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Cultural Management of Viral Diseases in Capsicum (*Capsicum spp.*)

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ABSTRACT

For instance, in tropical and subtropical pepper production practices, the numbers of virus species infecting pepper (Capsicum spp.) crops and their occurrences have expanded significantly during the past years. Due to a number of variables, such as the development of pepper farming, the prevalence of insect vectors, and climate change, there are an increasing number of viral outbreaks that affect pepper (Capsicum spp.). More crucially, sick plants should be destroyed, disease-resistant cultivars should be grown, cultural techniques should be improved, and pesticides should be used sparingly, especially while plants are young and susceptible to vector colonization. Recent years have seen a rise in the demand for environmentally friendly management strategies to lower viral disease incidence in Capsicum spp.

Keywords: Capsicum, climate change, economic loss, management options, viral infection.

Introduction

One of the most important vegetables grown worldwide is pepper (Capsicum spp.). It is widely used in fresh, dried or processed foods and is very valuable in terms of economic and nutritional value. The crop is a member of the Solanaceae family, which includes more than 90 genera and 2,500 flower species, including important crops such as tomatoes and eggplant. Due to the diversity of Capsicum plants and the properties of the fruit, this product has become popular and ideal for many uses. There are more than 30 different species in this genus, 5 of which are C. annuum, C. frutescens, C. chinense, C. baccatum and C. pubescens have been domesticated and used mostly for food and non-food (e.g. cosmetic) purposes. The main challenges in the development of vegetable crops are those related to food security, the development of sustainable agriculture and the increasing consumer demand for food. There are many types of diseases that affect peppers, including fungi, bacteria, viruses and insects. A feature of many populations of this group of vectors is that they can be rapidly developed for specific insecticides. The main insect family that infects peppers is transmitted by aphids, whiteflies, or thrips. For this reason, and due to growing concerns

about the effects of overuse or misuse of pesticides on the environment, producers and consumers, it is necessary to reduce dependence on pesticides to control disease spread across crops. Capsicum spp. production. It is under threat in places such as Asia, Australia, Europe and Africa for many reasons, especially diseases. They are infected with diseases that not only reduce fruit yield and quality, but also increase the cost of preservation and production of hygiene products. In addition, since there are many different types of infectious diseases and these diseases accumulate in children's belongings, unaffected areas can easily become infected. To improve the prevention of pepper disease, it is necessary to stop the use of general pesticides in favor of transmitting a significant part of the viral disease. Instead, disease control strategies must be comprehensive and effective, carefully combining cultural practices that reduce the source of disease inoculum in pepper crops and slow the rate of disease transmission, with pesticides that should be used only while the plants are growing. Use only synthetic pesticides. Larvae are the most easily transmitted diseases, and appropriate products and biocontrols can increase resistance in plants, influence insect behavior, and reduce the cost of spread. Planting and pesticides are used to increase the yield and health of the pepper crop. Considering the increasing demand for permaculture, the main way to protect pepper plants from biological competition is the use of resistant plants.

Viruses of pepper

1. Potyvirus

Many plant diseases that occur and affect major crops, including tomatoes, potatoes, eggplants, and peppers, constitute the genus Potyvirus Y. Non-enveloped, flexible filamentous single-stranded RNA (ssRNA) particles of this genus are 680-900 nm in length. and 11-15 nm wide. Potato Y virus causes symptoms such as spotting, mosaicing, curling, veining or translucency, chlorosis, blistering and severe stunting on all plants. The type of pepper, the type of disease, and the presence of other diseases can affect the severity of these symptoms. The main potyviruses affecting the Capsicum genus include TEV, PVY, ChiVMV, PepMoV, and PVMV.

a) Pepper Veinal Mottle Virus (PVMV)

Pepper vein mottle virus (PVMV), first discovered in Ghana in 1971, can reduce crop yields by up to 100%. This virus has also spread to other countries. Other Solanaceae plants, such as eggplant and tomato, are also susceptible to PVMV infection. Eight aphid species have been identified as persistent pests, including peach aphid, red aphid, cotton aphid, and aphids. Spirulina is the best carrier. The disease can also be spread through contact with infected juice, but not

through seeds. Symptoms of PVMV include small leaves, leaf mosaic, leaf curl, leaf spider veins, leaf ring spots, leaf deformation, leaf chlorosis, blistering, and severe stunting of the entire plant.

