

## Viruses That Have Occurred Naturally in Agronomic and Vegetable Crops in Florida <sup>1</sup>

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Viral diseases of plants occur commonly in Florida. Some viral diseases have impacted on crop production by reducing yield or quality while other viral diseases in Florida have not had notable effects in this regard. However, potential exists for future epidemics caused by those quiescent or "silent" viruses. The purpose of this publication is to present information about viruses that have occurred **naturally** in Florida in agronomic and vegetable crops. It is possible that viral diseases not presented herein have occurred in Florida. Virus listings (see Table 1 ) within this publication are based upon published reports, or communications with other scientists, and on our unpublished data.

No attempt is made herein to list complete host ranges of the viral diseases found in Florida. Host range studies done by artificial inoculation in the greenhouse have been numerous and useful but such tests are not necessarily representative of natural infections or epidemics. For example, tobacco mosaic virus is infective in hundreds of plant species but this virus has been of consequence in only a few crop species in Florida. Also, watermelon mosaic virus 2 has an extensive host range, but none of the

noncucurbitaceous experimental host species have been related to the epidemics in squash or watermelons grown in Florida. On the other hand, epidemics of papaya ringspot virus Type W (formerly named watermelon mosaic virus 1) have been traced to nearby cucurbitaceous weeds such as balsam apple and creeping cucumber.

The ultimate purpose of attaining a diagnosis, it seems to us, is to provide a foundation for selection of possible control tactics. For example, lettuce mosaic virus is controlled by not planting seed lots that have been identified to contain lettuce mosaic virus. However, even with an accurate diagnosis of some viral diseases, control is not possible because the diagnosis is too late or control measures are not available. Again, let us compare the situation between papaya ringspot virus type W and watermelon mosaic virus 2. Papaya ringspot virus type W predominates in south to central Florida where creeping cucumber and balsam apple flourish as weeds. Eliminating these two weeds around the field with the cucurbit crop will aid significantly in controlling this viral disease. Watermelon mosaic virus 2, on the other hand, becomes destructive in

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some years and it can not be controlled because the primary source of the virus has not been identified. The reader should realize that although not all viral diseases are controllable at the present time, some viral diseases in Florida have been controlled or eliminated from an area with resistant varieties, seed indexing, vector control, sanitation practices or other cultural manipulations.

### **Basic Information about Some Viruses Found in Florida**

**Controls are not available for some viruses but for other viruses effective controls are available. Control begins with the proper identification of the virus. Specific control tactics begin prior to planting or transplanting for most viruses. Once a plant is infected, rescue or therapeutic treatments are not available except for roguing. Use controls specific for the viruses listed below if controls are available.**

**ALFALFA MOSAIC VIRUS (AMV) :** This virus is probably present in most if not all alfalfa plantings. Symptoms are usually not evident. Studies vary as to the amount of damage this virus causes in alfalfa. AMV infects plants in over 50 plant families. It is primarily transmitted via seed and aphids but it can be spread via plant sap. Practical controls for this virus are not available.

**BARLEY YELLOW DWARF VIRUS (BYDV) :** Prior to 1990, BYDV occurred occasionally in wheat and oats in Florida. Epidemics occurred in the panhandle in 1949, 1956, and 1959. Beginning in 1991, BYDV has occurred in wheat and oats for five consecutive years. In 1994 a severe epidemic occurred. Many grass species are susceptible to BYDV. Spread of BYDV is by aphids. It has not been transmitted via seed or mechanically with plant sap. The use of resistant varieties is the best control. Later planting in the fall and insecticidal sprays aid in reducing this disease.

**BEAN COMMON MOSAIC VIRUS (BCMV) :** This virus has been detected in breeding pedigrees of bean in Florida but not in commercial plantings, at least in the past 20-25 years or so. BCMV is transmitted primarily by seed and aphids. Transmission via plant sap can also occur. The host

range for BCMV is primarily in legumes and different studies vary as to the susceptibility of various legume species. Like many viruses, strains of BCMV exist and varieties differ in regard to susceptibility and symptom expression. The only known occurrences of BCMV in Florida were in beans, soybeans and Siratro. An effective seed indexing program by seed producers and distributors has so far offset potential problems from this virus. BCMV was recently diagnosed in soybean in Santa Rosa county.

**BIDENS MOTTLE VIRUS (BiMoV) :** This virus is spread primarily by aphids but is sap transmissible. BiMoV has been found in lettuce, escarole, endive, and lupine in Florida. In addition, hairy beggarticks (*Bidens pilosa*) and Virginia pepperweed (*Lepidium virginicum*) are major source-weeds for BiMoV. Cressleaf groundsel (*Senecio glabellus*) has been found to carry BiMoV. BiMoV is widespread in Florida and has been found in plant species from five plant families. Control of BiMoV is by eliminating hairy beggarticks and Virginia pepperweed within or near production fields.

