Tomato Yellow Top Virus: Host Range, Symptomatology, Transmission, and Variability

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ABSTRACT

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Tomato yellow top (TYT) is a destructive disease of tomato caused by tomato yellow top virus (TYTV). Terminal growth of field-infected plants is characteristically bright yellow, often with a purplish cast on lower leaf surfaces. Leaflets are ovate, cupped upward with constricted margins, and reduced in size. Blossoms often die and abscise and fruits are frequently asymmetrical. The causal virus was not transmitted mechanically or through seed but was readily transmitted by the green peach aphid (*Myzus persicae*) in a circulative manner. Symptoms produced by 66 TYTV isolates varied but all produced TYT symptoms on tomato plants, no symptoms or mild potato leafroll (PLR) symptoms on potato, and typical of PLR symptoms on *Physalis floridana* and *Datura tatula*. Potato leafroll virus (PLRV) isolates from Washington produced very mild symptoms on tomato, distinct from those of TYTV. Green peach aphid acquired TYTV in a minimum acquisition period of 2.5 hr and transmitted in a minimum access period of 2 hr after a minimum latent period of 20–24 hr. Aphids retained infectivity for life and the virus was not transmitted transovarialy to offspring. A single aphid routinely transmitted the virus to susceptible hosts and no difference in severity occurred when 5, 10, or 15 aphids were used per inoculation. Based on host range, symptomatology, and transmission characteristics, TYTV appears to be related to, but distinct from, PLRV and beet western yellows virus (BWYV).

Several viruslike diseases of tomato (*Lycopersicon esculentum* Mill.) that cause similar bright yellowing symptoms in the terminal growth of the infected plants (ovate, small, upward- or downward-cupped leaflets; abnormal fruit development; new growth proliferation with shortened internodes) and that are transmitted in a persistent manner by aphids have been reported from various areas of the world (1–4,8,11,12). These diseases were called tomato yellow top (TYT). A similar devastating tomato disease appeared in tomato research plots at the Irrigated Agriculture Research and Extension Center, Prosser, WA, and in home gardens in the Prosser area in 1973 (14), and the disease has recurred there annually in mild to severe epidemics. In California in 1979 we isolated a virus from TYT-diseased tomato plants that produced identical symptoms and had transmission characteristics identical to those of the disease described in Prosser on a number of hosts (*unpublished*). The widespread occurrence of a new tomato disease with TYT symptoms and that was called "tomato yellows" was reported in Florida (16). The Florida virus was related by host range, symptomatology, transmission characteristics, and serology to potato leafroll virus (PLRV). The TYT disease of Australia (1,2,11) was also attributed to a virus serologically related to PLRV. We report here the host range, symptomatology, transmission characteristics, and variability of the virus causing the TYT disease in Washington. A preliminary report was presented (7).

MATERIALS AND METHODS

Plant culture. Seeds of experimental plants were germinated in vermiculite and young seedlings were transplanted into 10-cm square plastic pots or round clay pots containing a mixture of loam, sand, and peat moss (2:1:1, v/v). Liquid fertilizer (16-6-6, N-P-K) was added to irrigation water at the rate of 500 ppm. Plants were grown in the greenhouse at 23–29 C or in growth chambers at 24 C with 16-hr light periods.

Insect culture. Nonviruliferous green peach aphids (*Myzus persicae*) were reared on healthy radish (*Raphanus sativus* L.) and Chinese cabbage (*Brassica pekinensis* Lour) plants in an isolated insectary under aphid-proof nylon-net-covered cages and were regularly tested on healthy plants to check for virus contamination.

Virus transmission. Plants of *Physalis floridana*, *Datura tatula*, and *L. esculentum* were used both as virus sources and as diagnostic indicator hosts in all transmission experiments. Plants were inoculated in the seedling stage in insect transmission tests and as young plants in mechanical transmission tests.

Mechanical transmission was attempted from field- and greenhouse-infected plants. Inoculum was prepared at 1:10 dilution of macerated tissue in 0.03 M phosphate buffer, pH 8, and rub-inoculated on Carborundum-dusted leaves of the three indicator species.

To test for TYTV transmission through seed, several thousand seedlings grown from seed collected from tomato yellow top virus (TYTV)-infected plants of *D. tatula*, *P. floridana*, and *L. esculentum* were observed visually for TYTV symptoms and tested for latent infection by aphid transmission to indicator hosts.

