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*Coccinia grandis* has not been reported to be infected from viral diseases except for some reports of Bhargava *et al.* (1975) and Purcifull *et al.* (1989) which suggests that *Coccinia grandis* is a ready source of Watermelon Mosaic Virus strain-2 (WMV-2). This has led me to review the literature pertaining to reports and work done WMV-2.

Provvidenti (1974) worked on the inheritance of resistance to watermelon mosaic virus-2 in *Phaseolus vulgaris*. Of 280 bean accessions tested, 229 were resistant, 22 developed a local reaction, 21 were systemically infected (susceptible) and 8 were heterogeneous populations. Among the resistant lines a few responded with a severe necrotic hypersensitive reaction when graft inoculated or when mechanically inoculated and incubated at 35°C. In F₁, F₂ and reciprocal F₁, backcross progenies of resistant × susceptible and hypersensitive × susceptible lines, resistance was monogenically dominant. On susceptible genotypes, foliar and pod symptoms of WMV2 were similar to that those caused by some strains of yellow mosaic virus.
In 1974, Ebrahim-Nesbat reported the distribution of watermelon mosaic viruses 1 and 2 in Iran. WMV-2 was the most prevalent, and WMV-1 were isolated from watermelon and cantaloupe, and identified by symptoms and differential hosts. Cucumber mosaic virus was isolated only twice and tobacco ring spot virus once.

Occurrence of watermelon mosaic virus- 2 on cucurbits in Chile was reported by Auger et al. in 1974. WMV strain 2 was widely distributed in the cucurbit growing area in central Chile, infecting squash (Cucurbita maxima), honey dew melon and zucchini squash (C. pepo). All WMV isolates induced local lesions on Chenopodium amaranticolor and local lesions and systemic necrotic flecking on Lavatera trimestris. Flexuous, rod shaped particles 747 nm long and pinwheel and tubular inclusions were associated with lesions in C. amaranticolor and in infected tissue of C. pepo cv. small sugar. The virus showed stylet-borne transmission by Myzus persicae. The thermal inactivation point was 55-60°C and dilution end point $10^{-3}$-$10^{-4}$.

Bhargava et al. (1975) reported the perpetuation of watermelon mosaic virus in eastern Uttar Pradesh, India. The commonly cultivated Trichosanthes dioica and
Lagenaria vulgaris, and the wild perennials Memordica dioica and Coccinia grandis were shown to be ready sources of WMV inoculum. Cultivation of the 2 former spp. increases availability of the virus throughout the year. The presence of Aphis gossypii, as a major component of vector populations during the growing period of main cucurbits crops, is considered important in the spread of the virus.

Horvath et al. 1975 isolated two viruses from patisson (Cucurbita pepo L. var patissonina Greb. f. radiata Nois.), a new vegetable, and natural host in Hungary. WMV strain2 was isolated from patisson plants with mosaic symptoms and identified on the basis of host range, transmission by Myzus persicae and seed, serology, electron microscopy-cytological observations and physical properties. Of 67 plants tested, 11 were found to be previously unrecorded hosts of WMV strain 2, 6 were locally susceptible, 12 systemically and 9 both locally and systemically susceptible.

Tewari (1976) observed Zinnnia elegans Jacq. as the latent hosts of watermelon mosaic virus. They tested an isolate of WMV obtained from Trichosanthes dioica, on 23 plants spp. from 11 different families and was
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recovered only from Z. elegans. This was the first report of this plant as a symptomless carrier of WMV and may be of importance in its epidemiology.

Arteaga et al. in 1976 detected a strain of watermelon mosaic virus (WMV-II) in southeast France. A flexuous rod shaped virus (745-760nm), always associated with cucumber mosaic virus was isolated from melon. It was transmitted mechanically and by Myzus persicae and Aphis gossypii in a non-persistent manner. The host range was similar to that of WMV isolates and the virus reacted with an antiserum against WMV-II.

Fegla and Al-Menoufi (1976) studied effect of two cucurbit viruses on chlorophyll content of infected vegetable marrow leaves.

Martelli and Russo (1976) found unusual cytoplasmic inclusions induced by watermelon mosaic virus. Under the light microscope, epidermal strips of squash plants infected with isolated of strain 2 of WMV from Italy, Greece, Jordan and Kuwait, exhibited striking intracellular inclusion bodies. They were of 2 kinds: spindle shaped fibrous inclusions and compact rounded bodies. When exposed to specific cytochemical staining both types of inclusions reacted positively for protein and
RNA but not for DNA or lipids. Both were equally digested by subtilisin. At the ultra structural level the fibrous inclusions consisted of pinwheels and scrolls with which virus particles were often associated. The amorphous bodies proved to be accumulation of closely packed electron opaque material with a granular texture, often containing and surrounded by thin rods resembling virus particles. These inclusions became larger as infection progressed. Their possible implication in virus assembly and / or synthesis is envisaged in the light of the available evidence.

Bhargava in 1977 studied some properties of two strains of watermelon mosaic virus. Strains of the virus from *Lagenaria vulgaris* (WMV-Lv) and *Trichosanthes dioica* (WMV-Td) infected several members of cucurbitaceae and cowpea. *Zinnia* was a symptomless carrier of WMV-Td. The 2 trains reacted differently with various cucurbit cvs.; they were non-persistently transmitted by aphids but not transmitted by seed. Particles of WMV-Td were 730x15 nm and those of WMV-L 675x15 nm. Cross protection and serological tests confirmed their identity.
Bhargava & Bhargava (1977) studied cucurbit mosaic viruses in Gorakhpur. Seven cultivated and 2 wild cucurbits yielded pumpkin yellow-vein mosaic virus, pumpkin mosaic virus, cucumis virus 3 (cucumber green mottle mosaic virus), 3 strains of cucumber mosaic virus and 7 of watermelon mosaic virus, the last being the most widespread in the Gorakhpur area of Uttar Pradesh. Strains of WMV showed minor differences in their physical properties and were serologically related. These were basically restricted to cucurbitaceae, but they also infected cowpea cv. Black Turtle. *Zinnia elegans* was a symptomless carrier of the WMV strain from *Trichosanthes dioica*.

Nome et al. (1977) observed reduction in productivity of *Cucurbita maxima* Duch. var. *zappallito* Carr. Millan plants infected by watermelon mosaic virus 2. In the field, 20 plants out of 80 were inoculated with the virus at the 2-4 leaf stage. Symptoms appeared 8-10 days later. The disease spread and plants were divided into 4 groups according to the date on which symptoms appeared. The most important reduction occurred in the rate of fruit growth (g/day) and the total growth (g/plant), being 67% and 60% respectively for plants attacked earlier. Fruit production fell by 51% in such plants, while
in plants attacked at intermediate stages the reduction was 19-15%. This suggests that infection before the 4th week of life of the plant produced some importance change resulting in lower fertility.

In 1997, Karl studied correlation between acquisition by aphids of some non-persistent viruses and the age of infection. He showed that *Myzus persicae* and *Aphis gossypii* could acquire cucumber mosaic virus from inoculated cucumber plants 1-3 days before the appearance of symptoms. Watermelon mosaic virus 2 was acquired from squash by both these species 3 days and by *A. craccivora* 4 days before symptoms appeared. Acquisition of beet mosaic virus from sugar beet by *M. persicae* before symptom appearance occurred only once, and *A. fabae* acquired the virus only from plants with symptoms.

Eulitz (1977) observed the incidence of watermelon mosaic virus on vegetable marrow and the occurrence of its aphid vectors in the Eastern Transvaal Lowveld. Results of field observations indicated that incidence is more dependent on the availability of virus sources than on the presence of aphid vectors, thus confirming previous observations on watermelon mosaic virus 2.
Wu and Su (1977) reported watermelon mosaic virus in Taiwan. WMV is the major cause of watermelon mosaic disease, which has increased in prevalence in Taiwan with increasing acreage of the crop. The virus could not infect test plants in the solanaceae and Leguminosae and was transmitted by *Myzus persicae* but not soil or seed-borne. Cells of squash plants infected with WMV contained amorphous or circular inclusions bodies. The virus infected 16 cucurbitaceae but wax gourd (*Benincasa cerifera*) was hypersensitive and calabash (*Cucurbita lagenaria*) was immune. The incubation period depended on temperature and photoperiod. Usually high temperatures (30-35°C) and long photoperiod (16 h/day) were most suitable for disease development.