**BLACKEYE COWPEA MOSAIC VIRUS (BICMV) :** This virus occurs commonly in Florida when seed are planted that have not been indexed to be free of BICMV. Seed produced in Oklahoma, Wyoming, Texas and other areas in the western USA are more likely to be free of this virus compared to seed produced in the southeastern USA. This virus has caused total ruination of plantings of *Vigna* spp. in Florida. BICMV is transmitted primarily by seed and aphids but it is sap transmissible. Although BICMV can infect plants in seven plant families, it is primarily a problem in Florida in southern peas, cowpeas and other *Vigna* spp. The only control is to use seed that has been indexed free of BICMV.

**CELERY MOSAIC VIRUS (CeMV):** This virus was once called western celery mosaic virus. It is not seed-borne and is limited to plants in the celery family (Umbelliferae). Mockbishopweed (*Ptilimorium capillaceum*) and wild cherry (*Apium leptophyllum*) are possible sources of CeMV but celery is a more likely source. Aphids are considered the main vector for CeMV but leafminers have been shown to transmit CeMV. Celery plantings should be

isolated to the extent possible and growers should observe a celery-free planting period each and every year.

**CORKY RINGSPOT (TOBACCO RATTLE VIRUS, TRV) :** This disease occurs in the northeast potato growing area in Florida. It is the most important viral disease in potato in Florida. Other viruses occur from time to time in potato in Florida, but they have not been of significant consequence. In the field, TRV is transmitted by a dozen species of stubby root nematodes. Little is known about how these nematodes acquire the virus or how this disease becomes established in fields. Seed pieces have been shown to carry the virus but transmission of the virus from these seed pieces to nematodes has not been proven. This disease tends to recur in the same areas of a field from year to year. Spread within or between fields may occur via soil adhering to equipment but even this aspect of spread has not been proven. Spread within a field from an infested area may be slow or does not occur. Symptoms occur in the tubers but not the vines. In the field, the best diagnostic technique is to look for arcs or rings on the surface or within the tuber. For some varieties (e.g. Atlantic) the arcs or rings may be diffuse and not clear-cut. Other symptoms include specks on the tuber surface, tuber malformation, and tuber cracking. Because this virus has a wide host range, resistant varieties and the use of certain soil-applied nematicides (primarily Temik) are the primary controls. Multiple sprays of Vydate (insecticide-nematicide) have been somewhat effective. At this time the varieties Superior and Pungo are the most resistant. This viral disease has not been a problem in other crops in Florida.

**CUCUMBER MOSAIC VIRUS (CMV):** Prior to 1970, CMV was identified fairly often, particularly in south Florida. Since 1970, CMV became a problem of lesser importance until 1995 & 1996 when CMV became severe in tobacco and peppers (hot) in Alachua County. Interestingly, large patches of *Commelina* spp. were present in some fields in Alachua County. CMV had been associated with *Commelina* spp. previously. *Commelina* spp. includes day flower and wandering jew. Celery, cucumber, squash, cantaloupe, tomatoes, and sometimes pepper had been the crops primarily infected with CMV. Lilies previously grown in

Highlands County are susceptible to CMV. However, CMV has a wide host range including 40 or more plant families. In Florida, plants within 10 plant families have been identified with CMV. Apparently, infected propagation stock of gladiolus are brought into Florida commonly but secondary spread to other gladiolus or other crops in Florida appears to be low. CMV is reported to be worldwide in distribution. Strains of CMV have been reported to be seed-borne in some species, including cowpea. Within the field, CMV is transmitted by aphids primarily, but mechanical transmission with plant sap can occur. Symptoms are variable including mild mosaic to severe plant deformation and stunting. This virus has many strains including the "southern celery mosaic virus."

**DASHEEN MOSAIC VIRUS (DsMV):** This virus is recognized as a problem in the production of quality ornamental foliage plants in the Araceae family (*Caladium*, *Aglaonema*, *Dieffenbachia*, etc). However, malanga and taro are two aroid plants that are quickly increasing in acreage in southern Florida because of the growing Hispanic population. Both of these crops are susceptible and have been infected with DsMV in Florida. DsMV is transmitted primarily by aphids and clonal propagation but not by seed. It is also transmissible by plant sap. For taro and malanga no controls are available at this time. In the ornamental foliage plant industry, sanitation, insect control and tissue culture are used to control DsMV.

**LETTUCE MOSAIC VIRUS (LMV):** This virus caused severe losses to lettuce during the early 1970's. Since the establishment of the mandatory state seed indexing program for freedom from LMV, this viral disease has become a very sporadic problem in Florida. It has occurred in the Belle Glades area in 1995 and 1996. LMV is spread primarily by infected seed and aphids, but it can be transmitted mechanically from contaminated sap. Although LMV has been found in plant species from 10 plant families, weed sources have not maintained LMV to the level necessary to initiate epidemics. Lambsquarters (*Chenopodium album*) has been found to be naturally infected with LMV in Florida.

