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Comparison of Diagnostic Hosts and Serological Tests for Four Cucurbit Potyviruses

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ABSTRACT

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Four cucurbit potyviruses, *i.e.* zucchini yellow mosaic virus (ZYMV), type W isolate of papaya ringspot virus (PRV-W), watermelon mosaic virus-2 (WMV-2) and melon vein-banding mosaic virus (MVbMV), were compared by their reactions on six diagnostic hosts, SDS-immunodiffusion and ELISA tests. Results of host reactions indicated that isolates of PRV-W group (PRV-W FL, PRV-W T and PRV-Wv) did not infect *Cucumis metuliferus* PI "292190", but other three viruses did. Both *Phaseolus vulgaris* "Black Turtle 2" and *Nicotiana benthamiana* were only infected by WMV-2. In *Luffa cylindrica*, ZYMV induced severe mosaic and rugose symptoms, MVbMV mild mosaic, PRV-W latent infection or mild mosaic, while WMV-2 did not infect this plant. Another diagnostic host, *Lagenaria siceraria*, generally produced conspicuous mosaic symptoms when infected with MVbMV but latent or mild mosaic when infected with isolates of PRV-W group. This plant did not react to WMV-2 and ZYMV. *Chenopodium quinoa* separated MVbMV from other three viruses by producing systemic local lesions in contrast to localized lesions of other viruses. In SDS-immunodiffusion tests, antisera to virus particles (VP) of each virus were specifically reactive to their homologous antigens. However, antiserum to PRV-W FL VP did not react with PRV-Wv. Conversely, antiserum to PRV-Wv VP produced spur precipitin bands with PRV-W FL. Antisera to cylindrical inclusion (CI) proteins were specific for the homologous viruses except that antiserum to MVbMV CI which produced spur precipitin lines with WMV-2 antigen. In ELISA tests, antiserum to PRV-W FL VP did not detect PRV-Wv, and antiserum to PRV-Wv VP reacted only weakly with PRV-W FL antigen when compared with the homologous antigen/antibody reactions.

Key words: Cucurbit potyvirus, ZYMV, PRV-W, WMV-2, MVbMV.

INTRODUCTION

Cucurbits have become an important vegetable and fruit crops in Taiwan. About 45,000 ha are planted with different cultivars each year (1). The major cultivars are watermelon (*Citrullus vulgaris* Schard.), melon (*Cucumis melon* L.), cucumber (*Cucumis sativus* L.) and sponge gourd (*Luffa cylindrica* [L.] Bailey). Virus diseases have been considered to be one of the limiting factors affecting the cucurbit production. To date, six viruses have been identified (3,6,7,10,31). Surveys of the viruses in the cucurbit producing areas indicated that zucchini yellow mosaic virus (ZYMV) was the most prevalent, followed by type W isolate of papaya ringspot virus (PRV-W)(formerly watermelon mosaic virus-1, WMV-1) and cucumber mosaic virus (CMV)(3,7). However, the melon vein-banding mosaic virus (MVbMV), a newly identified cucurbit potyvirus, is also common especially in sponge gourd, bottle gourd and melon plants (10).

For a virus identification, it is generally based on host reactions, physical properties, insect vector, serology and electron microscopic observation (6,13,17). In this study we reported the use of selected diagnostic hosts, sodium dodecyl sulfate (SDS)-immunodiffusion test and enzyme-linked immunosorbent assay (ELISA) for diagnosis of four cucurbit potyviruses.

MATERIALS AND METHODS

Viruses

Four cucurbit potyviruses used were zucchini yellow mosaic virus (ZYMV), type W isolate of papaya

ringspot virus (PRV-W), watermelon mosaic virus-2 (WMV-2)(provided by D. E. Purcifull, University of Florida), and melon vein-banding mosaic virus (MVbMV). In the PRV-W group, a Florida isolate (PRV-W FL, provided by D. E. Purcifull), a Taiwan isolate (PRV-W T) and a variant of PRV-W (PRV-Wv) were included. All viruses were maintained on *Cucumis pepo* L. var. "zucchini" squash in screenhouse.

Diagnostic hosts

The diagnostic plant species were bottle gourd (*Lagenaria siceraria* Standl.), sponge gourd, *Cucumis metuliferus* (Naud.) Mey. Acc. "2459" (line 35) and PI "292190" (line 37), *Phaseolus vulgaris* L. "Black Turtle 2", *Nicotiana benthamiana* Domin., and *Chenopodium quinoa* Willd. All plants were grown at temperatures 25–30 C under screenhouse conditions. Inoculum of each virus was prepared from zucchini leaves inoculated with each virus. For each species, groups of 3 plants were mechanically inoculated with virus and the plants were observed for symptom development for 3 wks. Back inoculation to zucchini squash was carried out if inoculated plants produced no clear symptoms.