Ghosh *et al.* (1977) worked on electron microscopy of some viruses of pumpkin (*Cucurbita moschata* Poir). All 9 isolates were flexuous rods differing in length and breadth. Particle length of 2 isolates (a strain bottle gourd mosaic virus and strain of cucurbit latent virus) was 500-600 nm, that of another strain of the latter was 600-700 nm. In 4 isolates (a strain of bottle gourd mosaic, [cucumber] vein yellowing, pumpkin mild mosaic cucurbit mosaic viruses) it was 700-800 nm. In watermelon mosaic virus-1 and pumpkin enation virus, it
was 800-900 nm. The results indicated that similarities in particle length do not always corroborate the similarities in visual properties of the virus.

Amiri and Ebrahim-Nesbat (1977) reported *Reseda lutea* L. and *Fumaria asepala* Boiss. as the natural hosts of watermelon mosaic virus in the Mashhad areas, Iran. The 2 weed species were found to be symptomless carriers of the virus.

Raychaudhuri and Varma (1977) studied virus-vector relationship of marrow virus with *Myzus persicae* Sulz. In laboratory tests the virus, a strain of watermelon mosaic, was transmitted by the vector to vegetable marrow in a typical stylet-borne manner. Pre-acquisition starving of vector was not essential but increased the transmission rate. Although a single aphid could transmit the virus, >5/ plant were required for 100% transmission. A feeding period of only 30 sec. was needed for virus acquisition but one of 2 minutes resulted in maximum transmission.

Bhargava and Bhargava (1977) studied reaction of some cucurbit cultivars to seven strains of watermelon mosaic virus. In tests with 80 cvs. of 19 cucurbits 6 cvs.
were resistant to all the strains while 11 were resistant to some and symptomless carriers of others.

Migliori et al. (1977) carried out preliminary observations on the epidemiology of cucumber mosaic and watermelon mosaic viruses in Guadeloupe. Spread of cucumber mosaic virus in Guadeloupe is slight, despite the presence of numerous hosts. It was noted on 11 species, including 4 newly recorded as hosts. However, incidence on tomato in 1 region has increased. Watermelon mosaic virus spreads rapidly, being transmissible throughout the year, unless there is heavy rainfall. Conditions for epiphytosis are most favourable in Dec-Apr. when it is cool and dry.

Kawagoe and Okada (1978) studied Ecology and Control of watermelon mosaic virus. Further studies were based on relation between prevalence of the aphid (Aphis gossypii) and occurrence of WMV on cucumber in vinyl house.

Joshi (1978) observed the efficiency of Aphis gossypii as vector of turnip mosaic and watermelon mosaic virus. A. gossypii transmits TrMV to radish, causing radish mosaic, and WMV to marrow causing vegetable marrow mosaic. Both viruses could be
transmitted by a single aphid. After a 1 minute acquisition feed, more infection was obtained with WMV but TrMV was retained in the vector for a longer period.

Adlerz (1978) reported secondary spread of watermelon mosaic virus 2 by *Anuraphis middletonii*. Aphids trapped in yellow water pans near and in a watermelon planting during an epidemic of WMV-2 were placed on indicator plants but no vector transmissions were detected before disease levels reached 4%. Final mosaic incidence reached 99%. Of the aphids trapped, 87% were *A. middletonii*.

Komm and Agrios (1978) observed incidence and epidemiology of viruses affecting cucurbit crops in Massachusetts. Watermelon mosaic virus strain 2 predominated in 1973. It was the only virus present in 53% of all samples showing virus symptoms. Cucumber mosaic virus was present in 17%, bean yellow mosaic virus (severe strain) in 14%, a mixture of CMV and WMV-1 in 1%. Host distribution of the diseases is tabulated. CMV was found in several weed hosts but WMV-2 was not.

Rahimian and Izadpanah (1978) worked on the identity and prevalence of mosaic-inducing cucurbit
viruses in Shiraz, Iran. In a survey, the viruses were identified on the basis of differential host range, insect transmission, electron microscopy and serology. Watermelon mosaic virus-2 (WMV-2) was the most prevalent, followed by cucumber mosaic virus (CMV). Cucumber green mottle mosaic virus was isolated only from few melon plants. Some isolates of WMV-2 caused systemic infection on inoculation of Chenopodium quinoa and broad bean. Twelve isolates of CMV from cucurbits, Zinnia, Petunia and Viola hybrids were divided into 4 groups, according to the type of symptoms produced, and into 2 serological categories.

Ahmed (1978) studied the virus diseases of vegetable crops in Sudan. In fields tests against tomato leaf curl virus by insecticidal spraying against Bemisia tabaci, combined with frequent roguing of infected plants, incidence was significantly reduced and yield increased. All 15 Hibiscus esculentus cvs. tested in the field proved susceptible to H.esculentus leaf curl virus. A severe strain of tobacco mosaic virus was isolated from tomato and a strain of watermelon mosaic virus causing severe damage to cucurbit was also reported.
Adlerz (1978) studied epidemics of watermelon mosaic virus 2 in Florida. WMV-2 incidence in selected plots in a 6 hectare annual spring planting was > 57%, in 4 of 11 yr. As primary infections were limited and isolated in the area studied, epiphytotic development depended on events during secondary spread. In the years of high incidence, primary symptoms appeared in April, leaving 43-57 days for secondary spread and uninfected plants were downwind from primary infection sites on 16-43 days of the latter period. Direction of aphid migration was more important than aphid numbers in secondary spread.

Wijs and Suda-Bachmann (1979) compared long-term preservation of potato virus Y and watermelon mosaic virus in liquid nitrogen with other preservation methods. Watermelon mosaic virus in clarified sap of diseased squash was very infective for >4yr when deep frozen (-18°C), whereas most of the infectivity was lost within 4 yr after freeze drying and subsequent storage at 4°C. Potato virus Y in Capsicum annuum sap lost most of its infectivity in <4ys when deep frozen, but retained it for >4yr when freeze-dried and stored at 4°C. Infectivity of both viruses decreased in deep frozen and freeze-dried inocula during the first few months of storage.
However, inoculum stored in or over liquid nitrogen maintained its activity for at least 22 months for VWMV and 32 for PVY.

Horvath (1979) identified new artificial hosts and non-hosts of plant viruses their role in the identification and separation of viruses of potyvirus group (Subdivision-III), potato virus Y, turnip mosaic virus and watermelon mosaic virus (strain 2 or general strain). In PVY tests over 15 yr. With 162 species (14 families), 32 species were locally, 40 systemically and 8 locally and systemically susceptible. Some new virus susceptible but *Peronospora tabacina* resistant *Nocotiana* species and cvs. are of special importance as virus production hosts. Of the 82 resistant plants, 17 are important as resistance sources (12 hypersensitive, 5 resistant with TuMV, 3 local, 8 systemic and 3 local and systemic hosts were found, and 14 were resistant with WMV. Of 48 plants tested (14 families), 2 were local, 5 systemic, and 6 local and systemic hosts (4 families); the rest were resistant (10 families). Some 25 plants suitable for separating WMV and cucumber mosaic virus (often occurring together) are particularly important, as are those enabling the separation of WMV, TuMV and CMV, which often occur together.
Fegla and Badr (1979) studied the effect of plant population on the incidence of mosaic diseases and productivity of vegetable marrow (*Cucurbita pepo*, L.). Infection was caused by cucumber mosaic virus and watermelon mosaic virus-2 in the spring, and mainly by WMV-2 in summer. An increase in plant population, the distance between hills being reduced from 50 to 20 cm, decreased infection in the summer and increased yield.

Turner and Stace-Smith (1979) made a survey of plant-virus disease of Jamaica. The survey resulted in new records for cowpea mosaic virus on kidney bean (*Phaseolus vulgaris*) and broad bean, squash mosaic on cantaloupe melon and watermelon mosaic virus on pumpkin. Other viruses previously identified mainly on the basis of field symptoms were confirmed by host-range studies and serology. Lyophilized leaf tissue was inoculated to a range of indicator plants. Those that developed symptoms were checked by electron microscopy for virus particles and extracted sap was used in serological tests to identify the viruses.