Transmission properties (minimum access periods and latent period) of the virus in *M. persicae* were determined with TYTV isolate 14. In routine virus transmission tests, aphids were given 48-hr acquisition feedings on detached virus source plant leaves held in plastic petri dishes on moist filter paper. They were then caged on test plants (15–20 per plant) for 72 hr under inverted plastic water tumblers. The bottoms of the tumblers had been removed previously and replaced with nylon net to provide ventilation.

To determine transovarial transmission, viruliferous adult aphids were placed on radish leaves. A newly born nymph was then transferred to each of 100 healthy index plants of *P. floridana* and given a 1-wk transmission access period.

Virus isolates. Forty-six isolates were selected in 1980, and 20 were selected in 1981, from tomato plants of diverse genetic

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TABLE 1. Plants susceptible to one or more of five isolates of tomato yellow top virus (TYTV)[a]

Family	Species	Reactions to TYTV isolates: 1	14	17	19	25
Amaranthaceae	*Gomphrena globosa* L.	0[a]	0	0	0	0
Chenopodiaceae	*Spinacia oleracea* L.	+	−	−	+	−
Compositae	*Zinnia elegans* Jaeq.	0	−	−	0	0
Cucurbitaceae	*Cucurbita pepo* L.	−	−	+	−	−
Labiatae	*Ocimum basilicum* L.	−	−	0	−	−
Malvaceae	*Hibiscus golfrosens* L.	−	o	o	+	−
	H. moscheutos L.	+	o	o	o	o
Solanaceae	*Datura fastuosa* L.	+	+	+	+	+
	D. stramonium L.	+	+	+	+	+
	D. tatula L.	+	+	+	+	+
	Hyoscyamus niger L.	0	0	0	0	0
	Lycopersicon esculentum Mill.	+	+	+	+	+
	L. pimpinellifolium (Jusl) Mill.	+	+	+	+	+
	Nicotiana acuminata Grah.	+	+	+	+	+
	N. angustifolia Comes	+	+	+	+	+
	N. clevelandii Gray	+	+	−	+	+
	N. rustica L.	−	0	0	0	0
	N. tabacum L. 'Xanthi NC'	−	−	0	0	0
	Physalis floridana Rydb.	+	+	+	+	+
	P. ixocarpa Brot.	+	+	+	+	+
	P. lanceifolia Michx.	+	+	+	+	+
	P. peruviana L.	+	+	+	+	+
	Solanum demissum PI 230579[b]	−	−	−	−	+
	S. demissum PI 175404[c]	−	−	−	0	0
	S. rostratum Dund.	0	0	0	0	0
	S. tuberosum L.	+	+	+	+	+

[a]Symbols for host reactions: +, disease symptoms; 0, symptomless infection; −, no infection; 0, no index performed. *Lactuca sativa* L. (Compositae) and *Capsella bursa-pastoris* L. (Cruciferae) were immune to the five virus isolates but were infected by other TYTV isolates.

[b]This is an increase of the specific self-fertile isolate selected as a diagnostic host for PVA (15).

[c]This is an increase of the specific self-fertile isolate selected as a diagnostic host for PVY (16).

backgrounds, growing in curly top elimination plots. An isolate from Florida was supplied by J. E. Duffus. Each isolate was transmitted to *P. floridana* and *D. tatula* in the greenhouse and then back to tomato to ensure that passage through these hosts had not changed the symptoms produced on tomato. The host range of TYTV was determined for isolates 1, 14, 17, 19, and 25, because reactions to them represented the range of symptom types observed in the field and on *P. floridana* in the greenhouse. In addition, all isolates of TYTV were tested on selected diagnostic hosts of PLRV and of beet western yellows virus (BWYV).

Host range. The host range of isolates 1, 14, 17, 19, and 25 was tested (Table 1). Later, a selected range of luteovirus diagnostic hosts were tested against the 66 field isolates of TYTV and three PLRV isolates. Seedlings were exposed for 72 hr to aphids (40–50 per seedling) that previously had a 48-hr acquisition feeding on infected plants of *D. tatula*. When one or more, but not all five, of the virus isolates infected a species, the species was retested by inoculating the test plants with large numbers of aphids to ensure against false negative results. Presence or absence of virus in each test plant was indexed 5–6 wk after inoculation by testing for transmission to seedlings of *P. floridana* by 15–20 aphids per seedling after 48-hr acquisition and 72-hr transmission periods. Again, when a positive index was achieved for one or more, but not all five, virus isolates, the test plants were reindexed.