SDS-immunodiffusion test

Antisera to virus particles (VP) and cylindrical inclusion (CI) proteins of each virus were prepared in our laboratory. The agar medium for SDS-immunodiffusion tests was prepared as described eleswhere (8,10). Crude antigens for each virus were extracted from fresh leaves of infected zucchini plants. Generally, the leaf tissues were ground in distilled water (1 g/ml), followed by adding 1 ml of 3% SDS and then filtered through cheesecloth. The formation of precipitin bands in agar gel was observed after a 24 hr incubation at room temperature.

ELISA tests

Antisera to VP of ZYMV, WMV-2, PRV-W, MVbMV and PRV-Wv were used. The procedures for the purification and conjugation of immunoglobulin (IgG) for double antibody ELISA (direct ELISA) were similar to those described by Clark and Adams (4), and Lister (15). Dilutions of coating and conjugated IgG were 0.67 ug/ml and 1/1500 for each virus, respectively. Leaves were harvested from zucchini plants 8 days for ZYMV, 10 days for WMV-2, PRV-Wv and MVbMV, and 20 days for PRV-W FL after inoculation at temperatures 25–30 C under screenhouse conditions. Antigens prepared from those infected leaves were extracted in 0.1 M phosphate buffer, pH 7.5, and serially diluted to 10^1, 10^2, 10^3, 10^4 and 10^5. Absorbance A_{405} was read by a Bio-Tek ELISA reader, Model EL 310 (Bio-Tek Instruments, Winooski, VT, USA) after incubation at room temperatures (25–30 C) for 15 or 25 min depending on absorbance values of the reactions from different viruses.

TABLE 1. Reactions of six plant species to the inoculation of four cucurbit potyviruses

Test plants	Symptoms					
	PRV-W			WMV-2	ZYMV	MVbMV[1]
	FL	T	V			
Chenopodium quinoa Willd.	—[2]	LL	—	LL	LL	SLL[2]
Lagenaria siceraria Standl.						
Sib 82-12	—	—	MM	—	—	M, F, MO
89-904	—	—	—	—	—	M, F, MO
82-13	—	—	SL	—	—	M, F
Luffa cylindrica (L.) Bailey	—	MM	MM	—	SM, R	MM
Cucumis metuliferus (Naud.) Mey.						
Acc. 2459 (Line 35)	M	M	M	M	SM, S	M, S
PI. 292190 (Line 37)	—	—	—	M	SM, S	M
Phaseolus vulgaris L. var.						
Black Turtle 2	—	—	—	M	—	—
Nicotiana benthamiana Domin	—	—	—	M	—	—

[1] PRV-W: type W isolate of papaya ringspot virus (FL: Florida isolate, T: Taiwan isolate, V: Variant of PRV-W); WMV-2: watermelon mosaic virus-2; ZYMV: zucchini yellow mosaic virus; MVbMV: melon vein-banding mosaic virus.

[2] —: no infection; M: mosaic; MM: mild mosaic; SM: severe mosaic; R: rugose; S: stunting; F: flecking; MO: mottle; SL: symptomless; LL: local lesion; SLL: systemic local lesion.

RESULTS

Diagnostic host reactions

The results of inoculation of ZYMV, WMV-2, MVbMV, and PRV-W isolates on six diagnostic hosts were summarized in Table 1. Symptoms induced by different viruses in selected diagnostic hosts were in Fig. 1. It showed that PRV-W group did not infected *C. metuliferus* PI "292190", whereas the other three viruses induced clear mosaic or rugostic symptoms. This plant could be used to differentiate PRV-W from other viruses. Both *P. vulgaris* "Black Turtle 2" and *N. benthamiana* inoculated with WMV-2 produced mosaic symptoms, but the other three viruses did not. These two plants could be used for diagnosis of WMV-2.