Purcifull and Heibert (1979) performed serological distinction of watermelon mosaic virus isolates. Antisera to purified preparations of Floridian isolates of WMV type
1 (WMV-1 FL) and WMV type 2 (WMV-2 FL) were used in immunodiffusion tests with sodium dodecyl sulphate (SDS)-treated extracts from virus infected plants. Based on reciprocal tests with sera collected 2-6 months after the 1st injection, WMV-1 FL and WMV-2 FL did not cross-react. Among 13 other WMV isolates obtained from other areas-3 types were identified: (i) isolates that were closely related to WMV-1 FL but not reactive with WMV-2 FL (1 each from California, NY, Texas, Australia, Jordan and Greece); (ii) isolates that were closely related to WMV-2 FL did not reactive with WMV-1 FL. (1 each from Ariz, NY, Australia and New Zealand, and 2 from California) and (iii) an isolates from Morocco, which was non reactive with either WMV-1 FL or WMV-2 FL. The SDS-immunodiffusion methods were reliable for detecting either WMV-1 or WMV-2 in extracts from symptomatic leaves from a variety of host plants. Freeze-dried leaf extracts proved convenient as reference antigens. The papaw ringspot virus was closely related serologically to WMV-1 FL but not reactive with WMV-2 FL, whereas soybean mosaic virus was unrelated to WMV-1 but related to, although distinct from, WMV-2 FL.

Wyman (1979) from observed a new vector of cucurbit viruses in southern California. It was
**Acyrthosiphon kondoi.** The vector transmitted watermelon mosaic virus 1 and 2 to squash, watermelon, cantaloupe and vegetable marrow under glasshouse conditions. Transmission of WMV 1 was more efficient than that of WMV 2. Efficiency was low with single aphid inoculation (1.9- 6.7%) but increased when 5 aphids/plant were used (12.1- 31.6%). Alate forms were trapped throughout the growing season of summer squash and were most numerous in Jan. when susceptible seedlings were present in the field.

Shawkat and Fegia (1979) identified two viruses from eggplant and *Cucurbita pepo* in Iraq. Cucumber mosaic virus isolated from naturally infected eggplant and watermelon mosaic virus 2, from vegetable marrow, their first report in Iraq, induced local lesions on *Chenopodium amaranticolor* and infected cucurbits as well as representatives of other families. WMV-2 did not infect tobacco or other solanaceous plants. The thermal inactivation points were 55 and 65°C, dilution end points $10^{-4}$ and $10^{-3}$ and longevity *in vitro* 4 and 8 days for CMV and WMV-2 respectively. Both viruses were transmitted by *Myzus persicae* and *Aphis fabae.*
Preliminary attempts were made by Kibata (1979) to control the insect transmitted watermelon mosaic virus (WMV-K) on baby marrows. Results of insecticide tests in Kenya to control the Kenyan strain of the virus by controlling the vector (mainly *Aphis gossypii*) were presented. Aphid number on treated plants was very low, but it is suggested that the disease could also be transmitted by other insects. Weekly sprays with 0.025% pirimicarb or a summer oil emulsion increased yield but to a lesser extent than did a polythene mulch, which delayed incidence of WMV-K.

Pitrat and Vaulx (1979) studied disease resistance in some *Cucumis* species. *C. zeyheri* was the least susceptible of accession from 8 species to inoculation with cucumber mosaic virus and watermelon mosaic virus 2. *C. zeyheri*, *C. prophetarum* and *C. ficifolius* PI 196884 were the least susceptible to natural infection. The first 2 species were resistant to corky root (*Pyrenochaeta lycopersici*) and with *C. dipsaceus*, *C. metuliferus* and *C. ficifolius*, were resistant to *Sphaerotheca fuliginea*.

Russo *et al.* (1979) made comparative studies on Mediterranean isolates of watermelon mosaic virus. The virus causes severe infection of squash in Italy. When 8
WMV isolates from Mediterranean countries were compared with one another and with authentic WMV-2 and WMV-2 isolates from USA. 4 of the Mediterranean isolates were WMV-1 and 4 WMV-2. The strains could be differentiated serologically and by host range. Also, WMV-1 isolates contained amorphous cytoplasmic inclusion bodies, which are considered to be of diagnostic importance. It was suggested that WMV-1 and WMV-2 are 2 different entities for which use of same vernacular was not justified.

Singh et al. (1980) observed some metabolic changes due to watermelon mosaic virus infection in bottle gourd fruits. The effect of WMV infection on the nitrogenous and carbohydrate fractions from *Lagenaria vulgaris* fruit was tabulated. In general, the former increased, while the latter decreased in diseased fruit.

Yoshida et al. (1980) isolated five viruses from melon (*Cucumis melo* L.) in Hokkaido. The most prevalent virus infecting this crop was an isolate of cucumber mosaic virus related to strain Y. A watermelon mosaic virus belonging to the WMV-2 group and a watermelon strain of cucumber green mottle mosaic virus were also isolated. Muskmelon necrotic spot virus was
present and all naturally infected plants also had *Olpidium* in the roots. Tomato ringspot virus was isolated for the 1st time from melon but was not transmitted through the seeds, although it was transmitted through the seeds of infected soybean plants.

Lisa and Dellavalle (1981) characterized two potyviruses in *Cucurbita pepo*. Of the 2 viruses found on squash in N. Italy 1, very widespread and damaging to crops, was identified as watermelon mosaic virus 2 (WMV-2). Serologically it was identical with isolates of the same virus in the S. Italy, though there were minor differences in the host range. All the Italian isolates were serologically closely related to bean yellow mosaic virus from bean. WMV-2 and BYMV also had a similar host range. The 2nd virus, less frequent and less damaging on squash, was serologically closely related to the pea necrosis strain of clover yellow vein virus, and distantly related to BYMV-B25, but not to WMV 1 or 2.

Sako and Ogata (1981) studied different helper factors associated with aphid transmission of some potyviruses. *Myzus persicae* transmitted watermelon mosaic virus after acquiring it through artificial membranes from a solution of purified virus mixed with
the soluble fraction from infected pumpkin leaf extracts or by prefeeding on the soluble fraction before acquiring purified virus. WMV-induced helper factor assisted *M. persicae* in transmitting purified turnip mosaic virus but not potato virus Y. TuMV-induced helper factor from infected turnip leaves was in-effective for the transmission of purified WMV or PVY. PVY-induced helper factor from infected tobacco leaves was capable of helping the transmission of TuMV but not WMV. The results indicate that there are at least 3 distinct helper factors with different specificity associated with potyviruses.

Sowell and Demski (1981) observed resistance to watermelon mosaic virus in muskmelon. Inoculation of muskmelon with WMV-2 produced significantly fewer infected seedlings in PI 403994 than in Hales Best Jumbo-WMV1 produced local lesions on PI 180283 and the virus did not move systemically. Local lesions were 4-8 times more numerous on PI 180280 than on selection 633-3.

Pei *et al.* (1982) worked on etiology of virus diseases on Hemi-melon (*Cucumis melo* var. *hami*). Three virus diseases described, which caused large
reductions in yield and sugar content in Xinjiang, were caused by a cucumber mosaic virus strain, squash mosaic virus and watermelon mosaic virus strain 2. Mc Guire and Wickizer (1982) studied watermelon mosaic virus in zucchini and summer squash. They described the symptoms caused by WMV-1 and WMV-2 in squash varieties and incidence of the disease in Arkansas.

Chen et al. (1982) studied watermelon mosaic disease. The disease caused severe losses in the suburbs of Shanghai, the main symptoms being mosaic, mottle, stunting and distortion. In specimens prepared from diseased leaves by the dip method and negatively stained with phosphotungstic acid, thread like virus particles c.16x770 nm were observed, and believed to be watermelon mosaic virus.

