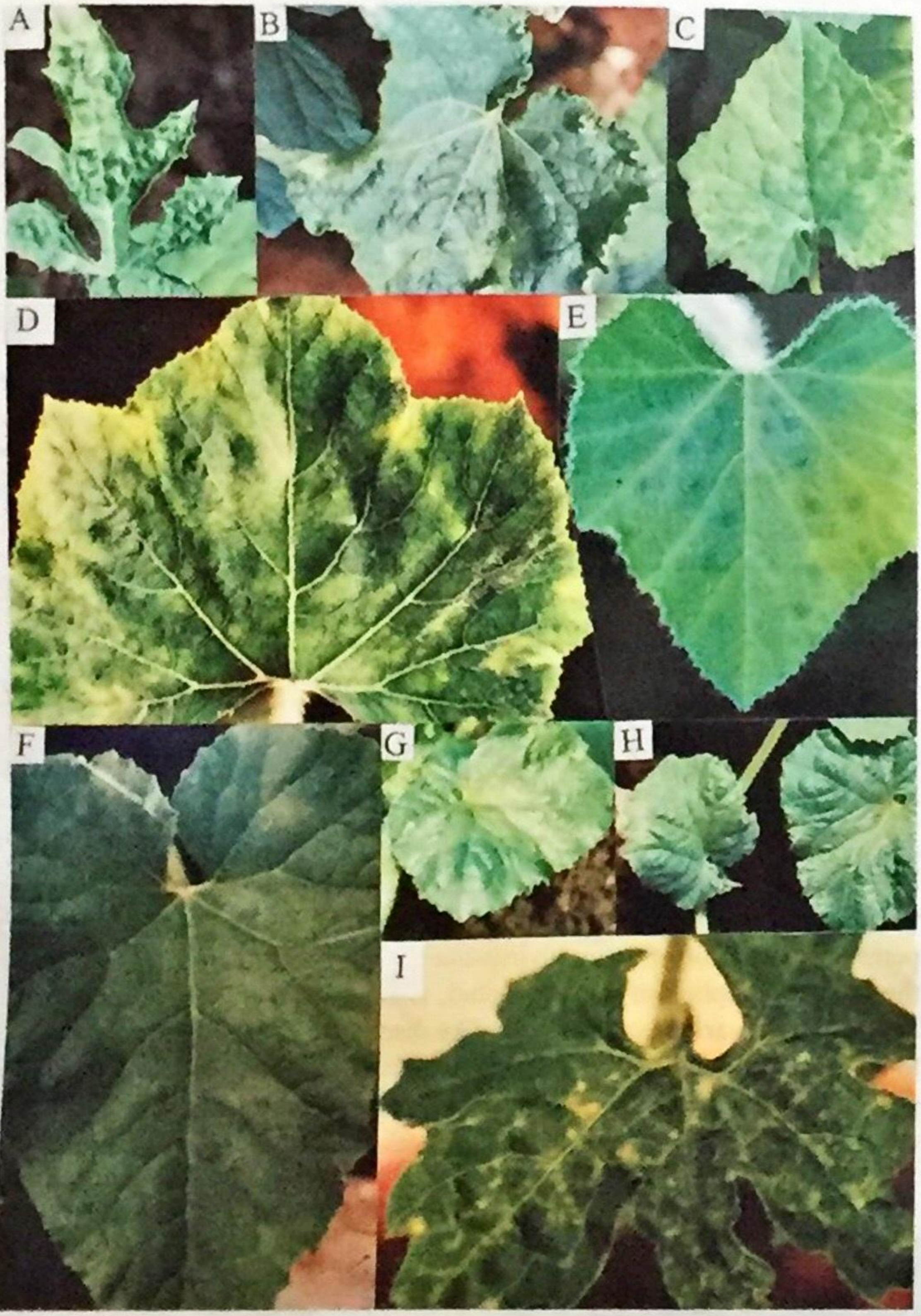

Figure 1. Cucurbit plants showing mosaic symptoms: A. ampalaya, B. musk melon, C. patola, D. squash, E. upo, F. squash green, G. squash yellow, H. cucumber, and I. water melon mosaic.

flecks after a few days developed into a slight mosaic with a pale green and yellow color. Infected leaves turned small (stunted) compared to the normal or healthy ones. Mosaics were observed on the succeeding leaves but were less pronounced than the older infected ones. It was also observed that chlorotic flecks and slight mosaic were absent on the succeeding leaves; instead, malformation, distortion, mild mottling and crinkling were noted. Later on, all kinds of symptoms were lost in the newly formed leaves as the plant grew older. Sometimes, other infected ampalaya plants showed leaves with slight mosaic but mosaic was not observed on leaves directly succeeding the infected leaves; rather it was observed in the newly formed leaves far from the previously infected portion. When ampalaya was infected with mosaic, it was different from other cucurbits which showed distinctively well-defined mosaic symptoms.

Muskmelon mosaic. Symptoms first appeared as vein yellowing on the infected leaves of muskmelon plant. Vein yellowing developed on the larger scale on the succeeding newly formed leaves. Later on, infected leaves showed raised dark green areas with occasional malformation and leaf edge spineness (Fig. 1B) caused by the sharp protrusions of the ends of the veins. The succeeding leaves of the infected ones showed typical mosaic of light and dark green areas sometimes interspersed with definite borders. Infected leaves continued to show mosaic symptoms. As the plant aged, more yellow color of the mosaic on leaves was observed. Some plants died at the early stage of infection while others grew stuntedly. Slight mosaic was mostly observed at the early stage of virus infection when the plants were still young while severe mosaic symptoms were mostly observed on the old plants infected with virus at their early stage of growth.

