Table 5. Control of insects on 'Florida Market' eggplant at AREC-Bradenton, spring 1980.[z]

Insecticide and formulation	Lb. AI/ 100 gal.	No. green peach aphids/5 leaves (Nov. 5)	No. leafmines/ 5 leaves (Nov. 5)	No. fruit damaged by lepidopterous larvae[y]
Permethrin 2EC	0.8	0.0 a[x]	0.5 a	0.0 a
Permethrin 2EC	0.2	9.2 a	1.2 a	0.0 a
Permethrin 2EC	0.1	34.5 ab	7.2 b	0.0 a
Methomyl 1.8L	0.9			
+ ethion 4EC	0.225	26.5 ab	11.5 b	0.6 b
Check (water)	—	97.2 b	10.7 b	1.7 c

[z]Plots were transplanted Sept. 8 and sprayed Sept. 16, 22, 29, Oct. 6, 13, 20, 27, Nov. 3, 10, 19, 14, and Dec. 1.
[y]Data are totals/10 plants harvested Nov. 7, 14, 21, and Dec. 1.
[x]Means within columns followed by the same letter are not significantly different at the P = 0.05 level, Duncan's multiple range test.

cabbage looper larvae. Permethrin was phytotoxic, particularly at the 0.8 lb AI rate, reducing plant height. Foliar symptoms included leaf distortion and mottling similar to a yellows-type virus infection.

Pesticides were identified which gave control of arthropods equal to or better than chemical standards, i.e. lindane on cucurbits and either azinphosmethyl and dicofol or methomyl and ethion on eggplant. Methomyl and acephate gave consistent control of melonworm larvae on cucurbits. These compounds plus methamidophos also consistently controlled pickleform larvae on cucumber. *B. thuringiensis* generally gave significant but intermediate control of melonworm larvae.

The insecticides methamidophos, oxamyl, acephate and fenvalerate gave as good control of both the Glover's and twospotted spider mites on eggplant as the miticides cyhexatin and hexakis (Vendex®). The chemical standards azinphosmethyl and dicofol controlled the Glover's mite but not the twospotted spider mite, indicating the need for proper identification before attempting chemical control. Methamidophos and permethrin controlled the green peach aphid, vegetable leafminer and cabbage looper. Oxamyl controlled the aphid and leafminer but not the looper, while acephate and fenvalerate controlled the aphid and looper but not the leafminer. Results indicate that there are compounds that may be used for arthropod control on eggplant when different combinations of pests are present.

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A VIRUS AS THE CAUSAL AGENT OF SPRING YELLOWS OF LETTUCE AND ESCAROLE[1]

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Abstract. **A virus was isolated from lettuce and escarole plants showing typical symptoms of spring yellows. The virus, called the spring yellows virus (SYV), was demonstrated to be the causal agent of spring yellows by aphid transmission studies done in the laboratory. Shepherd's purse,** Capsella bursa-pastoris, **was the best assay host for detecting SYV, and SYV was found occurring naturally in other south Florida vegetables (broccoli, kohlrabi, cauliflower, turnip, and mustard). The green peach aphid,** Myzus persicae, **was an efficient vector for SYV, while** Hyadaphis pseudobrassicae **and** Aphis coreopsidis **were not vectors in these experiments. Transmission properties of SYV by** M. persicae **were typical for persistent-circulative aphid transmitted viruses. SYV reacted positively in double antibody sandwich ELISA tests with antiserum to the RYIR isolate of beet western yellows virus, which is the causal agent of "June Yellows" of lettuce in California.**

The spring yellows disorder of lettuce and escarole has occurred annually in south Florida for approximately 15 years. Substantial economic losses can be attributed to spring yellows each year. This disorder is characterized by the progressive overall yellowing that occurs in escarole and lettuce plants during the growing season; however, it is most common in spring crops, hence the name spring yellows. Individual affected plants show a progressive interveinal chlorosis and thickening of leaves that begins on the older leaves (Fig. 1A). In sensitive varieties, entire plants may become yellow and thereby give a whitish-yellow cast to entire fields. Considerable work as to the cause of this disorder had met with no success (V. L. Guzman, unpublished). As a result, the selection for varieties tolerant to this disorder has been somewhat slow.

Because of the similarities in symptomatology of spring yellows to the virus induced yellowing diseases of lettuce found in other areas of the world, e.g., June yellows in California (3), and premature yellowing in the Netherlands (1), it was postulated that a similar virus might be the causal agent of the spring yellows disorder in south Florida. This report summarizes efforts to determine if a virus is the causal agent of spring yellows.