**MAIZE DWARF MOSAIC VIRUS (also see under SUGARCANE MOSAIC VIRUS):** Maize dwarf mosaic virus strain A is a distinct virus and infects Johnson grass. Maize dwarf mosaic virus strain B is a strain of sugarcane mosaic virus and does not infect Johnson grass. Like other strains of sugarcane mosaic virus, maize dwarf mosaic virus is spread by aphids. It has been found in Alachua, Dade and Levy Counties in corn. Johnson grass has been naturally infected in Alachua and Levy Counties. Control includes the use of resistant varieties, if available, and the elimination of Johnson grass in the vicinity of corn plantings.

**PAPAYA RINGSPOT VIRUS TYPE W (PRSV-W, WATERMELON MOSAIC VIRUS 1, WMV 1) :**

Although PRSV-W is sap transmissible, it is spread primarily by aphids from infected cucurbitaceous weeds and crops. However, leafminers also can transmit PRSV-W. This is not a seed borne virus. Control can be achieved by eliminating volunteer cucurbit crops and cucurbit weeds near the crop. Creeping cucumber and balsam apple are two major weed hosts for PRSV-W. When planting cucurbits, separate them from other plantings of cucurbits to the extent possible. Keep this point in mind when you are planning for successive plantings. This virus predominates in south and central Florida but is found in North Florida later in the primary watermelon season and during the summer and fall.

**PEANUT MOTTLE VIRUS (PeMoV):**

Although this virus can be detected in many peanut plantings in Florida, with or without symptoms, its effects on yield and quality of the crop is unknown. It has also been detected in soybeans with and without symptoms. Mosaic symptoms and black specks on *Cassia* spp. have been associated with PeMoV in Florida. Beans are another host. PeMoV is transmissible via peanut seed and aphids primarily but it is also sap transmissible. No control measures are being used.

**PEANUT STRIPE VIRUS (PStV):** This virus was detected in breeding pedigrees of peanuts in Florida in 1983. It has rarely been detected in commercial plantings up to this point in time in Florida. It is transmitted via seed and aphids

primarily but it is sap transmissible. It was introduced into the United States via peanut pedigrees that were introduced from Asia for use in breeding programs. The presence of this virus in the United States exemplifies how easily new, unnecessary problems become established into different geographical areas. It is conjecturable as to the amount, if any, of damage that was caused by this strain of PStV. Certainly, the mere presence of this virus in breeding stocks had caused considerable disagreement among researchers and disruption of various peanut research and Extension programs. For a few years efforts were made to release seed from the Florida Foundation Seed Producers Inc. that were free of this virus via a seed indexing program. However by the early 1990's, that program was discontinued.

**PEPPER MOTTLE VIRUS (PepMoV):** In Florida, this virus was first described from Palm Beach County in the early 1970's. It has also been found in Collier County. It has not been found in North Florida. At one time it was thought to be a strain of

potato virus Y. Along with Potato virus Y and tobacco etch virus, PepMoV caused significant damage to peppers grown in Palm Beach County. Pepper is the main host but tomato and *Datura meteloides* are also susceptible. The latter host is a reservoir for PepMoV in Arizona. Although PepMoV is sap transmissible, aphids are the main vectors for spread. PepMoV has not been detected in seed. The primary controls for PepMoV include the use of resistant varieties (e.g. DelRay Bell), the use of disease free transplants, and spraying with JMS Stylet Oil. In some situations, adjusting the planting date to avoid primary aphid flights has proven worthwhile but has sometimes interfered with critical market periods.

**POTATO VIRUS X (PVX):** It is often assumed that most seed piece stocks of potato and their resulting plants are infected with PVX. In Florida, the extent of contamination of seed pieces and plants is not known. Symptoms of PVX are not always expressed. Symptoms of PVX are most likely to be expressed during cooler temperatures or when the plant is also infected with other viruses. PVX plus PVY are reported to cause rugose mosaic symptoms.

Potato virus X is highly contagious via plant sap transmission and is transmitted via seed pieces. Grasshoppers and one soil fungus have transmitted PVX. Because PVX is easily sap transmitted, many methods of transmitting this virus can occur during tuber handling stages. Cutting knives are known to be one mechanical type of transmission. Potato is the principal host for PVX but tobacco and tomato are reported to be susceptible. Yield losses from this virus have been reported but in Florida such information is not known. Control is not always deemed necessary for this virus, but regardless, the grower should attempt to purchase seed stocks that are certified free of most if not all viruses.