RESULTS

Field observations. Two distinct TYT symptom categories were distinguished in the field, based on variation in foliage color, leaf malformation, and axillary stem proliferation. In the typical TYTV syndrome (Fig. 1), earliest symptoms appeared in the terminal growth of the plant. Margins of leaflets were restricted, producing an ovate shape, an upward cupping and considerable malformation. Leaflets were bright yellow in color with a purplish cast on the lower surfaces. Internodes were not severely shortened and there was little axillary stem proliferation. In a variation of the typical symptom type internodes were shortened and axillary

Fig. 1. Symptoms of tomato yellow top disease in terminal growth of field-grown tomato plants. Note cupping and distortion of leaflets and bright yellow coloration. (Tomato Yellow Top Virus Isolate 85).

proliferation was pronounced resulting in a cushionlike appearance of the plants (Fig. 2). Fruit set stopped on all infected plants in the field with onset of earliest symptoms due to wilting and abscission of the calyx and blossom pedicels. Fruit formed at the onset of symptoms were often asymmetrical as a result of failure of one or more locules to develop (Fig. 3).

Virus was transmitted from plants in all field symptom categories to experimental greenhouse plants on which all isolates produced the same general type of yellows symptoms and no differences in transmission properties were observed.

Mode of transmission. *M. persicae* routinely transmitted TYTV in a persistent manner and acquired the virus both from infected tissue and from extracts of infected tissue in 20% sucrose when fed through membranes. Mechanically inoculated plants never developed symptoms in repeated attempts. None of thousands of seedlings grown from seed of TYTV-infected plants of *D. tatula*, *L. esculentum*, and *P. floridana* had TYTV symptoms, and virus was never recovered from these plants by aphids.

Fig. 2. Field symptoms of tomato yellow top disease showing the cushion growth syndrome. Pronounced axillary shoot proliferation combined with shortening of internodes (top) produces a characteristic cushionlike growth habit (bottom).

Transmission properties. Aphids acquired TYTV in a 2.5-hr threshold access period on leaves of *D. tatula* and 4.5 hr on *L. esculentum* (Table 2). After a 6-hr acquisition access period, efficiency of transmission was the same when either species was the source of virus.

The threshold transmission access period was 2 hr with *D. tatula* as a source of virus, and *P. floridana* as the test plant. All test plants inoculated were infected after a 6-hr access period (Table 3). When *L. esculentum* served both as the virus source and the test species, the threshold transmission access period was 3 hr and 100% infection was never achieved in access intervals up to 24 hr.

Latent period was >20 hr and <24 hr (Table 4). As the acquisition feeding period was increased, the transmission feeding period was decreased, resulting in a consistent 24-hr latent period.

Following a 48-hr acquisition period, *M. persicae* retained, with no abatement, the capacity to transmit TYTV for at least 8 days without further access to virus. The tests were suspended after 8 days since the aphids died by the ninth day of serial transmission, and the original viruliferous aphids, maintained on immune radish leaves, were visually indistinguishable from their progeny.

Transmission efficiency. *M. persicae* was a highly efficient vector of the TYTV. A single aphid never failed to transmit the virus to seedlings of *P. floridana* following a 48-hr acquisition on infected leaves of *D. tatula*. However, initial symptoms were somewhat more severe when 5, 10, or 15 aphids per seedling were used than when one aphid was used to inoculate seedlings.

Transovarial transmission. One hundred nymphs from viruliferous parents tested on 100 seedlings of *P. floridana* all failed to transmit TYTV.

Host range. Host range and symptom production for the initial five TYTV isolates tested varied widely (Table 1). Three of the isolates could be separated from a mixture of all five based on infectibility of selected hosts.