Mc lean et al. (1982) worked on the use of reflective mulch to reduce the incidence of watermelon mosaic virus in western Australia. The virus had caused losses in the last 8 yr in the Gascoyne river district. Neither insecticides nor oil sprays have reduced incidence in 3 trails, melon and watermelon plants mulched with reflective (Al) polythene were less infected (by 21, 30
and 72%) than the controls; yield increases were 77-270% Black polythene mulch also reduced incidence and increased yield but to a lesser degree. In all tests WMV incidence rose more slowly in the mulch plots; this greatly contributed to the observed yield increase.

Basky (1982) studied the role of aphids in virus transmission in cucumber seed production. The aphid population as determined by Moeriche traps was maximum in early June, while virus infection was first noted in late July or early August, when the number of aphids was very small. Cucumber mosaic and watermelon mosaic viruses alone were identified. Virus reservoirs could account for infection when few aphids were present.

Abu-Samah and Randles (1982) made comparisons between virus isolates in the bean yellow mosaic virus and watermelon mosaic virus subgroups. Three type isolates of BYMV (G, Q and S) can be distinguished on the basis of their biological and serological properties, and their RNA homology. Isolates related to BYMV-S predominate in faba bean crops growing in south eastern S.Australia. Isolates of BYMV from other parts of Australia had negligible homology with BYMV-S.
electron microscopy showed that watermelon mosaic viruses 1 and 2 are serologically related but not identical. Molecular hybridization analysis indicated no relationship between them on the basis of RNA homology.

Yamamoto et al. (1982) performed serological grouping of watermelon mosaic virus isolates. Isolates of WMV collected from different locations of western Japan were examined by leaf dip serology and immunodiffusion tests. The antiserum used was prepared to an isolate 8(E) which induced typical mosaic, vein banding, leaf distortion and dwarf symptoms on cucurbits. Of the 20 isolates, 13 reacted positively with the antiserum while 7 from Kagawa prefecture were negative. The serologically positive isolates were further classified into 2 groups on the basis of reactions on faba bean and garden pea; 4 caused systemic infection and 9 did not. Isolates that did not react with the antiserum infected both hosts systemically. The 2 types of WMV were detected in field-infected cucurbit plants collected from Kagawa prefecture. Thus there are at least 2 serologically distinct types of WMV in this area.
Al-Musa and Mansour (1982) studies some properties of a watermelon mosaic virus in Jordan. WMV-2 was newly reported from Jordan on squash and melon plants. The virus was identified on the basis of host range, properties in sap, transmission and serology tests.

Singh (1983) studied changes in enzymatic activity of pumpkin plants infected with watermelon mosaic virus. Catalase activity, which was always lower in diseased than in healthy leaves, increased in both healthy and inoculated plants with age upto 60 days after inoculation and then declined. Nitrate reductase activity increased in infected leaves, stem and roots, being maximum in leaves on the 60th day.

Singh (1983) observed changes in different phosphorus fractions in watermelon mosaic virus infected- pumpkin plant. Total Organic P levels were higher in virus-infected leaves at all stages of growth in comparison to healthy controls. Inorganic P was low in virus-infected plants.

Wang (1983) carried out serological detection of the watermelon mosaic virus which infected the Hami muskmelon.
Basky (1983) studied the effect of reflective mulches on virus infection in seed cucumber. Different plastic strips were placed between rows of cucumbers grown for seed. Transparent and light blue plastics decreased the number of infected plants by 70 and 77% respectively, compared to the control, black plastic had no effect. Cucumber mosaic virus caused 77% of the infection and watermelon mosaic virus 23%. The movement of aphid vectors was most intensive in the last decade of June and the first 2 decades of July as indicated by infection of test plants, although considerably fewer aphids were caught in yellow traps during this period than at the beginning of June.

Basky (1983) described a new way to use paraffinic oil-surfactant blends "Atplus 411F" in seed cucumbers to decrease stylet-borne virus infections. In 1979-82 infection by cucumber mosaic and watermelon mosaic virus in a seed cucumber field in Hungary was 30-50%. Swarming of winged aphids (*Aphis gossypii* and *Myzus persicae*) peaked during the first 10 days of June, virus infection on trap plants (cucumbers in the cotyledon stage, replaced weekly) appearing at least 2 weeks later, and on cucumber plants in the field, from the end of June or during July. Weekly spraying with 1% light oils Atplus
411F, Agridex EG 318 and span 80 during high aphid activity (20 June - 20 July) in 1982 reduced numbers of infected plants by 83 and 67% respectively. These oils are recommended for virus control through vector control in cucumber and bell and red pepper (Capsicum) crops in Hungary.

Dikova et al. (1983) studied watermelon mosaic virus on cucumber. The virus was isolated from 6 cucumber cultivars at a testing station in the Plovdiv district and identified on the basis of its host range. The thermal inactivation point was 58°-60°C, dilution and point $10^{-4}$ and longevity in vitro 6-7 days. Isolates reacted positively only with antiserum of WMV-2. Average length of the virions was 705.4 nm. Inclusions typical of potyviruses were seen.

Yamamoto and Ishii (1983) worked on aphid transmission from cucumber cultivars infected with watermelon mosaic virus and cucumber mosaic virus. The virus concentration in leaves inoculated with either virus showed a highly positive correlation with the rate of transmission by Aphid gossypii. The concentration of CMV was low in the cultivars showing milder symptoms; that of WMV was high in all the cultivars and it was
easily transmitted from the symptomless, tolerant Aonaga-suyo. In all 3 cultivars tested symptoms were more severe on leaves infected with both viruses than in those with only 1 virus. Transmission of CMV from doubly infected leaves was higher than that from singly infected leaves in all cultivar. It was increased 7-fold in the resistant Aonaga-suyo-conversely, the transmission rate of WMV from doubly infected leaves in all the cultivars tested was much lower than that from singly infected leaves. These results are thought to reflect the difference in the concentration of the 2 viruses in leaves infected with both simultaneously.

Avgeus (1983) reported occurrence of watermelon mosaic virus 1 and 2 in cucurbits in Crete (Greece). Characteristics of isolates from cucumber, melon, squash, watermelon and Lagenaria vulgaris were reported.

Almeida and Borges (1983) studied watermelon mosaic virus in Portugal. Characteristics, serology and ultrastructural aspects of the host were also studied. A severe distorting mosaic was found on pumpkin grown from imported seeds. The virus was transmitted by sap to pumpkin, squash, watermelon, melon and cucumber only.
Nonpersistent transmission by *Myzus persicae* was 70% with 1 aphid and 100% with 7 or more. The dilution end point was $5 \times 10^{-4}$, thermal inactivation point 50°C and longevity *in vitro* 10 days. In dehydrated tissues at -17° the virus survived for more than 5 months. An antiserum was obtained with a titre of 1:16000. In host sap and purified suspensions scrolls and pinwheels characteristic of subdivision I of potyviruses were seen. The ultrastructural host-virus relationships for WMV and the 4 subdivisions of potyviruses are considered.

Tiwari and Shukla (1984) studied Peroxidase activity of *Cucurbita maxima* Dusch. infected with three strains of watermelon mosaic virus. Peroxidase activity was higher in infected than in healthy (squash) plants.

Purcifull *et al.* (1984) studied serological relationships and partial characterisation of zucchini yellow mosaic virus isolated from squash in Florida. Of 39 plants with foliar mosaic symptoms collected from 3 Floridian counties in autumn 1981 and tested by SDS-immunodiffusion against antisera to several cucurbit viruses, 7 were infected with watermelon mosaic virus-1 only, 21 with WMV-2 only, 8 with both WMV-1 and WMV-2 and 3 with a virus serologically related to WMV-2 but
distinct from it. None of the samples was infected with WMV-M (a Moroccan isolate), squash mosaic virus or cucumber mosaic virus. One of the WMV-2 related isolates (1119) was mechanically transmitted to zucchini squash in the green house, where it caused systemic mosaic, distortion, vein banding and blistering of leaves. This isolate also induced systemic infections on cucumber, watermelon, cantaloupe and Luffa acutangula and local infection on Chenopodium amaranticolor, C. quinoa, bean (Phaseolus vulgaris) and Alaska peas. The virus was transmitted in a stylet borne manner by Myzus persicae. Striated inclusions and filamentous particles (C. 760nm long) were found in negatively stained leaf extracts. Isolate 1119 was found closely related serologically to zucchini yellow mosaic virus from Italy in SDS- immunodiffusion tests. Virus isolates serologically similar to ZYMV were found in 6 countries representing the northern, central and southern portions of Florida in 1982.