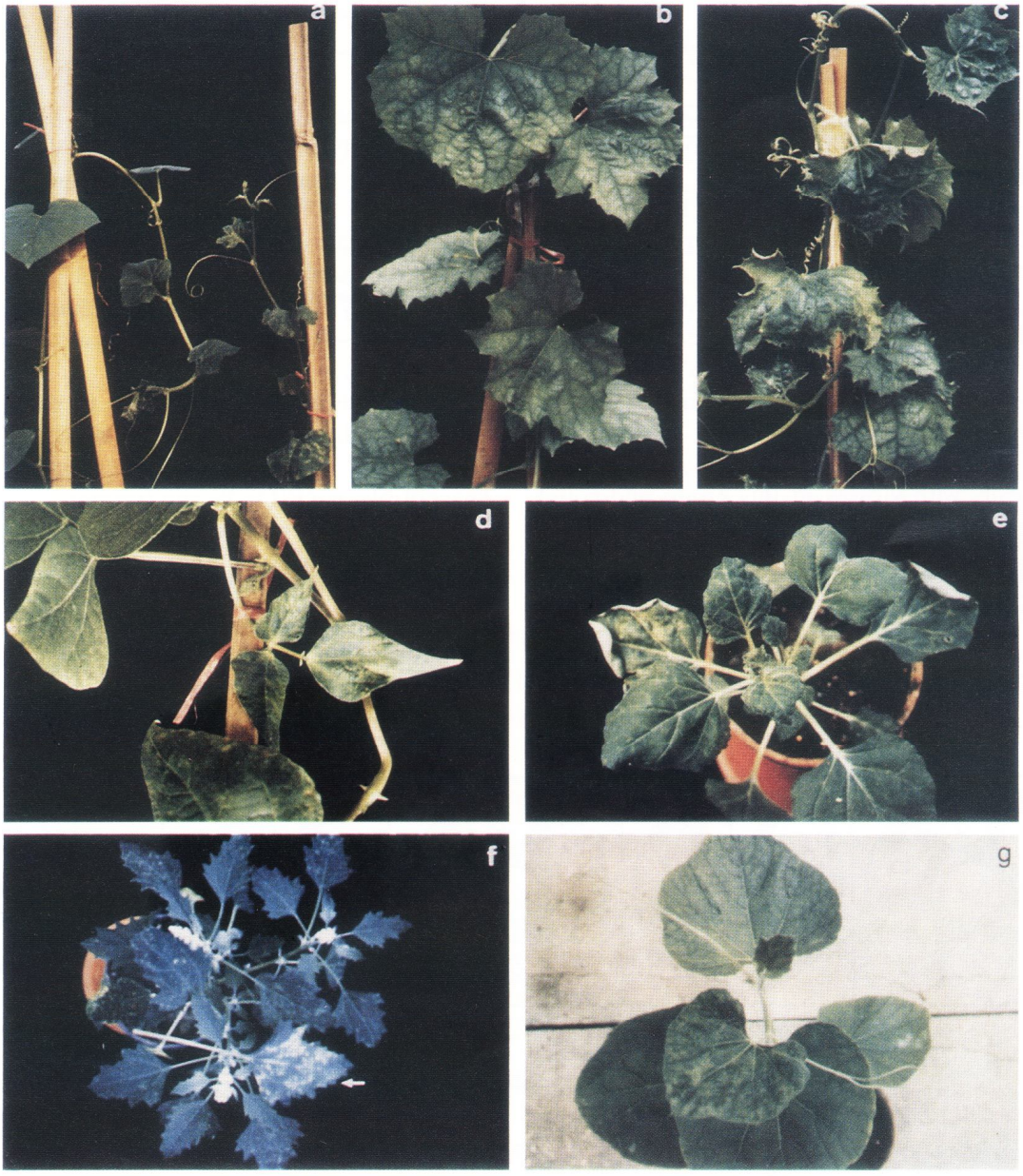

Fig. 1. Symptoms of different diagnostic plants induced by one of the four cucurbit potyviruses after inoculation. (a) no symptom in *Cucumis metuliferus* PI "292190" 2–3 weeks after inoculation with type W isolate of papaya ringspot virus (Left); severe mosaic and stunting induced by zucchini yellow mosaic virus (ZYMV)(Right). (b) mild mosaic in *Luffa cylindrica* by melon vein-banding mosaic virus (MVbMV). (c) severe mosaic and rugose symptoms in *L. cylindrica* by ZYMV. (d) mosaic in *Phaseolus vulgaris* "Black Turtle 2" by watermelon mosaic virus-2 (WMV-2). (e) mosaic in *Nicotiana benthamiana* by WMV-2. (f) systemic local lesions in *Chenopodium quinoa* by MVbMV; local lesions on inoculated leaf (arrow). (g) mosaic in *Lagenaria siceraria* by MVbMV.