Materials and Methods

During the 1980-81 growing season, field collected lettuce (*Lactuca sativa* L.) and escarole (*Cichorium endivia* L.) plants showing typical symptoms were used as aphid acquisition source plants for virus transmission studies in the laboratory.

Colonies of non-viruliferous green peach aphids (*Myzus persicae* Sulzer) and turnip aphids (*Hyadaphis pseudobrassicae* Davis) were reared on radish (*Raphanus sativa* L., cv. White Icicle), and *Aphis coreopsidis* Thomas, was reared

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on *Bidens pilosa* L., at 21 C and constant light in a growth room. Aphids were allowed a 24 hr acquisition access period (unless otherwise stated) to detached source leaves in petri dishes. Groups of aphids were then caged on individual indicator test plants for a 48 hr (unless otherwise stated) inoculation access period. To terminate inoculation access periods, plants were sprayed 3 times with nicotine sulfate, followed by once with Metasystox R®. Plants were then kept in an insect free greenhouse that was fumigated weekly with Vapona®, and observed for two to three months.

Virus-Vector Relationships

Virus-vector relationships for *M. persicae* and spring yellows virus (SYV) were investigated. The acquisition threshold was estimated by allowing aphids acquisition access to SYV infected shepherd's purse for various acquisition periods and then transferring 5 aphids per plant to individual shepherd's purse seedlings for a 72 hr inoculation access period. Similarly, the inoculation threshold was estimated by allowing aphids a 48 hr acquisition access period to SYV infected shepherd's purse and then 5 aphids per plant were transferred for various inoculation periods to individual shepherd's purse seedings.

The length of time (days) that individual *M. persicae* retained the ability to transmit SYV (retention) was examined by allowing *M. persicae* acquisition access to spring yellows infected shepherd's purse and transferring individual aphids, daily, to individual shepherd's purse seedlings for 7 days.

Enzyme-linked immunosorbent assay. Enzyme-linked immunosorbent assay (ELISA) tests were done to determine if the spring yellows virus was related to beet western yellows virus (BWYV). Antiserum to the DYIR isolate of BWYV was supplied by J. E. Duffus. Double antibody sandwich ELISA tests were done essentially as described by Clark and Adams (2). Polystyrene microtiter plates were coated (5 μg/ml for 2 hrs at 25 C) with immunoglobulins (IgG) purified from BWYV antiserum. Plates were washed with PBS-Tween (2) and test samples, prepared in PBS-Tween containing 2% PVP-40, were incubated in plates overnight at 5 C. The plates were then washed, and alkaline phosphate conjugated IgG (1/500 dilution) was added and the plates were incubated for 2 hrs at 25 C. Plates were washed and p-nitrophenyl phosphate (0.6 mg/ml) in diethanolamine buffer was added. Plates were observed for 2 hrs at ambient temperature. Results were assessed by determining absorbances of samples at 405 nm with a spectrophotometer.

Results and Discussion

In the first experiments when attempts were made to transmit a virus from spring yellows lettuce plants, no symptoms developed on escarole or lettuce test plants kept in the greenhouse. Various other species were then tested as possible indicator plants to determine if any might be more sensitive indicator species than escarole or lettuce for any possible virus involved in spring yellows. Species tested were: *Bidens pilosa* L., *Sonchus oleraceus* L., *Brassica caulorapa* Pasq. (kohlrabi), *B. campestris* L. (field mustard), *B. napobrassica* Mill. (rutabaga), *B. rapa* L. (turnip), *Raphanus sativa* L., White Icicle (radish), *Lepidium virginicum* L., *Capsella bursa-pastoris* Medic, *Solanum nigrum* L., *Physalis floridana* Rydb., *Datura metel* L., *Nicotiana clevelandii* Gray, *N. debneyi* Domin, *N. tabacum* L., Xanthi n.c., *N.* x *edwardsonii* Christie and Hall, and *Saponaria vaccaria* L. Symptoms failed to develop on any of the test species by aphid transmission tests from spring yellows lettuce and escarole plants except for *Capsella bursa-pastoris,* shepherd's purse, and *N. clevelandii.* Consistent symptoms of yellowing, curling and hardening of the leaves (Fig. 1B) were produced on shepherd's purse. *N. clevelandii* developed similar symptoms, but shepherd's purse was preferable because symptoms developed generally within 3 weeks, whereas in *N. clevelandii,* symptoms sometimes took 2 months to develop. *M. persicae* also readily fed on shepherd's purse for inoculation and acquisition access periods, whereas mortality was often very high on *N. clevelandii.* Check aphids, those not given access to spring yellow plants, never induced any of the above mentioned symptoms on shepherd's purse or *N. clevelandii.* Therefore, in subsequent experiments, shepherd's purse was used to maintain the virus recovered from spring yellows lettuce and escarole plants.