**POTATO VIRUS Y (PVY):** This virus is spread primarily by aphids but mechanical transmission is possible. Several solanaceous weeds and crops are commonly infected in Florida. Peppers, tobacco and tomato are the crops most commonly infected in Florida. This is not a seed-borne virus but could be transmitted via clonal propagation in crops such as potatoes. Roguing weeds such as black nightshade, groundcherry, and jimsonweed and destroying old crop debris and volunteers in and near fields, greenhouses and plant beds will reduce sites that perpetuate this virus. Use disease free transplants. Spraying correctly with JMS Stylet Oil will reduce spread of PVY and certain other aphid transmitted viruses in peppers and tomatoes. Some pepper varieties have some resistance to certain strains. Adjusting planting dates to avoid major aphid flights has been somewhat worthwhile in some situations but has interfered with critical market periods.

**PSEUDO-CURLY TOP VIRUS** (See TOMATO PSEUDO-CURLY TOP VIRUS)

**SOIL-BORNE WHEAT MOSAIC VIRUS (SBWMV):** This has been the most important viral disease in wheat in Florida since it was first found in 1970 in Escambia County. Later it has been found in Okaloosa, Madison and Santa Rosa Counties. Although this virus can be spread by sap transmission from plant to plant, the most common mechanism of spread is by movement of soil that contains the fungal vector, *Polymyxa graminis*. Mosaic symptoms appear in leaves from three to four weeks after planting up through April in Florida. Triticale, rye and

barley are susceptible, but only wheat has been infected in commercial situations in Florida. The best control is the use of resistant varieties. Soil clinging to farm equipment should be removed prior to moving the equipment from infested to noninfested fields. In Escambia and Santa Rosa Counties, this viral disease is so widespread, the cleaning technique may no longer be useful for this virus. Later planting dates with adaptable varieties reduce symptom expression to some extent but yields will still be reduced by this disease. All factors that contribute to stress of the crop should be reduced to the extent possible when susceptible varieties are planted.

**SOYBEAN MOSAIC VIRUS (SbMV):** This virus occurs in soybeans in Florida but it is not a widespread problem. However, SbMV has caused significant plant and yield losses elsewhere. When plants are infected with SbMV and certain other viruses (eg peanut mottle), strong symptoms of rugosity, mosaic and stunting occur; this has been seen on occasion in Florida. SbMV is transmitted primarily by seed and aphids but it is sap transmissible. Although many legume species are susceptible to SbMV by artificial inoculations, soybeans are the only field-grown crop of concern at the present time. No controls are available for SbMV in Florida.

**SQUASH MOSAIC VIRUS (SMV):** This virus is uncommon in Florida. The occurrence of SMV in commercial cucurbits in Florida has been documented only in cantaloupe. It is common for growers to refer to any mosaic symptoms in squash to be "squash mosaic". Watermelon mosaic virus 2, Papaya ringspot virus type W, and Zucchini yellow mosaic virus are the most commonly occurring viruses in squash or other cucurbits in Florida. The distinction of these viruses is important because SMV is seedborne. Also, SMV is transmitted via certain beetles and grasshoppers whereas watermelon mosaic virus 2, Papaya ringspot virus type W and Zucchini yellow mosaic virus are transmitted primarily by aphids. SMV infects plants in the cucurbit (gourd) family. Control for SMV at this time is not warranted in Florida.

**SUGARCANE MOSAIC VIRUS (SCMV):** SCMV occurs in Florida in sugarcane but has not

caused significant damage. Varieties (clones) are inoculated with various strains of SCMV prior to release to determine what degree of resistance is available. It is a major part of varietal development so that SCMV does not become a severe problem in Florida as it has in other states. SCMV is spread primarily by aphids and infected seed pieces but it is sap transmissible. The host range of this virus is limited to certain grass crops including corn, St. Augustine grass and sorghum. Like many viruses, SCMV consists of strains, each with their own etiological manifestations. Maize dwarf mosaic virus strain B (see above) is included among SCMV strains but maize dwarf mosaic virus strain A is a different virus.

**TOBACCO ETCH VIRUS (TEV) :** Spread is primarily by aphids but mechanical transmission is possible. Several solanaceous weeds and crops are commonly infected in Florida. Peppers, tobacco, and tomato are the crops most commonly infected. Black nightshade and groundcherry are weeds that often are infected with TEV. This is not a seed-borne virus. Roguing weeds such as nightshade and jimsonweed and destroying old crop debris and volunteers in and near fields, greenhouses, and plant beds will reduce sites that perpetuate this virus. Use disease free transplants. Spraying correctly with JMS Stylet Oil will reduce spread of TEV and certain other aphid borne viruses in tomato and pepper. Adjusting planting dates to avoid major aphid flights has been worthwhile in some situations but has interfered with critical market periods.