A total of 29 species in eight plant families were infected by one or more TYTV isolate (Table 1). Two genera, initially immune to the five virus isolates in initial tests, were infected by other isolates later. They were: Compositae—*Lactuca sativa* L.; and

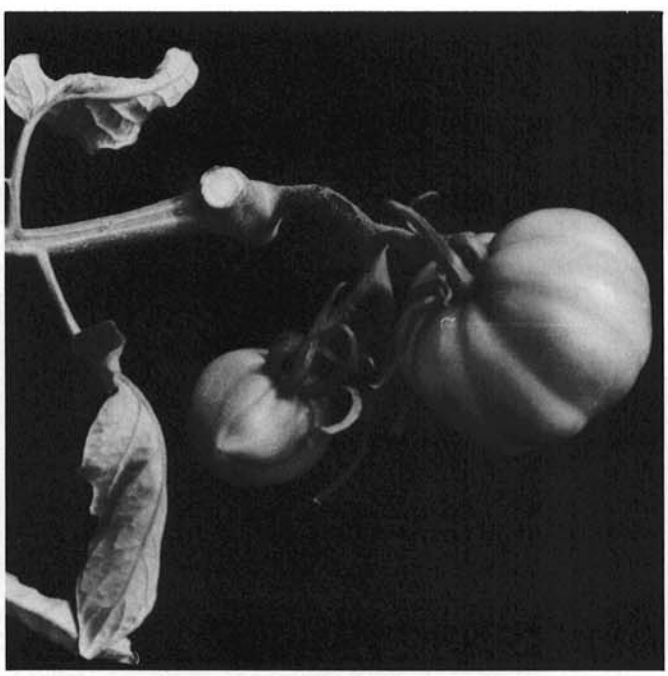

Fig. 3. Field symptoms of tomato yellow top disease showing blossom abscission and asymmetrical fruit development. Blossoms fertilized at a critical early stage of disease development form asymmetrical fruit, those fertilized earlier form normal fruit, and those fertilized later abscise. On this raceme a normal fruit appears on the oldest blossom, an asymmetrical fruit on the next blossom, and naked pedicel stumps (between the two fruits) appear where the two youngest blossoms abscised.

Cruciferae—*Capsella bursa-pastoris* L. Sixty-five species among 17 families were not infected by any TYTV isolate tested. They were: Amaranthaceae—*Amaranthus caudatus* L., *A. retroflexus* L., and *A. tricolor* L.; Basellaceae—*Basella alba* L.; Boraginaceae—*Borago officinalis* L.; Caryophyllaceae—*Dianthus barbatus* L.; Chenopodiaceae—*Atriplex semibaccata* R. Br., *Beta vulgaris* L., *Chenopodium quinoa* Willd., and *C. urbicum* L.; Compositae—*Aster cordifolius* L., *Cichorium endivia* L., *Helianthus annuus* L., and *Tagetes erecta* L.; Cruciferae—*Brassica chinensis* L., *B. nigra* (L.) Koch, *B. oleracea* var. *botrytis* L., *B. oleracea* var. *capitata* L., *B. oleracea* var. *viridis* L., *B. rapa* L., *Raphanus sativus* L., and *Sisymbrium altissimum* L.; Cucurbitaceae—*Citrullus vulgaris* Schrad, *Cucumis angumens*, *C. melo* var. *reticulatis* Naud., *C. melo* var. *indorus* Naud., and *C. sativus* L., *Cucurbita maxima* Dene; Labiatae—*Nepeta cataria* L.; Leguminaceae—*Glycine max* (L.) Merr., *Medicago sativa* L., *Mimosa pudica* L., *Phaseolus vulgaris* L., *Pisum sativum* L., *Trifolium pratense* L., and *Vigna sinensis* (Torner) Savi; Liliaceae—*Asparagus officinalis* L.; Linaceae—*Linum grandiflorum* Desp.; Malvaceae—*Althea rosea* (L.) Cau, *Hibiscus diversifolius* L., *H. esculentus* L., *H. syriacus* L., *H. trionum* L., and *Malva neglecta* Wallr.; Plantagenaceae—*Plantago lonceolata* L., and *P. virginica* L.; Portulacacae—*Portulaca grandiflora* Hook; Solanaceae—*Atropa belladonna* L., *Capsicum annuum* L., *C. chameleon*, *Datura meteloides* DC, *Lycopersicon hirsutum*, *L. peruvianum* (L.) Mill. (some), *L. peruvianum* var. *dentatum* Dun., *Nicandra physalodes* Gaertn., *Nicotiana debneyi* Domin., *N. glauca* Graham, *Petunia multiflora* Hort., *Physalis philadelphica*, *Solanum melongena* L., and *S. nigrum* L.; Umbelliferae—*Coriandrum sativum* L., *Daucus carota* L., *Petroselinum crispum* (Mill.) NYM, and *Pimpinella anisum* L.