To determine if this virus was involved in the spring yellows disorder, aphid transmission experiments were done using *M. persicae* with greenhouse infected shepherd's purse as the virus source, and escarole (*C. endivia*) cv. Full Heart and lettuce (*L. sativa*) cvs. Gallega, Great Lakes 659, and Cos type Fl. 39067 as the test plants. Symptoms of spring yellows were produced in escarole, and the two lettuce types, Gallega and Fl. 39067 after an incubation period of ca. 2 months. More prominent symptoms developed when test plants were kept under conditions of high light intensity (unshaded greenhouse) and warm temperatures (ca. 28 C). Overall yellowing of the entire plant, which is sometimes observed in field lettuce plants, was not produced under greenhouse conditions, but interveinal chlorosis and thickening of the older leaves were typical. This virus was therefore concluded to be the causal agent of the spring yellows disease and is referred to as the spring yellows virus (SYV).

Other plant species were also tested as potential field hosts of SYV. Samples of crop and weed species growing near lettuce and escarole fields were collected and brought to the laboratory for aphid transmission studies. Transmission experiments were done as before, using shepherd's purse as the indicator host. Typical symptoms of SYV infection developed on shepherd's purse when field samples of *Brassica oleracea* L. (broccoli and cauliflower), *B. caulorapa* (kohlrabi), *B. campestris* (mustard), and *B. rapa* (turnip) (all of which exhibited some yellowing of older leaves in the field) were used as source plants. Samples of *B. oleracea* (cabbage), *Raphanus sativa* (radish), the weed species, *Solanum nigrum* (black nightshade), and *Lepidium virginicum* (virginia pepperweed) were negative for SYV.

Results of testing two other aphid species common to south Florida as vectors of SYV showed that neither *Hydaphis pseudobrassicae,* the turnip aphid, nor *Aphis coreopsidis* transmitted SYV (0/10 and 0/10) when groups of aphids were used and shepherd's purse was the acquisition and indicator species. *M. persicae* transmitted to 36 of 45 plants in the same experiment.

Virus vector relationship experiments suggested that SYV has a persistent-circulative relationship with *M. persicae.* Although thresholds are not clearly demonstrated for acquisition or inoculation (Table 1), the increase in transmission percentage observed with longer inoculation access periods is indicative of an aphid transmitted persistent-circulative virus. Similarly, retention studies showed that while individual *M. persicae* were somewhat inefficient, some still transmitted SYV on the 7th day of the test period (Table 2). These results are again indicative of a persistent-circulative relationship for SYV and *M. persicae.*

Because SYV is a persistent-circulative virus, its relationship to BWYV, the aphid transmitted virus that causes June yellows, was further examined. Double-antibody sandwich ELISA experiments revealed that SYV is related to beet western yellows virus (BWYV) (Table 3). No isolates of BWYV were available for further comparisons, therefore,