**TOBACCO MOSAIC VIRUS (TMV):** TMV is spread primarily by sap transmission and it is highly contagious. Because of its highly contagious nature, down-the-row spread occurs often in tobacco. Sources include infected transplants, nearby crop plants or weeds, particularly solanaceous weeds such as black nightshade, ground cherry, etc. It is typically not seed-borne but could be transmitted via clonal propagation. Its host range is extensive in broadleaf (non grass) plants. Control is primarily by sanitation such as roguing of infected plants, reduction of volunteers and suckers by adequate plow down of previous crops, avoidance of contact with infected plants, and dipping hands in milk or hydrated phosphate detergent before handling plants. When

purchasing tomato varieties, determine from company sources what varieties have resistance. Such resistance is to certain strains, not all. TMV is primarily a problem in tobacco in Florida and some ornamental crops. Also, some scientists who work with peppers in the greenhouse in Florida and elsewhere have noted that a strain of TMV occurs in pepper stock used in breeding studies. Destruction of plant beds when transplanting is complete and destruction of stalks and roots after harvest is vital. This virus has a tendency to buildup over the years on farms if stalk and root destruction after harvests is inadequate.

**TOMATO MOSAIC VIRUS (ToMV):** Some have considered ToMV to be a strain of tobacco mosaic virus, but these two viruses are distinct even though they are related. Information about tobacco mosaic virus is applicable to tomato mosaic virus. ToMV is occasionally a problem in tomatoes.

**TOMATO MOTTLE VIRUS (TMoV) :** This virus was first found in southwest Florida in 1989. It is one of the many geminiviruses that exist. Tomato pseudo-curly top virus, bean golden mosaic virus, and cabbage leaf curl, listed herein, are geminiviruses. Tomato mottle virus, like many of the geminiviruses, is spread by whiteflies. Tomato mottle virus is closely related to sida golden mosaic virus. Tropical soda apple has been naturally infected with TMoV in Florida. Along with damage from whitefly feeding, TMoV has caused severe damage to yields and fruit quality in tomatoes, particularly in southern Florida.

**TOMATO PSEUDO-CURLY TOP VIRUS (TPCTV) :** This virus has occurred usually at low levels in tomatoes for many years, possibly since the mid 1940's. However, the incidence has been as high as 50% in one field. It is spread by treehoppers. Because the symptoms include highly deformed plants, it raises instant concern by growers. It is most likely found in South Florida production fields during the fall crop. Roguing is the main control. Black nightshade has been infected frequently with TPCTV as well as other viruses. Control of this solanaceous weed is important when producing solanaceous crops such as tomato, tobacco, and pepper.

**TOMATO SPOTTED WILT VIRUS**

**(TSWV):** This virus was found in Florida in tomatoes and peanuts in 1986. Some believe that TSWV was present in Florida earlier in gladiolus imported from other states. Since 1986, TSWV has spread from the panhandle of Florida to the southern tip of the peninsula. Also, it has been found in Florida in tomato, tobacco, pepper, watermelon, impatiens, gloxinia, and other ornamentals. Suspected occurrences in Florida include african violet, dieffenbachia, coffee senna, and Mexican tea. Spread of TSWV is primarily by thrips and recently, populations of thrips have increased tremendously in Florida. Mechanical spread from plant sap is possible. This virus has an enormous host range (34 plant families). Control of TSWV is not easy. Insecticidal sprays for thrips may offer some control. However, insecticidal sprays have increased the incidence of TSWV in peanuts. Roguing has been done but the benefits of such are not known although it seems reasonable that roguing would reduce secondary spread from within the field. Ornamental greenhouse production sites that contain TSWV are sometimes identified as being sources of TSWV for field-grown crops. Establishing high density stands of peanuts reduces incidence of TSWV. Some varieties of peanut have moderate resistance to TSWV. In Florida, earlier planted peanuts tend to have higher incidences of TSWV compared to those planted later.

**TOMATO YELLOWS VIRUS (ToYV):** This virus was first found in Florida in 1978. It is spread by aphids and apparently is not mechanically transmissible. ToYV has occurred erratically since 1978. Use of JMS Stylet Oil sprays has reduced spread of this viral disease. Insecticidal sprays may also offer control of this aphid-borne virus but not most of the aphid-borne viruses in Florida. Although tomato has been the main host for this virus, potato, black nightshade, ground cherry (*Physalis floridana*) and jimsonweed (*Datura stramonium*) have been infected with ToYV.

**TURNIP MOSAIC VIRUS (TuMV):** This virus has not been of much consequence in Florida but does exist commonly on cruciferous weeds in some parts of the state. TuMV is transmitted primarily by aphids but it is sap transmissible. It is not known

to be seed transmitted. TuMV infects plants in over 20 plant families. Controls for TuMV are not available.

**WATERMELON MOSAIC VIRUS 1:** (See PAPAYA RINGSPOT VIRUS TYPE W)

**WATERMELON MOSAIC VIRUS 2 (WMV 2):** This has become the most widespread virus in squash and watermelons in central and north Florida. Although WMV 2 is sap transmissible, it is spread primarily by aphids. Leaf miners have been shown to transmit this virus. WMV 2 has a wide host range including legumes but the source(s) plants for this virus in the field have not been determined. WMV 2 has not been demonstrated to be seed-borne. Recently, varieties of squash with resistance to WMV 2 have become available. Fall plantings or late spring plantings are more likely to incur more damage than early spring plantings. However, entire early spring plantings have incurred serious damage from WMV 2.