Patola mosaic. The symptoms of patola mosaic started with vein clearing. Vein clearing extended to the nearest veins followed by the interveinal yellowing. The youngest leaf was sharply serrated with uneven distribution of yellow and dark green color; some of the leaf blades had a raised dark green color (Fig. 1C). Infected leaves were brittle especially during sunny days and some varieties even showed lesions with defined pale yellow borders. As the infected leaves grew older, the color came in shades of green and yellow. The color was from dark green to light green; yellow, slight yellow then to faint yellow color. The colors mentioned were unevenly distributed in the leaf blade showing a distinct mosaic pattern. When the infection was on its initial stage, mosaic was still slight and only found mostly on the half or some other side of the leaf blade. When the leaf grew, the slight mosaic extended and scattered. Later, when the plant grew a little older (1½-2 mos old from the appearance of the disease), the mosaic became

slight, the varied color of the mosaic disappeared and the normal green color of the leaves appeared again. The leaves appeared normal atthis point.

Squash mosaic. Squash mosaic (Fig. 1D) disease symptoms varied from mild to severe mosaic pattern with or without mottling of leaves. The kind of mosaic pattern exhibited whether from mild to severe or from severe to mild, depended on the age of the squash plant. The mild mosaic pattern was usually observed on the newly opened leaf or in the leaf of squash plant 3-4 wks after inoculation. The color of the mosaic ranged from light yellow or light green to yellow green or yellow.

Vein chlorosis was observed after the new leaf opened. Later, yellow spotting of leaf turned to an interveinal yellow mosaic that spread all over the area of the leaf as in severe squash mosaic.

Severe mosaic continued as the plant became older. However, in the mild yellow mosaic, spotting was localized in a portion mostly near the edge of the blade in an angular manner in a fully expanded leaf. In the case of 4-5-wk-old plants with mild mosaic during the early stage (1-2 wks after inoculation), mosaic symptoms became severe. The leaves recovered as the plant grew resulting in only mild symptoms later.

Upo mosaic. Upo mosaic (Fig. 1E) disease symptoms also varied from mild to severe mosaic patterns. Most of the slight mosaic pattern was observed when plants had vein chlorosis as its initial symptom on its leaves. Light green interveinal specks followed which later turned to slight mosaic. Some portion of leaves had a light green mottling and speckling. As the plant grew older, mosaic was still observed on the leaves and in other cases mosaic became less distinct. In severe upo mosaic, newly formed leaves had interveinal dark mottling and speckling. Distinct, typical mosaic of dark (raised) and light green areas on the leaves followed. Leaves were sharply broadened and mosaic was irregularly distributed on the leaf area. Severe and very severe mosaic were observed as the plant grew older.

Squash green mosaic. On the initial stage of infection, the youngest leaf had a dark green color and the blade was sharply serrated and thicker (Fig. 1F). Vein yellowing appeared as the youngest leaf was completely and flatly opened. Later, light green streak symptoms followed. Vein yellowing and light green streaks developed on a larger scale as the young plant continued to grow. Green mosaic developed on the infected leaf especially on the youngest one.

Sometimes, green mosaic did not appear on the youngest leaf but by pruning some of the older leaves, it reappeared and became more defined. The color of this mosaic was mostly dark or light green. When the infected leaf or plant was already old, the yellowing took place before the leaf or plant withered.

Squash yellow mosaic. The youngest leaf showed vein clearing and small yellow spots. Vein clearing continued to develop as the leaf grew wider and became a vein chlorosis. Interveinal yellow mosaic (Fig. 1G) appeared later as the plant grew. Well-emphasized yellow mosaic of squash was observed on the younger leaves especially when the older leaves were pruned. The development of the yellow mosaic of squash was more or less the same as that of squash mosaic. The only main difference was that in squash yellow mosaic, yellow was the major color of the mosaic while in squash mosaic, yellow and green color were more or less evenly distributed on the leaf blade.

Cucumber mosaic. Like any other cucurbit mosaic disease, the symptoms of cucumber mosaic varied from mild to severe mosaic patterns. Slight mosaic pattern was noted on cucumber having vein clearing as its early symptoms. Interveinal yellowing (Fig. 1H) was observed in younger leaves. Well-expanded leaves later showed a slight mosaic of light green and yellow color of leaves. Older leaves with slight mosaic especially during sunny days produced blister-like raised lesions. Leaves were also brittle and dry.

Severe cucumber mosaic was not any different from the exhibition of mild mosaic symptoms on cucumber. Some of the cucumber showed vein clearing at its early stage of virus infection also but mostly cucumber with severe mosaic, especially the youngest leaf or newly opened leaf, showed a dark green color with sharp serrated edges. Later, uneven distribution of the dark green color of leaves was observed to become a natural green color with mild mottle. Not all parts of the leaves turned to a natural green color; instead there were still dark green coloring of leaves resulting in an interveinal dark green (raised) and a natural green color. As the plant became older, severe mosaic of green and light green or yellow color was observed spreading throughout the whole leaf area. In other varieties of cucumber, severe cucumber mosaic had very well-defined initial mosaic symptoms of light green and yellow interveinal mosaic.

Watermelon mosaic. Watermelon mosaic (Fig. 1I) had initial symptoms of vein chlorosis on infected leaves. A few days after inoculation, raised dark green areas appeared like blisters (similar to symptoms induced by squash mosaic). Some watermelon plants only had slight mosaic while others showed severe mosaic infection especially when the plants were older.

Vein chlorosis was not the only early symptom observed. Tiny yellow specks and puckering of the leaves were also noted. Some leaves with mosaic also showed raised dark green areas and crinkling, making their shape irregular. Most of the infected watermelon plants became stunted and eventually died.

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