Generally, ZYMV produced severe mosaic or rugose symptoms on sponge gourd but did not infect bottle gourd. However, MVbMV induced mild mosaic symptoms on sponge gourd, and mosaic, flecking or mottling on bottle gourd. In addition, MVbMV produced systemic local lesions in *C. quinoa*. Thus, ZYMV and MVbMV could be distinguished by above three diagnostic hosts.

SDS-immunodiffusion tests

The reactions of four cucurbit potyviruses were serologically distinguishable in SDS-immunodiffusion tests (Fig. 2). Antiserum to VP of each virus only produced precipitin band with its homologous antigen (Fig. 2A,C,D,E). However, antiserum to PRV-W FL VP did not react with PRV-Wv antigen (Fig. 2A), but antiserum to PRV-Wv VP produced spurred precipitin bands between homologous and PRV-W antigens (Fig. 2B). Antiserum to CI proteins of ZYMV or WMV-2 only produced precipitin band with respective antigen (Fig. 2C,D), but antiserum to MVbMV CI protein formed spurred bands between homologous and WMV-2 antigens (Fig. 2E). Of the PRV-W virus group, antisera to CI protein of both PRV-W T and PRV-Wv reacted specifically with viruses in this group and could be used to separate PRV-W from other three viruses (Fig. 2A,B).

ELISA tests

Results of ELISA tests are shown in Fig. 3. Generally, IgG purified from antisera to individual virus was only specific to its antigen or to different isolates/strains of same virus. In PRV-W group, the serological reactivity was stronger in homologous than in heterologous antigens. Interestingly, IgG purified from PRV-W FL antiserum had no serological reactivity to PRV-Wv (Fig. 3a). Conversely, PRV-Wv antiserum reacted with PRV-W FL antigen although the absorbance value of PRV-W FL was much lower ($A_{405}=0.4$) than that of PRV-Wv ($A_{405}=1.21$)(Fig. 3b).

DISCUSSION

Previously we reported the occurrence of two cucurbit potyviruses, namely ZYMV and PRV-W, in the cucurbit production areas in Taiwan (3,7). Although more than 3000 samples were collected from virus infected cucurbits and tested by ELISA, we did not detect the presence of WMV-2 (3,7). However, a new cucurbit potyvirus, melon vein-banding mosaic virus (10), and a type W variant of papaya ringspot virus were isolated (9).

The use of diagnostic hosts to distinguish different potyviruses from cucurbits have been reported (14,21,25, 26). Webbs (30) showed that *Luffa acutangula*, which is susceptible to PRV-W but immune to WMV-2, is a good host for separating PRV-W from WMV-2. Milne *et al.* (18) reported that WMV-2 strains could be readily identified by their ability to induce local lesions on *C. amaranticolor*, but PRV-W strains did not. However, strains of PRV-W inducing local lesions on *C. amaranticolor* have been reported (25). We have also found that several Taiwan isolates of PRV-W induced