Hiebert et al. (1984) studied the effect of limited proteolysis on the amino acid compositions of five potyviruses and on the serological reaction and peptide map of the tobacco etch virus capsid protein. The capsid protein subunits of the selected potyviruses (TEV, pepper
mottle, soybean mosaic, and watermelon mosaic 1 and 2) were studied after limited proteolysis *in situ*. The ranges of molecular weight of the protein subunits of these 5 viruses, estimated by SDS-PAGE were 32-35 kd before and 26-29kd after proteolysis. Comparisons of amino acid analysis of non-proteolysed and proteolysed virus capsid protein for each virus showed that the cleaved portion of the subunit (c.6 kd) had a high content of lysine. Electrophoresis of TEV capsid proteins cleaved by cyanogen bromide revealed the loss of 2 peptides after the limited proteolysis. Reaction of TEV with a lyzyl-specific reagent 2,4,5- trinitrobenzene sulphonate, before and after limited proteolysis indicated that at least 6 lyzyl residues/ protein subunit were lost during the limited proteolysis. Serological tests indicated that some serological determinants are lost after limit proteolysis of TEV and PeMV. The amino acid compositions of the 5 potyviruses are compared with each other as well as with 10 other potyviruses from the literature, using Pearson's correlation coefficient.

Dodds *et al.* (1984) made a survey of aphid and whitefly transmitted cucurbit viruses in Imperial county, California which detected watermelon mosaic virus-2 and squash mosaic virus, but not WMV-1 or cucumber mosaic
virus. In 920 samples collected from 10 cantaloupe fields between May and June 1981 the most common virus detected was WMV-2 (present in all samples from plants with mosaic symptoms in 8 fields); 2 fields had a low incidence of SqMV; WMV-1 and CMV were not detected. Squash leaf curl (SLC) disease, associated with the whitefly, *Bemisia tabaci*, reached epidemic levels in cucurbit crops in late summer 1981. Symptoms on cantaloupe were less severe than on watermelon and squash. WMV-1, WMV-2, CMV and SqMV were not detected in symptomatic plants. Germinate virus particles were associated with field-collected plants of these cucurbit crops and were also detected in squash plants experimentally inoculated with the SLC agent by whiteflies. Mechanical transmission of SLC was also achieved, but efficiency was poor. A strong crop-reaction between sap from SLC-infected squash and bean golden mosaic virus antiserum was detected by ELISA. Results of the study indicated that whitefly-transmitted geminiviruses caused serious field diseases of vegetable crops in that area.

Sako *et al.* (1984) studied mediation of helper component in aphid transmission of some potyviruses. Turnip mosaic virus and watermelon mosaic virus were
acquired and transmitted simultaneously by *Myzus persicae* after prior acquisition of WMV-helper component (HC) from infected leaves and the virus specificity of the HC was confirmed. *Aphis crassivora* could only transmit TuMV; *Dactynotus gobonis* transmitted TuMV efficiently but WMV rarely. Unlike *M. persicae*, neither of these species acquired TuMV from purified preparation after prior acquisition of WMV-HC from infected leaves, suggesting some dissimilarity between the species. When *M. persicae* acquired HC from WMV-or potato virus Y-infected leaves and then fed on purified TuMV through membranes, the aphids lost the ability to transmit TuMV after 10-30 minutes on healthy plants or after 7-9 hours in glass containers; they acquired WMV-or PVY-HC after feeding for 2 minutes-9 hours on a source, but the shorter acquisition feedings enabled them to acquire and transmit TuMV more efficiently. These results indicate that HC already acquired by vectors might lose the ability to interact with virus particles when the acquisition feeding is prolonged.

*Yamamoto et al.* (1984) described epidemiological studies of watermelon mosaic virus which cover the occurrence of the virus in the Shikoku district; properties of 2 WMV isolates varying in virulence; changes in virus
concentration in cucumber plants; transmission; plants as the source of spread and infection cycle of the virus; and methods of diagnosis was achieved with the double diffusion method using agar gel and the haemagglutination method. Control recommendations include disinfection of tools and fingers with sodium triphosphate, spraying source plants with machine oil and the possible use of resistant varieties. Among the 19 aphid species shown to transmit the virus, 10 are new vector records.

Nogay and Yorganci (1984) made investigation on the identification, seed transmission and host range of viruses infecting the culture plants in the cucurbitaceae in Marmara region. Of 269 cucurbit samples with virus-like symptoms collected in 1979 and 1980, 142 contained cucumber mosaic virus, 118 watermelon mosaic virus 2 and 9 CMV + WMV-2. Physical properties and particle dimensions of the viruses were determined.

Nameth et al. (1985) studied viruses which caused heavy melon loses in desert valleys. It included mention of the aleyrodid *Bemisia tabaci* as a vector of squash leaf curl virus and lettuce infectious yellows virus on squash and the aphid *Myzus persicae* as a vector of 2 strains of
watermelon mosaic virus and zucchini yellow mosaic virus on melon and squash.

Nogay and Yorganci (1985) studied the seed transmissibilities and cucurbit hosts of CMV and WMV-2 isolated from the culture plants in the cucurbitaceae. Cucumber mosaic virus and watermelon mosaic virus 2 were not seed transmitted in the cucumber, pumpkin, melon and watermelon cultivars tested. The CMV isolates induced local and systemic infection on cucumber, pumpkin and melon, while 1 CMV isolate infected watermelon systemically. All WMV-2 isolates systemically infected cucumber, pumpkin and melon, without inducing local lesions on inoculated leaves.

Singh (1985) observed the effect of watermelon mosaic virus on the oxygen uptake of pumpkin (*Cucurbita maxima* Dutch.) plants. Respiratory rates of WMV infected leaves, stems and roots were significantly higher than those of healthy plant parts. $O_2$ uptake decreased in both healthy and virus infected stems and roots with increasing age of the plants.

Horvath (1985) studied new artificial host- virus relations between cucurbitaceous plants (*Cucumis* and *Cucurbita* species) and viruses. On inoculation of 7
Cucumis species and derivatives, 16 new host-virus relationships were established; 3 of these were systemic and 13 were local and systemic. None of the plants showed resistance to the viruses. In studies on 27 Cucurbita species and derivatives, 60 new local and systemic relationships were detected. Most of the findings are related to cucumber mosaic virus (25), watermelon mosaic virus (17) and cucumber green mottle mosaic virus (5). No plant resistant to 1 or more viruses was found among these species.

Horvath (1985) studied new artificial host-virus relations between Cucurbitaceous plants (Benincasa, Bryonia, Bryonopsis and Citrullus species) and viruses. In inoculation experiments, Benincasa hispida was found to be a systemic host for 4 viruses (cucumber mosaic, Melandrium yellow fleck, tobacco ring spot and turnip mosaic) as well as local and systemic host for cucumber green mottle mosaic virus, CGMMV and TRV inducing latent infection. Bryonia cretica subspecies dioica as a host for watermelon mosaic virus showed both local infection and a systemic mosaic. Bryonopsis laciniosa var. erythrocarpa was locally and systemically susceptible to CGMMV, CMV, MYFV and WMV but the local infection by MYFV was only latent. Citrullus
colocynthis proved to be a systemic host for TuMV and a local (latent) and systemic host for CGMMV and CMV; it was resistant to TRV. *C.lanatus* subsp. *vulgaris* var. *vulgaris* was locally and systemically susceptible to CGMMV, CMV and WMV, but local disease was latent in each case.

Tripathi and Joshi (1985) studied watermelon mosaic virus in pumpkin (*Cucurbita maxima*). A sap transmissible virus producing mosaic and leaf distortion symptoms on pumpkins in the Basti area, Uttar Pradesh was efficiently transmitted by *Aphis gossypii*, *A.crassivora* and *Myzus persicae*. The host range included members of the Chenopodiaceae, Compositae, Cucurbitaceae, and Leguminosae. The virus had a dilution end point of $10^{-5}$-$10^{-6}$, a thermal inactivation point of 60-65°C and longevity *in vitro* of 26-27 days at 32-34°C and 42 days at 17-19°C. It resembles a strain of watermelon mosaic virus.