**ZUCCHINI YELLOW MOSAIC VIRUS**

**(ZYMV):** This virus was found in Florida in 1981. By 1983 ZYMV became severe in some cucurbit fields from Dade to Hamilton Counties, but since then, the incidence of ZYMV has been sporadic. Although ZYMV can produce symptoms similar to PRSV-W or WMV 2, it has a tendency to produce severe leaf and fruit distortions. ZYMV is spread primarily by aphids but it is mechanically transmitted by plant sap. Conflicting reports exist about the seed transmissibility of ZYMV in squash. Recently, varieties of squash with resistance to ZYMV have become available.

Table 1.

<b>Table 1.</b> Naturally Occurring Viruses Found in Agronomic and Vegetable Crops in Florida.	
Agronomic/ Vegetable Crop	Naturally occurring virus
<b>AIZOACEAE (CARPET-WEED FAMILY)</b>	
New Zealand spinach ( <i>Tetragonia expansa</i> )	Cucumber mosaic virus (one time)
<b>AMARYLLIDACEAE (AMARYLLIS FAMILY)</b>	
Chives ( <i>Allium schoenoprasum</i> )	None
Garlic ( <i>Allium sativum</i> )	Unknown virus(s)
Leeks ( <i>Allium porrum</i> )	None
Onion ( <i>Allium cepa</i> )	Cucumber mosaic virus (one time)
Shallots ( <i>Allium ascalonicum</i> )	None
<b>ARACEAE (ARUM FAMILY-AROIDS)</b>	
Malanga ( <i>Xanthosoma caracu</i> )	Dasheen mosaic virus
Taro or Dasheen ( <i>Colocasia esculenta</i> )	Dasheen mosaic virus
<b>ARALIACEAE (ARALIA OR GINSENG FAMILY)</b>	
Ginseng ( <i>Panax</i> spp.)	None
<b>BORAGINACEAE (BORAGE FAMILY)</b>	
Borage ( <i>Borago officinalis</i> )	None
Comfrey ( <i>Symphytium</i> spp.)	None
<b>BRASSICACEAE (CRUCIFERAE, MUSTARD OR CABBAGE FAMILY)</b>	
Broccoli ( <i>Brassica oleracea</i> var. <i>botrytis</i> )	None
Brussels sprouts ( <i>Brassica oleracea</i> var. <i>gemmifera</i> )	None
Cabbage ( <i>Brassica oleracea</i> var. <i>capitata</i> )	Cabbage leaf curl virus
Cauliflower ( <i>Brassica oleracea</i> var. <i>botrytis</i> )	None
Chinese cabbage types	None
Collards ( <i>Brassica oleracea</i> var. <i>acephala</i> )	Turnip mosaic virus

Table 1.

Kale ( <i>Brassica oleracea</i> var. <i>acephala</i> )	None
Kohlrabi ( <i>Brassica caulorapa</i> )	None
Mustard greens ( <i>Brassica juncea</i> )	Turnip mosaic virus
Radish ( <i>Raphanus sativus</i> )	None
Rutabaga ( <i>Brassica napobrassica</i> )	None
Turnip ( <i>Brassica rapa</i> )	Turnip mosaic virus
Water cress ( <i>Nasturtium officinale</i> )	None
<b>CHENOPODIACEAE (GOOSEFOOT FAMILY)</b>	
Beets ( <i>Beta vulgaris</i> )	Cucumber mosaic virus (one time)
Spinach ( <i>Spinacia oleracea</i> )	Cucumber mosaic virus (one time)
Swiss chard ( <i>Beta vulgaris</i> var. <i>cicla</i> )	Cucumber mosaic virus (one time)
<b>COMPOSITAE (SUNFLOWER OR DAISY FAMILY)</b>	
Dandelion ( <i>Taraxacum officinale</i> )	None
Endive ( <i>Cichorium endivia</i> )	Bidens mottle virus
	Lettuce mosaic virus
	Escarole necrosis (Tobacco streak virus)
Escarole ( <i>Cichorium endivia</i> )	Bidens mottle virus
	Lettuce mosaic virus
	Escarole necrosis (Tobacco streak virus)
Lettuce ( <i>Lactuca sativa</i> )	Bidens mottle virus
	Big vein virus
	Cucumber mosaic virus (only on Cos types)
	Lettuce mosaic virus
	Sonchus yellow net virus
	Spring yellows virus

Table 1.