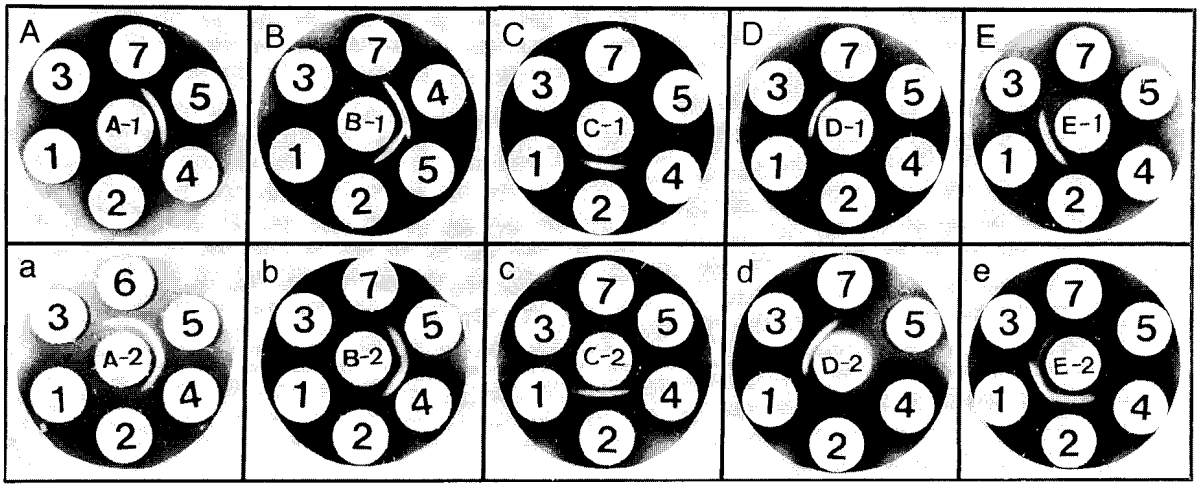

Fig. 2. Scrological reactions of four cucurbit potyviruses in SDS-immunodiffusion tests. Central wells contained antisera to virus particles: A-1 = type W isolate of papaya ringspot virus, a Florida isolate (PRV-W FL), B-1 = a variant of PRV-W (PRV-Wv), C-1 = watermelon mosaic virus-2 (WMV-2), D-1 = zucchini yellow mosaic virus (ZYMV), E-1 = melon vin-banding mosaic virus (MVbMV); antisera to cylindrical inclusion proteins: A-2 = PRV-W Taiwan isolate (PRV-W T), B-2 = PRV-Wv, C-2 = WMV-2, D-2 = ZYMV, E-2 = MVbMV. Outer wells contained SDS-treated antigens: 1 = MVbMV, 2 = WMV-2, 3 = ZYMV, 4 = PRV-Wv, 5 = PRV-W FL, 6 = PRV-W T and 7 = healthy extracts from zucchini leaf tissues.

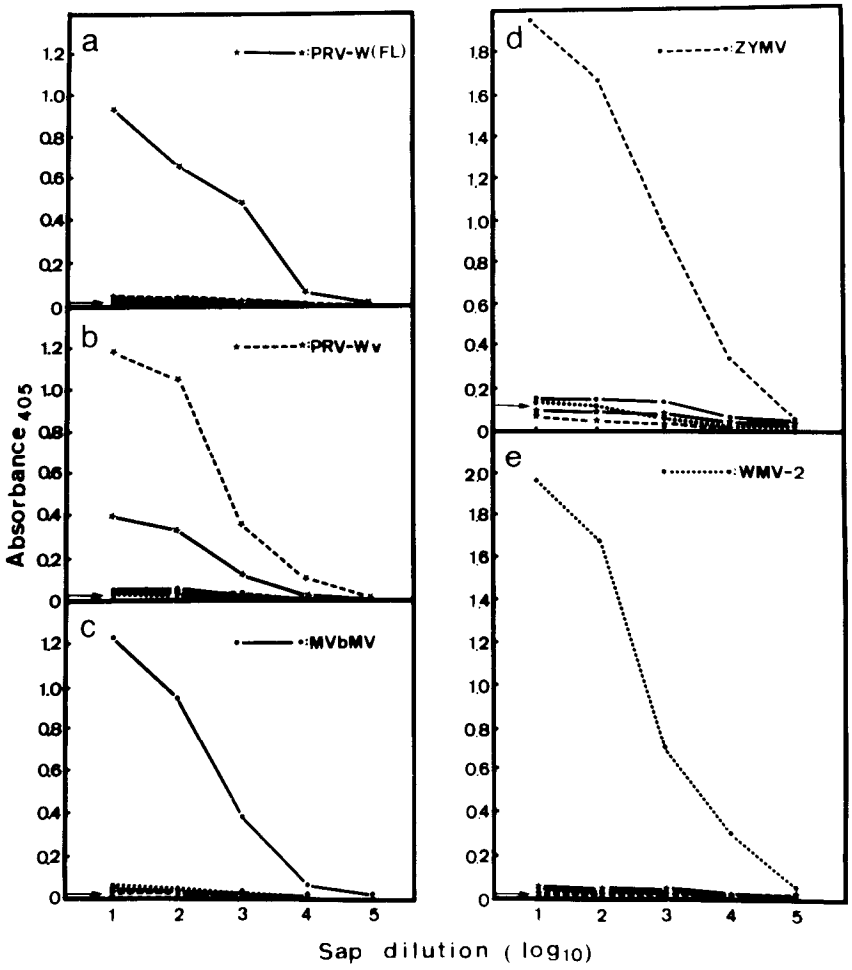

Fig. 3. ELISA tests of four cucurbit potyviruses. Immunoglobulin purified from antisera to: a=type W isolate of papaya ringspot virus, a Florida isolate (PRV-W FL); b=type W variant of papaya ringspot virus (PRV-Wv); c=melon vein-banding mosaic virus (MVbMV); d=zucchini yellow mosaic virus (ZYMV) and e=watermelon mosaic virus-2 (WMV-2). Absorbance A_{405} for different viruses were: *—*=PRV-W FL; *----*=PRV-Wv; •—•=MVbMV; •----•=ZYMV; •.....•=WMV-2. Arrows indicate control values from healthy zucchini leaf tissues.