Yamamoto (1986) studied infection cycle of watermelon mosaic virus. A survey of aphids conducted in Japan in 1981 in cucumber and pumpkin fields revealed that over half of the aphid species sampled were vectors of watermelon mosaic virus (WMV). It was shown that WMV
was transmitted to cucumber seedlings by *Aphis gossypii* at a high rate from many kinds of cucurbit crops infected with WMV. The infection cycle is summarized, and methods of control are suggested.

Li *et al.* (1986) described types and distribution of Xinjiang hami melon viruses. In addition to the 3 viruses previously isolated (Cucumber mosaic, squash mosaic and watermelon mosaic virus 2), 3 others have recently been isolated (hami-melon necrosis virus, hami-melon vein necrosis virus and an unidentified virus). A survey (1981-84) in 6 localities and on 20 cultivars showed that the percentages of mixed infection by WMV-2 + CMV, WMV 2 + SMV, CMV + SMV and WMV + SMS + CMV in the epidemic year 1983 were higher than in 1982. The infection percentages of each virus also differed among localities and cultivars.

Gray *et al.* (1986) monitored virus- suppression and aphid resistance effects on spatial and temporal spread of watermelon mosaic virus 2 in replicated plantings of 3 melon genotypes. One was resistant to *Aphis gossypii* and suppressively resistant to WMV-2, another was resistant to *A. gossypii* and a third was a commercial cultivar susceptible to both WMV-2 and *A. gossypii*. When
14 epidemics in 2 nonoverlapping plantings were analyzed separately, final virus incidence in the aphid-resistant genotype and the aphid / virus resistant genotype averaged 11 and 33% lower, respectively, than that in the susceptible genotypes during the spring planting. The 9 epidemics in the different genotypes of the spring planting were statistically best described by various nonlinear models. The rate of disease progress also varied among genotypes. Infected plants of all 3 muskmelon genotypes were consistently observed in a clustered pattern, but the degree of clustering differed among genotypes. The 5 epidemics occurring during the summer planting were also described by different nonlinear models, but the best single-model, statistical fit of the disease progress data from these epidemics was provided by the linear model. The rate of disease progress and final disease incidence were not significantly different among genotypes and the infected plants were observed in a random pattern. The increased incidence of WMV-2 during the summer planting was attributed to an increase in the number of alighting aphids and sources of WMV-2 in the surrounding area. The effects of the seasonal abundance and species composition of alate aphid populations, the amount and
proximity of virus sources, and the effectiveness of the
different resistance components are discussed in relation
to the field epidemics of WMV-2.

Mc Leod et al. (1986) studied zucchini yellow
mosaic virus; a new severe cucurbit disease. Samples
from zucchini, squash and watermelon crops taken during
1985 indicated that the predominant virus causing
disease in western and north western parts of the state
was ZYMV, which was responsible for severe loses often
approaching 100%. In samples from central Ark.
watermelon mosaic virus 2 was predominant. The
predominant cucurbit virus in 1981, WMV-1, was not
detected in any of the 1985 samples.

Romanow et al. (1986) studied alteration
efficiencies of acquisition and inoculation of watermelon
mosaic virus- 2 by plant resistance to the virus and to an
aphid vector. The effect of aphid and virus resistance on
acquisition and inoculation of WMV-2 were assessed
using colonizing (Aphis gossypii) and noncolonizing
(Myzus persicae) aphids and 3 muskmelon genotypes.
Together, these provided a treatment set containing all 4
combination of plant resistance or susceptibility to
aphids with resistance or susceptibility to virus. Plant
resistance to WMV-2 reduced the efficiency of virus acquisition by both aphid species, but had no detectable effect on inoculation efficiency. Virus acquisition efficiency was a function of virus concentration in the source plant and affected the probability of virus transmission by both aphid species similarly. Resistance to aphids reduced the efficiency of inoculation by *A. gossypii*, the resisted aphid, but not by *M. persicae*. Resistance to inoculation by *A. gossypii* without resistance to acquisition in the same genotype suggests that the requirements for aphid inoculation of viruses may differ from those for acquisition.

Davis and Mizuki (1987) worked on detection of cucurbit virus in New Jersey. During a 3-year study, different viruses were associated with severe disease symptoms, depending on the year. In 1983, cucumber mosaic virus caused the most severe disease in squash (*Cucurbita pepo*) although watermelon mosaic virus 2 was the most prevalent. In 1984, the watermelon mosaic strain of papaya [papaw] ring spot virus caused a destructive disease of squash. Zucchini yellow mosaic virus was detected for the first time in New Jersey in 1985 and caused severe losses in squash and other cucurbit crops. In field samples infected with various
mixtures of ZYMV, WMV-2 and PRSV- W, ZYMV usually predominated after rub-inoculation of susceptible test plants and detection by ELISA. The assay of field samples was more reliable as an indication of the viruses present in samples than ELISA of experimental test plants rub- inoculated with sap from field samples. ZYMV is highly aggressive and appears to have a competitive advantage over PRSV- W and WMV-Z in mixed infections. Most ZYMV isolates occurring in New Jersey were similar to the Connecticut strain; however, one isolate of ZYMV from zucchini squash, designated ZYMV- NJsn, unique from previously reported isolates in its ability to induce severe stunting and necrosis in squash, represents another biotype of ZYMV.

Meer et al. (1987) worked on purification and identification of a South African isolate of watermelon mosaic virus- Morocco. A flexuous rod-shaped virus 706-770 nm long, isolated from cucurbit leaves showing chlorotic mottling, vein banding, dark green blisters, malformation and stunting was purified and mechanically transmitted to a limited host range with Chenopodium amaranticator, C.album, C.quinoa and Gomphrena globosa being the only non-cucurbitaceous hosts; the cucurbits Luffa cylindrica, Cucumis metuliferus, Coccinia
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*sessilifolia*, and *Citrullus ecirrhosus* were not infected. The virus was non-persistently transmitted by *Myzus persicae*, produced pinwheel and bundle inclusions in the plant cell cytoplasm and had a single coat protein with MW 36,000 daltons and a degraded lighter component of 26,000 daltons. Serological comparisons with antiserum to watermelon mosaic virus 2, papaya [papaw] ring spot virus strain W and WMV- Morocco identified the virus as an isolate of WMV- Morocco. It was found to be the dominant virus in all the main cucurbit-producing areas of South Africa, which were surveyed.

Yoshida and Iizuka (1987) isolated watermelon mosaic virus-2, zucchini yellow mosaic virus and cucumber mosaic virus from cucurbitaceous plants in Hokkaido. They gave details of isolation, characterization and identification of these viruses from squash, bottle gourd [*Lagenaria siceraria*] and cucumber.

Hseu *et al.* (1987) reported the occurrence of five viruses in six cucurbits in Taiwan. In 1985, 583 leaf samples were collected from cucurbits in Taichung, Yu-Chia- Nan and Kao- Ping, Taiwan. These included cucumber, *Luffa* spp., bitter gourd (*Memordica charantia*), wax gourd (*Benincasa hispida*), pumpkin and
bottle gourd (*Lagenaria leucantha [L. siceraria]*)). Direct-ELISA was used to detect zucchini yellow mosaic potyvirus, watermelon mosaic 1 potyvirus and cucumber green mottle mosaic tobamovirus. ZYMV was most prevalent, followed by WMV. CGMMV was rare in cucumber, *Luffa* spp. *B.hispida* and pumpkin. In 1986, 908 samples from the same species were tested for the above viruses, plus watermelon mosaic 2 potyvirus and cucumber mosaic cucumovirus in an extended area covering Hwa-Tung and Penghu island. ZYMV was most prevalent, then WMV followed by CMV, but CGMMV was predominant in *L.siceraria*. WMV-1 was only detected in Hwa-Tung samples and no ZYMV was detected on Penghu island. ZYMV is thought to be the most important virus in cucurbit cultivation in Taiwan.