	Escarole necrosis (Tobacco streak virus)
Salsify ( <i>Trapopogon porrifolius</i> )	None
Sunflower ( <i>Helianthus annuus</i> )	None
Tarragon ( <i>Artemisia dracuncululus</i> )	None
<b>CONVOLVULACEAE (MORNING-GLORY FAMILY)</b>	
Sweet potato ( <i>Ipomea batatas</i> )	Cucumber mosaic virus (one time)
	Sweet potato feathery mottle virus
	Sweet potato internal Cork virus
<b>CRUCIFERAE (See BRASSICACEAE)</b>	
Cantaloupe ( <i>Cucumis melo</i> )	Cucumber mosaic virus
	Squash mosaic virus
	Papaya ringspot virus type W
	Watermelon mosaic virus 2
	Zucchini yellow mosaic virus
Cucumber ( <i>Cucumis sativus</i> )	Cucumber mosaic virus
	Papaya ringspot virus type W
	Watermelon mosaic virus 2
	Zucchini yellow mosaic virus
Squash & Pumpkin ( <i>Cucurbita spp</i> )	Cucumber mosaic virus
	Papaya ringspot virus type W
	Tomato spotted wilt virus
	Watermelon mosaic virus 2
	Zucchini yellow mosaic virus
Ivy Gourd ( <i>Coccinea grandis</i> )	Papaya ringspot virus type W
	Unnamed potexvirus

Table 1.

Trichosanthes ( <i>Trichosanthes dioica</i> )	Unnamed potexvirus
Watermelon ( <i>Citrullus lanatus</i> )	Papaya ringspot virus type W
	Tomato spotted wilt virus
	Watermelon mosaic virus 2
	Zucchini yellow mosaic virus
	Unnamed Potyvirus
<b>EUPHORBIACEAE</b>	
Cassava ( <i>Manihot esculenta</i> )	None
Chaya ( <i>Cnidocolus acotifolius</i> )	Cassava common mosaic
<b>FABACEAE (LEGUMINOSAE, PEA OR PULSE FAMILY)</b>	
Alyce clover ( <i>Alysicarpus vaginalis</i> )	Blackeye cowpea mosaic or related virus
	Peanut mottle virus
	Peanut stripe virus
	Watermelon mosaic virus 2
Alfalfa ( <i>Medicago sativa</i> )	Alfalfa mosaic virus
Beans, green ( <i>Phaseolus vulgaris</i> )	Bean common mosaic virus
	Bean golden mosaic virus
	Bean yellow mosaic virus
	Red Node (tobacco streak virus)
Beans, lima ( <i>Phaseolus lunatus</i> )	Cucumber mosaic virus
Beans, butter ( <i>Phaseolus lunatus</i> )	None
Hairy indigo ( <i>Indigofera hirsuta</i> )	Blackeye cowpea mosaic virus Watermelon
	mosaic virus 2
Lupine ( <i>Lupinus</i> spp.)	Bean yellow mosaic virus
	Bidens mottle virus

Table 1.

	Cucumber mosaic virus
	Peanut mottle (blue lupine)
	Watermelon mosaic virus 2
Macroptilium ( <i>Macroptilium lathyroides</i> )	Bean golden mosaic virus
Peas, English ( <i>Pisum sativum</i> )	Watermelon mosaic virus 2
Peas, southern ( <i>Vigna unguiculata</i> )	Blackeye cowpea mosaic virus
	Cucumber mosaic virus
Peanut ( <i>Arachis hypogaea</i> )	Peanut mottle virus
	Peanut stripe virus
	Peanut stunt virus
	Tomato spotted wilt virus
Red clover ( <i>Trifolium pratense</i> )	White clover mosaic virus
Siratro ( <i>Macroptilium atropurpureum</i> )	
Also, See <i>Macroptilium</i> above.	Bean common mosaic virus (or a related strain)
Soybean ( <i>Glycine max</i> )	Peanut mottle virus
	Peanut stripe virus
	Soybean mosaic virus
	Bean common mosaic virus
Sweet clovers ( <i>Melilotus alba</i> & <i>M. indica</i> )	Bean yellow mosaic virus
White clover ( <i>Trifolium repens</i> )	Clover yellow vein virus
	Peanut stunt virus
	White clover mosaic virus
<b>GRAMINEAE (GRASS FAMILY, See POACEAE)</b>	
<b>LABIATAE (MINT FAMILY)</b>	
Basil ( <i>Ocimum basilicum</i> )	None

Table 1.