local lesions on both *C. amaranticolor* and *C. quinoa* (Huang *et al.*, unpublished). Therefore, *C. amaranticolor* is insufficient to separate PRV-W from WMV-2. *C. metuliferus* PI "292190" is resistant to type P and W isolates of PRV (20,25), but susceptible to WMV-2 and ZYMV (21). *Phaseolus vulgaris* "Black Turtle 2" and *Nicotiana benthamiana* were reported to be systemically infected by WMV-2, but not or only locally infected by PRV-W and ZYMV (5,19,21). We have confirmed that *C. metuliferus* PI "292190" is resistant to PRV-W, but susceptible to other 3 viruses (Table 1). In addition, both *P. vulgaris* "Black Turtle 2" and *N. benthamiana* were not infected by PRV-W, ZYMV and MVbMV, but WMV-2 did. Thus, the above 3 species are useful for differentiating PRV-W, WMV-2 and ZYMV. In comparing ZYMV with MVbMV, we found that the former produced severe mosaic or rugose, while the latter induced mild mosaic symptoms in *L. cylindrica*. In addition, MVbMV produced systemic chlorotic local lesions in *C. quinoa*, but ZYMV only induced lesions on the inoculated leaves. Another selected host, *Lagenaria siceraria* was also susceptible to the infection of MVbMV. Therefore, these six selected hosts are good for diagnosis of the four cucurbit potyviruses under this study, but they are not suitable for distinguishing the isolates/strains of PRV-W.

The SDS-immunodiffusion technique is useful for detecting and distinguishing several isometric and anisometric viruses (22). Mokkouk and Gumpf (17) reported that the five PVY strains could be devided into two groups by agar-gel double diffusion tests using purified SDS-degraded virus preparations as antigens.

In cucurbit potyviruses, Purcifull *et al.* (23,24) reported that PRV-W, WMV-2, WMV-M (a Moroccan isolate of WMV) and ZYMV were distinguished by SDS-immunodiffusion tests although WMV-2 antiserum collected at late bleedings formed definite spur precipitin bands between WMV-2 and ZYMV 1119 isolate. We have confirmed that PRV-W, WMV-2, ZYMV, and MVbMV antisera can be used to distinguish the respective antigens by SDS-immunodiffusion tests. However, to recognize the strains or variant of a virus it would require the use of different antisera to VP, CP and CI proteins of a virus. Purcifull *et al.* (25) reported that PRV-W and PRV-P show different biological and physical properties but possess serologically indistinguishable capsid proteins. Another PRV isolate (PRV-T) had biological and physical properties similar to those of PRV-W, but its CP was distinct from the PRV-W CP (27,28). Our results indicated that antiserum to PRV-W FL VP did not react with PRV-Wv antigen, but antiserum to PRV-Wv VP produced spur precipitin bands between PRV-W FL and PRV-Wv antigen wells. Nevertheless antisera to PRV-Wv or PRV-W CI proteins reacted with both virus isolates were serologically identical.

Both direct and indirect ELISA for detection of plant viruses has been widely used. Regenmortel *et al.* (29) showed that indirect ELISA is better than direct ELISA for detecting serological distinct strains of tobacco mosaic virus, whereas other reports indicated that direct ELISA is extremely strain specific (2,12,16, 29). Therefore, we used direct ELISA for this study and demonstrated that four cocurbit potyviruses were readily distinguished by direct ELISA. However, in PRV-W group ELISA values are influenced by different isolates/strains. Interestingly, PRV-W FL antiserum did not react with PRV-Wv antigen. Conversely, PRV-Wv antiserum did react with PRV-W FL even at a low absorbance value. Huang *et al.* (11) reported that antiserum to ZYMV-7 reacted with homologous (ZYMV-7) antigen produced a higher ELISA values than those of three isolates of ZYMV from Taiwan and one ZYMV isolate from Florida under same conditions. Thus, to clarify these differences more research is needed.

In summary, the four cucurbit potyviruses described above can be readily diagnosed by six diagnostic hosts, ELISA or SDS-immunodiffusion tests.