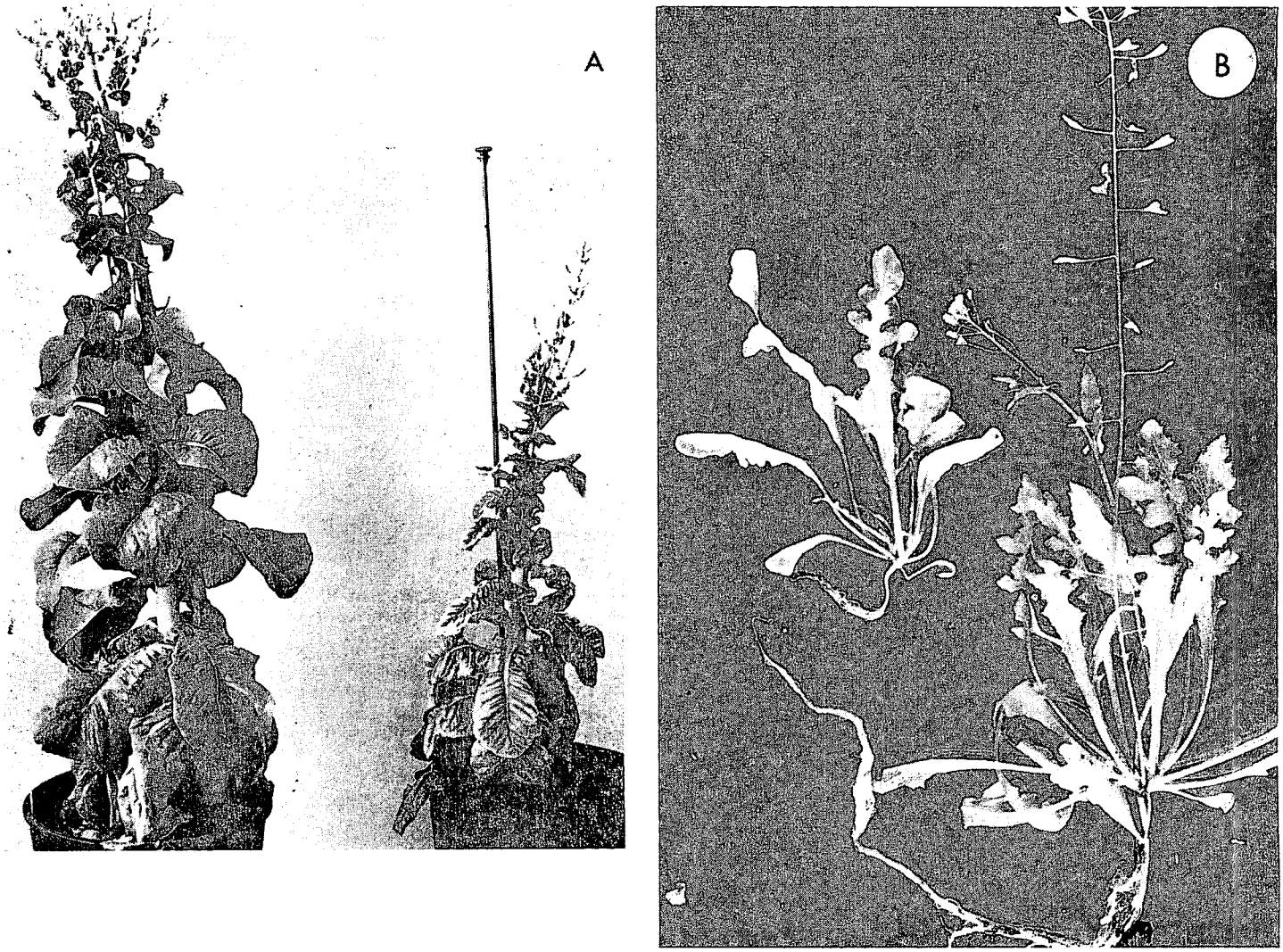

Fig. 1. A) Healthy (left) and spring yellows virus infected (right) lettuce plants. Note interveinal chlorosis on spring yellows infected plant. B) *Capsella bursa-pastoris* showing stunting, yellowing and leaf rolling typical of spring yellows virus infection. Healthy plant is on right.

Table 1. Transmission of spring yellows virus by *Myzus persicae* to *Capsella bursa-pastoris*.

Transmission aspect	Duration of access period (hr)					
	0	2	4	8	24	48
Acquisition[z]	0[x]	10	7	10	11	—
Inoculation[y]	0	3	9	9	13	14

[z]Aphids were allowed acquisition access to detached spring yellows virus infected *Capsella bursa-pastoris* leaves in petri dishes for the times given. Aphids were then transferred in groups of five to individual *C. bursa-pastoris* seedlings and caged for 72 hrs.
[y]Aphids were allowed acquisition access for 48 hrs to detached spring yellows virus infected *Capsella bursa-pastoris* leaves in petri dishes. Aphids were then transferred in groups of five to individual *C. bursa-pastoris* seedlings and allowed inoculation access periods for the times given.
[x]The number of *Capsella bursa-pastoris* plants infected of 15 inoculated.

Table 3. Reactions of spring yellows virus infected and healthy *Capsella bursa-pastoris* to beet western yellows virus antiserum by ELISA.

Test sample[z]	Dilution		
	1/50	1/500	1/5000
Spring yellows	0.9[y]	0.32	0.1
Healthy	0.11	0.08	0.08

[z]Numbers represent dilutions of sap from spring yellows virus infected and healthy *Capsella bursa-pastoris*.
[y]Numbers represent average absorbance values at 405 nm from two replicates per sample.

the degree of relationship between SYV and BWYV was not further studied.