In the second host range evaluation, the 66 TYTV isolates and the three PLRV isolates were inoculated on a selected luteovirus host range which included: *B. vulgaris*, *C. bursa-pastoris*, *D. tatula*, *G. globosa*, *L. esculentum*, *P. floridana*, and *S. tuberosum* 'Russet Burbank.' All isolates infected and produced clearly defined symptoms on *P. floridana* and *D. tatula*. All except TYTV isolate 75, and PLRV isolates 2 and 4 infected *G. globosa* without symptoms. All except TYTV isolate 51 infected cultivar Russet Burbank of *S. tuberosum*, and several isolates infected this species without producing symptoms. One TYTV isolate from Washington and the TYTV isolate from Florida infected *L. sativa*. None of the isolates infected *B. vulgaris*.

None of the 66 TYTV and three PLRV isolates infected *C. bursa-pastoris*. Infection of *C. bursa-pastoris* is regarded as a crucial distinction between PLRV and beet western yellows virus (BWYV) (6). Further intensive attempts were made to infect this species with selected isolates of TYTV and PLRV. The five 1980 TYTV isolates initially used in host range studies (Table 1), fourteen new TYTV isolates, and three PLRV isolates were tested. Two seedlings of *C. bursa-pastoris* were inoculated with each virus isolate in each of four tests.

Only one isolate infected *C. bursa-pastoris* in the initial test employing standard inoculation and indexing methods. In three additional tests, seedlings of *C. bursa-pastoris* were inoculated twice (15 aphids per seedling at 7 days after transplanting and 50 aphids per plant 7 days later). Eight, four, and seven isolates, respectively, infected *C. bursa-pastoris* in these three tests. Isolates that infected were PLRV 1, 4 TYTV 79, 81, 84, 86, 87, 102, 104, 105, and 106. None of these isolates infected this species routinely, and 12 of 23 isolates (PLRV 2, TYTV 1, 17, 19, 25, 72, 82, 85, 90, 103, 87A, and 102A) tested extensively never infected *C. bursa-pastoris* in four or more trials. None of the TYTV-infected or the one PLRV-infected plant of *C. bursa-pastoris* expressed symptoms. Back inoculation to tomato from the *P. floridana*, which was used to index *C. bursa-pastoris*, produced the typical TYTV symptoms of the original isolate.

Symptomatology. Symptoms on VF145 tomato plants in the greenhouse and in growth chambers varied widely with the different virus isolates but generally were not as severe as those observed in the field. Growth after infection typically had a strong yellow color, but it varied in intensity with different isolates. The purple cast, severe marginal restriction, and upward cupping of leaflets that were observed in the field sometimes did not occur in the greenhouse. Some isolates caused proliferation of axillary buds, while others did not. Plants were stunted and blossoms turned yellow and abscised.

Symptoms of TYTV on host species were similar to those of PLRV except on potatoes and tomatoes. While TYTV caused strong symptoms on tomato and mild or no symptoms on potato, PLRV caused mild symptoms on tomato and strong symptoms on potato.

TABLE 2. Time required for nonviruliferous *Myzus persicae* to acquire tomato yellow top virus from infected leaf tissue[a]

Acquisition access period (hr)	Virus source plant: *Datura tatula* Indices (no.)	*Datura tatula* Transmission (%)	*Lycopersicon esculentum* Indices (no.)	*Lycopersicon esculentum* Transmission (%)
0.3	3	0	···	···
0.5	18	0	···	···
1.0	3	0	18	0
1.0	18	0	···	···
1.5	18	0	···	···
2.0	18	0	18	0
2.5	18	11	···	···
3.0	18	33	18	0
4.5	···	···	18	22
6.0	3	66	9	44
8.0	···	···	9	33
10.0	···	···	6	83
12.0	3	66	6	66
24.0	3	100	6	100
Control	3	0	3	0

[a] Nonviruliferous *M. persicae* were fed on detached virus source leaves (species are specified) placed on moist filter paper in petri dishes for the specified acquisition access periods, caged (15–20 per plant) on index plants (seedlings of *Physalis floridana*) for 72 hr, then killed with nicotine sulfate fumes.