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LITERATURE CITED

1. Anon. 1990. Taiwan Agricultural Yearbook. Published by Department of Agriculture and Forestry, Taiwan Provincial Government, Taiwan. (In Chinese)
2. Bar-Joseph, M., and Salomon, R. 1978. Heterologous reactivity of tobacco mosaic virus strains in enzyme-linked immunosorbent assays. Journal of General Virology 47:509-512.
3. Chang, Y. M., Hsaio, C. H., Yang, W. Z., Hseu, S. H., Chao, Y. J., and Huang, C. H. 1987. The occurrence and distribution of five cucurbit viruses on melon and watermelon in Taiwan. Journal of Agricultural Research of China 36:389-397.
4. Clark, M. F., and Adams, A. N. 1977. Characteristics of the microplate method of enzyme-linked immunosorbent assay for the detection of plant viruses. Journal of General Virology 34:475-483.
5. Davis, R. F. 1986. Partial characterization of zucchini yellow mosaic virus isolated from squash in Turkey. Plant Disease 70:735-738.
6. Hseu, S. H., Wang, H. L., and Huang, C. H. 1985. Identification of a zucchini yellow mosaic virus from *Cucumis sativus*. Journal of Agricultural Research of China 34:87-95.
7. Hseu, S. H., Huang, C. H., Chang, C. A., Yang, W. Z., Chang, Y. M., and Hsiao, C. H. 1987. The occurrence of five viruses in six cucurbits in Taiwan. Plant Protection Bulletin (Taiwan) 29:233-244.
8. Huang, C. H., Hseu, S. H., and Chao, Y. J. 1986. Purification and serology of an isolate of zucchini yellow mosaic virus. Journal of Agricultural Research of China 34:495-503.
9. Huang, C. H., and Chang, L. 1989. Characterization of a type W variant of papaya ringspot virus in Taiwan. Plant Protection Bulletin 31:412 (Abstract).
10. Huang, C. H., Chang, L., and Tsai, J. H. 1993. The partial characterization of melon vein-banding mosaic virus, a newly recognized virus infecting cucurbits in Taiwan. Plant Pathology 42:100-107.
11. Huang, C. H., Hseu, S. H., and Tsai, J. H. 1989. Purification, serology and properties of five zucchini yellow mosaic virus isolates. Plant Pathology 38:414-420.
12. Koenig, R. 1978. ELISA in the study of homologous and heterologous reactions of plant viruses. Journal of General Virology 40:309-318.
13. Lisa, V., Boccardo, G., D'Agostino, G., Dellavalle, G., and d'Aquilio, M. 1981. Characterization of a potyvirus that causes zucchini yellow mosaic. Phytopathology 71:667-672.
14. Lisa, V., and Lecoq, H. 1984. Zucchini Yellow Mosaic Virus. CMI/AAB Descriptions of Plant