Nasser and Baskey (1987) studied inhibition of aphid transmission of plant viruses by light summer oils in seed cucumber field. The effects of 3 mineral oil sprays on the spread of cucumber mosaic and watermelon mosaic viruses in seed cucumber were investigated in field studies in Hungary in 1986. Sprays were applied weekly as 1% emulsions from 19 June to 20 July. Aphid numbers were monitored using yellow and green water pans and alate were trapped on cloth
netting. The activity of the aphid vectors was greatest between 23rd June and 14th July. The incidence of virus in leaf samples collected every two weeks was determined by inoculating mechanically herbaceous, indicator plants. Virus infection was 45% in the untreated control at the end of crop growth. The rate of infection of leaf samples treated with spray prover, Atplus R and Atplus 411F was 10, 15 and 10% respectively. Cucumber mosaic virus and watermelon mosaic virus were isolated from infected cucumber samples from untreated plots in the ratio 11:89%, but only watermelon mosaic virus was isolated from treated plots.

Iwasaski and Inaba (1988) reported viral wilt of cucumber plants grafted on squash rootstocks. Cucumber plants grafted on squash rootstocks showed symptoms of wilting with leaf mosaic while stems and roots were symptomless. Among 32 leaf samples collected in the field, 15 were infected with zucchini yellow mosaic virus, 9 with cucumber mosaic virus + ZYMV, 7 with CMV, ZYMV + watermelon mosaic virus- 2 and 1 with CMV-WMV-2. Non-grafted cucumber plants inoculated with these samples failed to show any wilt symptoms. Inoculation experiments established that mixed infection with CMV+ ZYMV, or CMV + ZYMV + WMV-2 caused
severe wilt in grafted cucumber plants whereas single infection with ZYMV or mixed infection with CMV+ WMV-2 caused only slight wilt.

Mohamed and Basky (1988) made study of virus infection and swarming dynamics of aphids in cucumber stands grown for seed. The incidence of virus infection in cucumber plants grown for seed was determined in samples collected twice weekly in Hungary. The activity of vectors was measured by exposing cucumber seedlings to aphid infestation for 1-week periods or by placing aphids captured alive with gray horizontal traps on tests plants evaluating the virus infection of the latter after a 3-week period. The dispersal of alate aphids was monitored using 2-yellow and 2 green Moericke traps. The first virus-infected samples was collected on 4 July. By the end of the vegetation period the infection of field plants had reached 50%. The trap plants indicated that aphid activity occurred from 23 June to 21 July. Alate aphids caught in gray horizontal traps were viruliferous only in the periods when the trap plants indicated vector activity. Ninety-five percent of the plants sampled were infected with watermelon mosaic virus and 5% with cucumber mosaic virus. Watermelon mosaic virus was isolated from 92% of the virus-infected trap plants and
cucumber mosaic virus from 8% of 378 alate aphids collected in gray horizontal traps, 6 were viruliferous; these transmitted watermelon mosaic virus in 33%. A total of 6751 aphids were caught in the yellow pan traps and 3456 aphids in the green traps from 5 May to 11 August.

Erdiller and Ertung (1988) worked on the identification of muskmelon viruses in Ankara Province. Strains 5 and 6 of cucumber mosaic cucumovirus and watermelon mosaic potyviruses 1 and 2 were isolated from melon in 1981-84 and identified by host range, serology, physical properties and EM. WMV 1 predominated, followed by CMV.

Purcifull et al. (1989) performed immunodiffusion tests for six viruses that infect cucurbits in Florida. In April 1986, leaves that exhibited chlorotic flecking were collected from *Trichosanthes dioica* in Dade county, Florida, U.S.A. An extract from the leaves was tested by sodium dodecyl sulfate immunodiffusion tests against antisera to each of 5 viruses previously identified in cucurbits in Florida: papaya ring spot (type W) potyvirus (PRSV-W), watermelon mosaic 2 potyvirus (WMV-2), zucchini yellow mosaic potyvirus (ZYMV),
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cucumber mosaic cucumovirus (CMV) and squash mosaic comovirus (SMV). The extract did not react with any of the antisera. A sample of the leaves from Trichosanthes was ground in buffer and rubbed on zucchini squash (Cucurbita pepo) plants in the green house. The squash plants developed vein clearing and mild mosaic symptoms in systemically infected leaves. A filamentous virus designated trichosanthes virus (TV), was associated with the infection. An antiserum was prepared to TV and serological tests confirmed that it was unrelated to PRSV-W, WMV-2, ZYMV, CMV and SMV. In 1987 and 1988, antisera to each of 6 viruses were used for immunodiagnosis of cucurbit samples, which represented different crops, seasons and locations in Florida. These samples were either collected in disease surveys or were submitted for diagnosis. Of 549 samples, 245 reacted with PRSV-W antiserum, 204 with WMV-2 antiserum, 51 with ZYMV antiserum, 13 with CMV antiserum, none with SMV antiserum and 22 with TV antiserum. The TV was detected in T. dioica and Coccinia grandis in Dade county, but not in squash from Dade county, nor in cucurbit samples collected elsewhere in the state. The cucurbits potyviruses, PRSV-W,
WMV-2 and ZYMV, continue to be important pathogens in the mosaic disease complex of cucurbits in Florida.

Singh et al. (1991) reported prevalence of viral diseases on pumpkin in Uttar Pradesh. In Sep. 1988, 20 samples of pumpkin infected with mosaic disease were collected from each of 4 districts (Kanpur, Fatehpur, Farrukhabad and Unnao) in Uttar Pradesh, India. Immunodiagnosis was used to identify cucumber mosaic cucumovirus (CMV). Watermelon mosaic virus [watermelon mosaic 2 potyvirus, WMV-2], pumpkin yellow mosaic virus (PYMV) and pumpkin yellow vein mosaic virus (PYVMV) as predominant and disease symptoms were described. It was thought to be first report of CMV and PYMV on pumpkin.

Perring et al. (1992) presented pattern of cucurbit virus spread. The epidemiology of watermelon mosaic 2 potyvirus (WMV-2) and zucchini yellow mosaic potyvirus (ZYMV) on melons in the Imperial valley, California, USA, was studied from 1985 to provide information, for the development of a disease management strategy. It included determination of spatial temporal spread of the disease and analysis of surrounding vegetation. It was concluded that most of the epidemics originate locally.
and that after cold winters, the only surviving source plants for ZYMV occurred in areas where they were protected from cold weather, i.e. mainly in garden planting of squash or sponge gourd, or in commercial plantings of melons or squash under plastic or in greenhouses. The number of surviving WMV-2 hosts was unaffected by temperature. This conclusion was confirmed in the following spring, when despite a cold winter, ZYMV was frequent in a number of fields. In each case a cultivated source plant could be identified in the surrounding area. The proposed management strategy is therefore to limit ZYMV source plants by surveying the areas surrounding the melon field prior to melon emergence, and to identify and remove source plants.

Kameya et al. (1992) obtained attenuated isolate of watermelon mosaic virus (WMV-2) and its cross protection against virulent. Attenuated isolates of watermelon mosaic 2 potyvirus were obtained by local lesion selection on Chenopodium quinoa after treatment of partially purified preparation of WMV-2 with UV radiation and nitrous acid. Squash, cucumber, muskmelon and watermelon seedlings inoculated with one of the isolates designated W1-9 remained symptomless, with the exception of mild symptoms on the
1st true leaf, and were protected against later inoculation with a virulent isolate of WMV-2 under greenhouse conditions.

Nakayama et al. (1992) worked on availability of attenuated strains of WMV-2 in bottle gourd. Inoculation of bottle gourds (*Lagenaria siceraria*) with attenuated strains of watermelon mosaic 2 potyvirus provided good protection against severe strains of the virus and had no significant effect on plant growth.