TABLE 3. Feeding time required for viruliferous *Myzus persicae* to transmit tomato yellow top virus[a]

Transmission access period (hr)	Source plant/index plant combinations: From *Datura tatula* to *Physalis floridana* Indices (no.)	From *Datura tatula* to *Physalis floridana* Transmission (%)	From *Lycopersicon esculentum* to *L. esculentum* Indices (no.)	From *Lycopersicon esculentum* to *L. esculentum* Transmission (%)
0.3	3	0	9	0
0.5	18	0	9	0
1.0	3	0	9	0
1.0	18	0	9	0
1.5	18	0	9	0
2.0	18	11	9	0
2.5	18	22	9	0
3.0	3	66	9	11
4.5	···	···	6	33
6.0	3	100	6	33
8.0	···	···	6	66
10.0	···	···	6	50
12.0	3	100	6	83
24.0	3	100	6	66
Control	3	0	3	0

[a] Nonviruliferous *M. persicae* were fed on detached virus source leaves (species as specified) placed on moist filter paper in petri dishes for 48 hr to acquire virus, caged (15–20 per plant) on the index plants (species are specified) for various transmission access periods as specified, then killed with nicotine sulfate fumes.

TABLE 4. Transmission latent period of tomato yellow top virus in *Myzus persicae*[a]

Acquisition access period (hr)	Transmission access period (hr)									Latent period[b]
	1	2	4	8	16	24	48	72	96	
1	0/3[c]	0/3	0/3	0/3	0/3	0/3	0/3	0/3	0/3	
2	0/3	0/2	0/3	0/3	0/3	0/3	0/3	0/3	0/3	
4	0/3	0/3	0/3	0/3	0/3	1/3	1/3	0/3	2/3	20–28
8	0/3	0/3	0/3	0/3	1/3	2/3	2/3	3/3	3/3	16–24
16	0/3	0/3	0/3	1/3	2/3	3/3	3/3	3/3	3/3	20–24
24	0/3	1/3	1/3	3/3	2/3	3/3	2/3	3/3	3/3	26

[a] Nonviruliferous *M. persicae* were given the specified acquisition access periods on virus-infected, detached leaves of *Datura tatula* placed on moist filter paper in petri dishes, caged (15–20 per plant) on index plants for the specified transmission access periods, then killed with nicotine sulfate fumes.
[b] The minimum period of time required between beginning of acquisition feeding by *M. persicae* and first transmission of virus.
[c] Ratios represent: (number of index plants infected)/(number inoculated).

D. tatula and *P. floridana* were valuable hosts for distinguishing between isolates of TYTV in the greenhouse since all isolates infected and produced clear symptoms in both species; passage through these hosts did not change the symptoms on tomato, and symptom expression varied. No isolates produced extremely severe symptoms on *D. tatula*, but stunting and, particularly, degree of development of bright yellow chlorosis varied widely. On *P. floridana*, isolates varied in degree of stunting, chlorosis, leaf size reduction, and etiolation. Symptoms produced by 37 isolates collected in 1980 compared on *P. floridana* were grouped into six distinct categories ranging from severe to mild stunting, leaf size reduction, chlorosis, and epinasty. Isolates 82 and 102, found later, were always lethal on *P. floridana*. There was no correlation between severity of symptoms produced by isolates on *D. tatula*, *P. floridana*, and tomato cultivar VF145 in the greenhouse.

DISCUSSION

A tomato disease that first appeared in the Yakima Valley of Washington in 1973 (14) shows characteristic yellows symptoms of a disease called tomato yellow top in other areas of the world (1–4,8,11,14), and is caused by a virus which is transmitted by *M. persicae* in a circulative manner. Symptomatology and transmission characteristics of the virus suggest it is a luteovirus. Host range and serological relationships (to be reported separately) indicate the virus is related to, but distinct from PLRV and BWYV. Its major distinction from these viruses is that it produces a severe, distinct disease of tomato, while PLRV causes a mild disease of tomato, and typical BWYV isolates do not infect tomato (J. E. Duffus, *personal communication*).

Minimum acquisition and transmission access periods for TYTV (2.5 and 2 hr, respectively) were within the range of those reported (9,10) for PLRV (2 and 0.5 hr, respectively) but were substantially different from those of BWYV (5 and 10 min, respectively). The incubation period for TYTV was 24 hr, compared with 12 hr for PLRV, and 24 hr for BWYV. The acquisition and transmission access periods, the incubation period and the efficiency of transmission of TYTV are somewhat dependent upon the source of virus, the index host, and the length of the acquisition access period. These variations probably reflect variations in virus concentration within the vector, which in turn, reflect differences in vector preferences and in virus concentration in hosts used to determine these characteristics.