Viruses. No. 282.
15. Lister, R. M. 1978. Application of the enzyme-linked immunosorbent assay to detect viruses in soybean seed and plants. Phytopathology 68:1393-1400.
16. Lister, R. M., and Rochow, W. F. 1979. Detection of barley yellow dwarf virus by enzyme-linked immunosorbent assay. Phytopathology 69:649-654.
17. Makkouk, K. M., and Gumpf, D. J. 1976. Characterization of potato virus Y strains isolated from pepper. Phytopathology 66:576-581.
18. Milne, K. S., Grogan, R. G., and Kimble, K. A. 1969. Identification of viruses infecting cucurbits in California. Phytopathology 59:819-828.
19. Provvidenti, R. 1974. Inheritance of resistance to watermelon mosaic virus-2 in *Phaseolus vulgaris*. Phytopathology 64:1448-1450.
20. Provvidenti, R., and Gonsalves, D. 1982. Resistance to papaya ringspot virus in *Cucumis metuliferus* and its relationship to resistance to watermelon mosaic virus I. Journal of Heredity 73:239-240.
21. Provvidenti, R., Gonsalves, D., and Humaydan, H. S. 1984. Occurrence of zucchini yellow mosaic virus in cucurbits from Connecticut, New York, Florida, and Califorina. Plant Disease 68:443-446.
22. Purcifull, D. E., Christie, S. R., and Lima, J. A. A. 1981. Detection of four isometric plant viruses in sodium dodecyl sulfate immunodiffusiion tests. Phytopathology 71:1221-1224.
23. Purcifull, D. E., and Hiebert, E. 1979. Serological distinction of watermelon mosaic virus isolates. Phytopathology 69:112-116.
24. Purcifull, D. E., Adlerz, W. C., Simone, G. W., Hiebert, E., and Christie, S. R. 1984. Serological relationships and partial characterization of zucchini yellow mosaic virus isolated from squash in Florida. Plant Disease 68:230-233.
25. Purcifull, D. E., Edwardson, J., Hiebert, E., and Gonsalves, D. 1984. Papaya Ringspot Virus. CMI/AAB Descriptions of Plant Viruses. No. 292.
26. Purcifull, D. E., Hiebert, E., and Edwardson, J. 1984. Watermelon Mosaic Virus 2. CMI/AAB Descriptions of Plant Viruses. No. 293.
27. Quiot-Douine, L., Lecoq, H., Quiot, J. B., Pitrat, M., and Labonne, G. 1990. Serological and biological variability of virus isolates related to strains of papaya ringspot virus. Phytopathology 80:256-263.
28. Quiot-Douine, L., Purcifull, D. E., Hiebert, E., and de mejia, M. V. G. 1986. Serological relationships and *in vitro* translation of an antigenically distinct strain of papaya ringspot virus. Phytopathology 76:346-351.
29. Van Regenmortel, M. H. V., Nicolaieff, A., and Burckard, J. 1980. Detection of a wide spectrum of virus strains by indirect ELISA and serological trapping electron microscopy (STREM). Acta Horticulturae 110:107-115.
30. Webb, R. E. 1965. *Luffa acutangula* for separation and maintenance of watermelon mosaic virus 1 free of watermelon mosaic virus 2. Phytopathology 55:1379-1380.
31. Yeh, S. D., Cheng, Y. H., Jih, C. L., Chen, C. C., and Chen, M. J. 1988. Identification of tomato spotted wilt virus infecting horn melon and watermelon. Plant Protection Bulletin (Taiwan) 30:419-420. (Abstract).

摘　　要

黃秋雄、梁素琴、鄧汀欽、許秀惠．1993．四種屬於PVY群之瓜類病毒在診斷寄主與血清反應特性之比較．植病會刊2:169-176．(台中縣　台灣省農業試驗所植物病理系)

四種病毒包括矮南瓜黃化嵌紋病毒(zucchini yellow mosaic virus, ZYMV)，木瓜輪點病毒-西瓜系統(type W isolate of papaya ringspot virus, PRV-W)，西瓜嵌紋病毒-2(watermelon mosaic virus-2, WMV-2)及甜瓜脈綠嵌紋病毒(melon vein-banding mosaic virus, MVbMV)。從供試的六種診斷寄主反應結果獲知，PRV-W不感染 *Cucumis metuliferus* "PI 292190"，但其他三種病毒可。*Phaseolus vulgaris* "Black Turtle 2"和 *Nicotiana benthamiana* 僅被WMV-2感染。利用 *Luffa cylindrica* 爲診斷寄主，ZYMV可引起嚴重嵌紋與葉片皺縮之病徵，MVbMV引起輕微嵌紋，PRV-W引起輕微嵌紋或潛伏，但WMV-2不會感染該植物。另外一種寄主，*Lagenaria siceraria*，如果感染MVbMV則產生明顯嵌紋病徵，而PRV-W僅引起輕微嵌紋或潛伏感染，該植物不被WMV-2或ZYMV感染。從目前所得結果，MVbMV可利用 *Chenopodium quinoa* 分開，因爲MVbMV在該植物上產生系統性單斑，而其他三種病毒僅在接種葉形成單斑。在血清反應特性上，四種病毒之抗血清(antisera to virus particles)在SDS-immunodiffusion tests上均可區別之。若以內含體抗血清(antisera to cylindrical inclusion (CI))，同樣可以分別出。然MVbMV CI抗血清會與WMV-2反應，但有交叉現象(spur precipitin lines)

。利用 ELISA tests，抗體與同源抗原 (homologous antigen) 反應之 ELISA 吸收值相當高，對不同病毒抗原均不反應。因此同樣可以利用 ELISA 將四種不同病毒區別之。然而相同病毒之不同分離株或系統 (virus isolate/strain)，不論利用 SDS-immunodiffusion test 或 ELISA，反應結果可能略有差異，必須視 isolate 或 strain 作進一步之研究。

關鍵詞：瓜類 PVY 病毒，ZYMV，PRV-W，WMV-2，MVbMV。