Huang et al. (1993) worked on comparison of diagnostic hosts and serological tests for four cucurbit potyviruses. Four cucurbit potyviruses, zucchini yellow mosaic potyvirus (ZYMV), papaya ring spot (type W) potyvirus (PRV-W), watermelon mosaic 2 potyvirus (WMV-2) and melon vein-banding mosaic virus (MV bMr), were compared by their reactions on diagnostic hosts and SDS- immunodiffusion and ELISA tests. Results of host reaction studies indicated that isolates of PRV-W group (PRV-W FL, PRV-WT and PRV-Wv) did not infect *Cucumis metuliferus* PI 292190, but the other 3 viruses did. Both *Phaseolus vulgaris* Black Turtle 2 and *Nicotiana benthamiana* were only infected by WMV-2. In *Luffa cylindrica* [L.aegyptica] (loofah), 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 by MvbMv but latent or mild mosaic when infected by isolates of PRV-W group. This plant did not react to WMV-2 and ZYMV. Chenopodium quinoa separated MVbMv from the other 3 viruses by producing systemic local lesions in contrast to the localized lesions of the 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-W FL VP produced spur precipitin bands with PRV-W FL. Antiserum to cylindrical inclusion (CI) proteins were specific for the homologous viruses, except 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 weekly with PRV-W FL antigen when compared with the homologous antigen/ antibody reactions.
Webb and Kok-Yokomi (1993) studied transmission of cucurbit potyviruses by *Uroleucon pseudambrosiae* (Homoptera: Aphididae), an aphid trapped during epidemics of watermelon mosaic virus 2 in Florida. As part of epidemiological studies of watermelon mosaic 2 potyvirus (WMV-2) in Florida, aphids were collected in green tile water traps in 1989 and 1990. A species of *Uroleucon* accounted for >25% of the aphids trapped. The same aphid was found infesting most of *Lactuca graminifolia* and *Sonchus asper* plants growing near plots of watermelon and was identified as *U. pseudambrosiae*. The vector propensity of this aphid was estimated and compared with that of 3 other known vectors of WMV-2, both in area tests and in tests using single aphids given limited acquisition and inoculation access. *U.pseudambrosiae* transmitted the virus relatively inefficiently in controlled-access tests but was not significantly different from *Aphis spiraecola* and *A.illinoisensis* in virus transmission in area tests. *Myzus pesicae* was the most efficient vector in all tests. This was the first report of *U.pseudambrosiae* transmitting WMV-2. Based on its abundance and the estimate of its vector propensity, it is thought that this species could
play an important role in the epidemiology of WMV-2 in areas in which both aphid and virus are commonly found.

Thomson et al. (1995) worked on identification of zucchini yellow mosaic potyvirus by RT-PCR and analysis of sequence variability. A reverse transcription polymerase chain reaction (RT-PCR) method was used to identify zucchini yellow mosaic potyvirus (ZYMV) in leaves of infected cucurbits. Oligonucleotide primers, which annealed to regions in the nuclear inclusion body (Nib) and the coat protein (CP) genes, generated a 300 bp product from ZYMV and also from the closely related watermelon mosaic-2 potyvirus (WMV-2). However, no product was obtained from papaya ring spot potyvirus which also infects cucurbits. ZYMV and WMZ were differentiated using a third primer which was complementary to a sequence in the 3 untranslated region; a 1186-bp amplified product was only obtained for ZYMV. Nucleotide sequence analysis of the 300-bp fragments of Australian ZYMV and WMV-2 strains revealed 93.7-100% sequence identity between ZYMV strains. Multiple sequence alignments suggested that the nucleotide sequence, which codes for the N-terminus of the CP was 74-100% identical for different isolates of ZYMV. The Australian isolate of WMV-2 was 43-46%
identical to all isolates of ZYMV and was 84.6% identical to a Florida isolate of WMV-2.

Munger et al. (1995) adapted leaf blower for large scale inoculation of plant with mechanically transmitted viruses. Plants to be screened for resistance to mechanically transmitted viruses can be inoculated using an inexpensive electric-powered leaf blower. The device was successfully used to inoculate melon, cucumber and squash with cucumber mosaic cucumovirus, watermelon mosaic 2 potyvirus, papaya ring spot potyvirus and zucchini yellow mosaic potyvirus (infection frequency 95-100%). This device greatly reduces the amount of time needed to inoculate large population compared with hand-rubbing methods. No significant differences were noted with regard to the frequency of seedlings that escaped infection.

Dikova (1995) reported establishment of viruses on cucurbit crops in Bulgaria. A total of 273 samples from melon, cucumber, watermelon, zucchini squash, zucchini marrow, patisson and winter squash was tested by indirect ELISA (I-ELISA) and distribution of cucumber mosaic cucumovirus (CMV), papaya ring spot potyvirus, watermelon strain (PRSV-W) [watermelon mosaic 1
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potyvirus], watermelon mosaic 2 potyvirus (WMV-2) and zucchini yellow mosaic potyvirus (ZYMV), mixed virus infections and percentages of each virus to total number of samples are outlined.

Kanematsu and Naito (1995) studied distribution of three cucurbit viruses in Yamare area [cucumber mosaic cucumovirus, zucchini yellow mosaic potyvirus, and watermelon mosaic 2 potyvirus].

A study was carried out by Kirde and Lokhande (1996) to locate sources of watermelon mosaic potyvirus (WMV) transmission between hosts in Akola Tahsil, India. Seeds from members of the Cucurbitaceae, Chenopodiaceae, Leguminosae[Fabaceae], Amaranthaceae, Cruciferae [Brassicaceae], Compositae[Asteraceae], Solanaceae and Malvaceae families were grown and leaves showing WMV symptoms were removed to prepare an inoculum. Plants from each family were than inoculated with WMV inoculum while others were kept as a control. Observation of symptoms development went on for 45 days after inoculation. Members of the Cucurbitaceae family (ridge gourd: Luffa cylindrica [L.aegyptica]), bottle gourd (Lagenaria siceraria), bitter gourd (Memordica charantia), pumpkin,
cucumber, muskmelon and watermelon (*Citrullus vulgaris* [*C.lanatus*]) contracted systemic infection 7 to 20 days after inoculation. Soybeans, cowpeas and radishes showed systemic symptoms within 10-12 days. Back inoculation showed no transmission of the disease.

Dahal *et al.* (1997) reported occurrence of papaya ring spot potyvirus and cucurbit viruses in Nepal. A survey of papaw and 10 cucurbitaceous vegetables (ash gourd [*Benincasa hispida*]), zucchini [marrow], watermelon, cucumber, pumpkin, bottle gourd (*Lagenaria siceraria*), snake gourd (*Trichosanthes cucumerina*), Sponge gourd (*Luffa acutangula*), bitter gourd (*Memordica charantia*) and choyote (*Sechium edule*) during 1989 and 1992-94 in more than 68 locations (both experimental plots and farmer's fields) covering 18 terai and inner-terai districts of Nepal, indicated that these crops were heavily affected with various virus-like symptoms. The most commonly observed symptoms were severe mosaic, leaf distortion, oily streaks or spots on papaya, leaf distortion, blisters and shoe stringing on zucchini and mosaic or yellow mosaic, blisters and leaf distortion on other cucurbits. Average incidence of plants with symptoms ranged from 75% to 100% on papaw, 85% to 100% on marrow, 4% to 100% on cucumber, 4% to
100% on pumpkin and 10% to 100% on bottle gourd, choyote and watermelon. The virus isolated from papaw and marrow was confirmed as papaya ring spot potyvirus-watermelon strain (PRSV-W) [watermelon mosaic 1 potyvirus]. It was also detected in survey samples from ash gourd, bitter gourd, snake gourd, sponge gourd, marrow, watermelon, bottle gourd and cucumber. Leaf extracts of some cucumber, choyote, pumpkin, marrow and snake gourd samples reacted with cucumber mosaic cucumovirus (CMV) and zucchini yellow mosaic potyvirus (ZYMV) antisera. Leaf extracts of ash gourd, cucumber and pumpkin reacted with antibodies against cucurbit aphid- borne yellows luteovirus (CABYV). No samples reacted with antiserum to watermelon mosaic 2 potyvirus (WMV-2) or squash mosaic comovirus (SQMV). Some papaw and most cucurbits leaf samples cross- reacted with antibodies against Moroccan (Mor) and Algerian (Alg) isolates of WMV. The Nepalese PRSV isolate was related to but distinct from a PRSV-W type strain from France. This is the first report on the identity of ZYMV and CABYV in Nepal.