TYTV, PLRV, and BWYV all infect *P. floridana*. TYTV has few other hosts in common with BWYV. None of 66 isolates infected *B. vulgaris*, and only one from Prosser and the isolate from Florida infected *L. sativa*. Eleven of 66 isolates infected *C. bursa-pastoris*. Tomato is not infected by isolates of BWYV originating from plants other than potato, and *D. tatula* (a major host of TYTV) is not infected by any isolates of BWYV (5). The host range of TYTV appears to be more restricted than that of PLRV, since five isolates of TYTV all failed to infect a number of hosts of PLRV, including *P. philadelphica*, *N. physalodes*, *C. annuum*, *S. nigrum*, and *S. melongena*.

It was impossible to describe a well-defined host range for TYTV because of wide variation in host range among isolates of the virus. In this regard, TYTV again resembles PLRV and BWYV, both of which are composed of complexes of rather widely divergent variants. Most of the variation in host range of TYTV isolates occurred among marginal hosts that were difficult to infect, did not develop symptoms when infected, and contained very low concentrations as indicated by aphid recovery of virus and ELISA tests. The considerable variation in symptomatology observed when isolates were returned from marginal hosts to diagnostic hosts, suggests selection of variants by the marginal hosts.

Infection of *C. bursa-pastoris* was used as a major criterion by Duffus (6) to classify luteovirus isolates from PLR-diseased potatoes as BWYV. By the same criterion, the eight TYTV isolates and one PLRV isolate of these studies that infected *C. bursa-pastoris* could be classified as BWYV. However, these isolates did not consistently infect *C. bursa-pastoris*. Thus, we believe the eight isolates of TYTV that infected *C. bursa-pastoris* should not be considered more unusual than other host range variants identified among the 66 TYTV isolates.

LITERATURE CITED

1. Braithwaite, B. M., and Blake, C. D. 1961. Tomato yellow top virus its distribution, characteristics and transmission by the aphid *Macrosiphum euphorbiae*. Aust. J. Agric. Res. 12:1100-1107.
2. Braithwaite, B. M., and Blake, C. D. 1961. Tomato yellow top virus. Agr. Gaz., N. S. W. 72:627-629, 660.
3. Costa, A. S. 1949. Duas novas molestias de virus do tomato em São Paulo. Biologica 15:79-81.
4. Costa, A. S., and Carvalho, A. M. B. 1961. Estudos sobre o topo amarelo do tomateiro. Biologica 28:71-83.
5. Duffus, J. E. 1964. Host relation of beet western yellows virus strains. Phytopathology 54:736-738.
6. Duffus, J. E. 1981. Beet western yellows virus—A major component of some potato leafroll affected plants. Phytopathology 71:193-196.
7. Hassan, S., and Thomas, P. E. 1981. Host range, transmission properties, and relationship of tomato yellow top virus. (Abstr.) Phytopathology 71:1004.
8. Lana, A. F., and Wilson, G. F. 1976. A similar virus disease in Nigeria. Plant Dis. Rep. 60:296-298.
9. MacCarthy, H. R. 1954. Aphid transmission of potato leaf roll virus. Phytopathology 44:167-175.
10. Mackinnon, J. P. 1965. A mild chlorosis virus of *Physalis floridana* found in turnip latent virus complex. Can. J. Bot. 43:509-517.
11. Sutton, W. S. 1955. Yellow top disease of tomato. Agric. Gaz., N.S.W. 66:655-658.
12. Thomas, J. E. 1981. Tomato yellow top—A probable luteovirus from Australia. Aust. J. Pathol. 10:33-34.
13. Thomas, P. E., and Martin, M. W. 1974. A new destructive, viruslike disease of tomato in eastern Washington. Plant Dis. Rep. 58:965-968.
14. Webb, R. E., and Buck, R. W., Jr. 1955. A diagnostic host for potato virus A. Am. Potato J. 32:248-253.
15. Webb, R. E., and Wilson, D. R. 1978. *Solanum dimissum* P. I. 230579, a true seed diagnostic host for potato virus Y. Am. Potato J. 55:15-23.
16. Zitter, T. E., and Tsai, J. H. 1981. Viruses infecting tomato in southern Florida. Plant Dis. 65:786-791.