Catnip ( <i>Nepeta cataria</i> )	None
Horehound ( <i>Marrubium vulgare</i> )	None
Lemon balm ( <i>Melissa officinalis</i> )	None
Majoram ( <i>Origanum</i> spp.)	None
Mints ( <i>Mentha</i> spp.)	None
Oregano ( <i>Origanum vulgare</i> )	None
Rosemary ( <i>Rosmarinus officinalis</i> )	None
Sage ( <i>Salvia officinalis</i> )	None
Savory ( <i>Satureja</i> spp.)	None
Thyme ( <i>Thymus vulgaris</i> )	None
<b>LEGUMINOSAE (See FABACEAE)</b>	
<b>LILIACEAE (LILY FAMILY)</b>	
Asparagus ( <i>Asparagus officinalis</i> )	None
<b>MALVACEAE (MALLOW OR HIBISCUS FAMILY)</b>	
Cotton ( <i>Gossypium hirsutum</i> )	None
Okra ( <i>Hibiscus esculentus</i> )	None
<b>PEDALIACEAE (PEDALIUM FAMILY)</b>	
Sesame ( <i>Sesamum indicum</i> )	Unknown virus
<b>POACEAE</b>	
Barley ( <i>Hordeum vulgare</i> )	None
Corn ( <i>Zea mays</i> )	Corn stunt (spiroplasma)
	Cucumber mosaic virus (one time)
	Maize mosaic virus
	Maize rayado fino virus
	Maize stripe virus

Table 1.

	Sugarcane mosaic virus
	(Maize dwarf mosaic virus)
Oats ( <i>Avena sativa</i> )	Barley yellow dwarf virus (Red leaf)
	Oat mosaic virus
	(Oat soilborne mosaic virus)
Rice ( <i>Oryza sativa</i> )	Hoja Blanca
Rye ( <i>Secale cereale</i> )	Cucumber mosaic virus (one time)
Sugarcane ( <i>Saccharum officinarum</i> )	Sugarcane mosaic virus
Sorghum ( <i>Sorghum bicolor</i> )	None
Various pasture, forage and biomass grasses	None
Triticale (X <i>Triticosecale</i> )	Soil-borne wheat mosaic virus
Wheat ( <i>Triticum aestivum</i> )	Barley yellow dwarf virus
	Soil-borne wheat mosaic virus
<b>POLYGONACEAE (BUCKWHEAT OR KNOTWEED FAMILY)</b>	
Rhubarb ( <i>Rheum rhabarbarum</i> )	None
<b>SOLANACEAE (NIGHTSHADE FAMILY)</b>	
Eggplant ( <i>Solanum melongena</i> )	Cucumber mosaic virus (one time)
Husk tomato ( <i>Physalis pruinosa</i> )	None
Pepper ( <i>Capsicum annuum</i> )	Black pod (Tobacco mosaic virus + tobacco etch virus)
	Cucumber mosaic virus
	Potato virus
	Pepper mottle virus
	Tobacco etch virus
	Tobacco mosaic virus
	Tobacco rattle virus (Aster ringspot)

Table 1.

	Tomato spotted wilt virus
Potato ( <i>Solanum tuberosum</i> )	Potato virus X
	Potato virus Y
	Potato leaf roll virus (net necrosis, tuber blotch)
	Rugose mosaic virus (Potato virus X and potato virus Y or Potato virus Y alone)
	Yellow dwarf virus
Tabasco pepper ( <i>Capsicum frutescens</i> or <i>C. annuum</i> )	None
Tobacco ( <i>Nicotiana tabacum</i> )	Cucumber mosaic virus
	Potato virus X
	Potato virus Y
	Tobacco etch virus
	Tobacco mosaic virus
	Tomato spotted wilt virus
Tomatillo ( <i>Physalis philadelphica</i> )	Tomato mottle virus
Tomato ( <i>Lycopersicon esculentum</i> )	Cucumber mosaic virus
	Potato virus Y
	Pseudo curly top virus
	Tobacco etch virus
	Tobacco mosaic virus
	Tomato double virus streak, (tobacco mosaic virus + potato virus X)
	Tomato fruit mottle, (tobacco mosaic virus + potato virus Y)
	Tomato mosaic virus
	Tomato mottle virus
	Tomato spotted wilt virus

Table 1.

	Tomato yellows virus
<b>UMBELLIFERAE (PARSLEY FAMILY)</b>	
Anise ( <i>Pimpinella anisum</i> )	None
Carrot ( <i>Daucus carota</i> var. <i>sativus</i> )	Cucumber mosaic virus (one time)
Celeriac ( <i>Apium graveoleus</i> var. <i>rapaceum</i> )	None
Celery ( <i>Apium graveolens</i> var. <i>dulce</i> )	Celery mosaic virus
	Cucumber mosaic virus
Chervil ( <i>Anthriscus cerefolium</i> )	None
Coriander ( <i>Coriandrum sativum</i> )	None
Cumin ( <i>Cuminum cyminum</i> )	None
Dill ( <i>Anethum graveolens</i> )	None
Fennel ( <i>Foeniculum vulgare</i> )	None
Lovage ( <i>Levisticum officinale</i> )	None
Parsley ( <i>Petroselinum crispum</i> )	Celery mosaic virus?
	Cucumber mosaic virus
Parsnip ( <i>Pastinaca sativa</i> )	None
<b>ZINGIBERACEAE (GINGER FAMILY)</b>	
Cardamom ( <i>Elettaria</i> spp.)	None
Ginger ( <i>Zingiber officinale</i> )	None