These data demonstrate that the causal agent of spring yellows, SYV, is a virus related to BWYV, which is a very widespread and economically important plant virus throughout the world. Isolates of BWYV cause lettuce diseases similar to spring yellows in California, Arizona, England and the Netherlands (1, 3, 4). Also, a recently reported disease of tomatoes (tomato yellows) that occurs near Naples and Immokalee, Florida, appears to be caused by a similar virus also transmitted by *M. persicae* (5, 6).

Epidemiologically, the persistent-circulative aphid transmitted viruses in the BWYV group are difficult to control for three reasons: 1) they generally have wide host ranges including many weed and crop species; 2) the aphid vectors retain the ability to transmit these viruses essentially for life and thus long distance spread is easily achieved; 3) inculation thresholds are such that insecticides do not control the spread of these viruses into the susceptible crop from outside sources of primary inoculum, but do generally prevent secondary spread within the crop. These properties, and the fact that many hosts other than lettuce and escarole (e.g. broccoli), are often grown concurrently and in adjacent

Table 2. Retention of spring yellows virus by individual *Myzus persicae*.[z]

Aphid	Transmission record (Days)[y]						
	1	2	3	4	5	6	7
1	−	−	+	+	D		
2	−	−	−	+	−	−	D
3	−	−	−	+	D		
4	−	−	−	+	−	−	+
5	+	−	−	−	−	−	−
6	−	−	+	−	−	−	D
7	−	−	−	−	−	−	−
8	−	+	+	−	−	−	−
9	−	+	+	+	−	−	−
10	−	D					
11	−	−	−	−	−	−	−
12	−	−	+	−	−	−	D
13	−	−	−	−	−	−	−
14	−	−	−	−	−	−	−

[z]Aphids were allowed a 24 hr acquisition access to detached spring yellows virus infected leaves with petri dishes. Individual aphids were transferred daily to single *Capsella bursa-pastoris*.
[y]Symbols: plus (+) indicates infection and minus (−) no infection; D is death of aphid.

fields in south Florida, suggest that perhaps the best way to control spring yellows may be to search for sources of resistance to SYV in lettuce and escarole.

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BOTRYTIS LEAF BLIGHT OF BULB ONION IN SOUTHEAST FLORIDA[1]

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Additional index words: *Botrytis squamosa* W., *Allium cepa* L, fungicides.

Abstract. **The occurrence, impact and control of Botrytis leaf blight (onion blast) incited by** Botrytis squamosa **Walker was discussed. The disease is endemic in onions in southeast Florida. Yield reduction of Texas Early Grano 502 and Granex 33 was measured in a planting severely affected by Botrytis leaf blight in the spring of 1978 at the Agricultural Research Center, Fort Pierce, Fla. Results from fungicide trials indicated the disease can be managed under southeast Florida conditions with mancozeb which is used successfully in other areas of the U. S. where Botrytis leaf blight is a problem. Work with other fungicides is also discussed.**

Bulb onions (*Allium cepa* L.) have been grown sporadically over the years in southeast Florida (5). There has been an upsurge of interest in growing onions in the last 4-5 years. Several leaf diseases of onion have been reported in Florida (12), however, Botrytis leaf blight, or onion blast, incited by Botrytis squamosa Walker has been the primary foliage disease problem observed on the few onion farms in southeast Florida. Several species of *Botrytis*, including *B. squamosa* have been reported as incitants of Botrytis leaf blight (4). Other leaf diseases observed on onions in southeast Florida by the authors over the past several years include those incited by *Alternaria porri* and *Stemphyllium* spp.

A leaf spot incited by *Botrytis cinerea* Pers. was reported as a disease of onion in the 1923 Annual Report of the Florida Agricultural Experiment Station (2). The disease was found in a half acre of onions near Gainesville, Fla. It reportedly killed the foliage in a short period of time. However, it was not until 1954 (6), that onion leaf blight or leaf spot, was re-identified as a *Botrytis* spp. incited problem outside of Florida. Until that time the cause of onion leaf blighting or onion blast, an endemic problem in the northeast U.S., was reported to be unknown and was listed as a non-parasitic disease by Walker (10). In Florida, the only subsequent reference found to onion blast was by E. A. Wolf reporting in the 1956 Annual Report of the Florida Agricultural Experiment Station where he stated (11): "purple blotch and a disease resembling blast . . . caused heavy reductions in yield from the November plantings."

B. squamosa is listed as an incitant of neck rot of onions in the Index of Plant Diseases in Florida (12), however, no reference to a source of this information was listed. The various species of Botrytis that cause leaf blight can incite

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