Management:

According to reports, plastic sheets can reduce damage caused by pests and diseases. Compared to monocropping, intercropping Capsicum spp. The use of corn also reduces diseases. To reduce the occurrence and spread of PVMV in the field, it is also necessary to use resistant bacteria, sow seeds in proof rows, and remove affected plants as soon as they are seen. These are recommended as general guidelines for the management of PVMV infections.

b) Chilli Veinal Mottle Virus (ChiVMV)

Capsicum vein mottle virus (ChiVMV) has been reported worldwide. This disease is not genetic; instead, it constantly spreads and infects the mechanis through various aphids. The virus is retained only by some insects (myzus, cotton aphid, bean aphid, meadow aphid, mediophora, citrus toxoptera and setaria) for about an hour after infection. Winged aphids are the most difficult to control and often the best vector for spreading the disease from field to field. Mottled leaves and dark green veins are symptoms of ChiVMV.

Management:

Infected plants should be identified immediately and mineral oil insecticides applied early in the planting period to limit the aphid population. Healthy crop production should be done with care and many disease-resistant varieties should be used. Additionally, removing eggplant plants from pepper plants may help reduce the frequency of ChiVMV when they become other hosts.

c) Potato Virus Y (PVY)

Potyvirus Y (PVY) is common in Solanaceae plants such as herbs, peppers, potatoes, tomatoes, and tobacco. PVY isolated from peppers does not spread to potatoes and vice versa. Based on the different responses of the host, PVY virus strains are classified according to their ability to overcome genetic factors. They can cause 20-70% losses in pepper production. Many aphids can regularly transmit this disease, but the green peach aphid (Myzus persicae) is generally considered the most important carrier. PVY virus can be spread during plant processing, grafting, and use of non-toxic agricultural tools. Dwarf or stunted plants, open and striped systemic veins, mosaic leaves, and small, misshapen fruits with a mosaic pattern all make them unmarketable and are symptoms of PVY.

Management:

Using pesticides, getting rid of solanaceous plants and nearby plants, planting when the aphid population is lowest, and tending to plants especially during childcare and farming times all contribute to PVY management. Early detection and control of affected plants is the best way to reduce the incidence of PVY. Intercropping of pepper and maize has also been shown to be beneficial in controlling potato blight in pepper crops.

d) Tobacco Etch Virus (TEV)

PVY and tobacco corrosion virus (TEV) always infect each other. Many aphid species do not need to infect plants. Infected plants have a mosaic pattern on their leaves, with occasional dark green lines appearing along the veins. The colors are lighter. Another possibility is that the plant is stunted, the leaves are curled and the fruits are damaged.

Management:

Since resistance to both viruses is related, the use of PVY-resistant varieties may help control TEV. To prevent aphids, pepper seedlings should be grown in a protective culture system with a net or screen. The amount of inoculum injected into crops can be reduced by planning planting dates to avoid high aphid activity early in the season and by removing plants and individuals volunteering to plant in and around the plant. It has been suggested that the use of mineral oil can reduce the TEV level in peppers.

2. Tobamovirus

Viruses of the Tobaccovirus genus are particularly important because they do not require a virus to spread. Members of this species exhibit curved filamentous ssRNA particles of approximately 300 nm in length and 18 nm in diameter, which are willing to live for many years and can withstand many harsh conditions, due to the protein coating process. Tobacco mosaic virus is persistent and can also spread to infected waste, compost, soil and water. This genus includes TMV, ToMV and PMMoV viruses.

a) Tobacco Mosaic Virus (TMV)

The first virus discovered was called Tobacco mosaic virus (TMV). More than 350 plant species have been infected with this disease, including at least 125 crops including tobacco, tomatoes, peppers, eggplants, potatoes and cucumbers. The virus can remain dormant in dead tissue and continue to spread even after surviving for months or years in plant material. The virus multiplies in living tissue. Tobacco mosaic disease does not require insects and is spread primarily by mechanical means, plant-to-plant contact, and seed contamination. Leaf chlorosis, mosaic patterning of leaves, deformed leaves and slow growth, often with small fruits, are symptoms of TMV infection.

Management:

Careful handling of plants, cleaning of farm equipment, removal of pathogens, and treatment of seeds with 10% trisodium phosphate are methods to control TMV (TSP). A healthy seed test and at least 2 years of planting are also recommended. Plant crops such as tomatoes and potatoes next to peppers. To disagree.

b) Tomato Mosaic Virus (ToMV)

Tomato mosaic virus (ToMV) is found worldwide. One of the most painful aspects of this disease is its ability to protect the plant outside and break down tissue. More than 150 commercially important crops, including vegetables and produce, are known to be susceptible to tomato mosaic disease. ToMV is usually transmitted through contact with infected fruit juice but can also be spread during farming. ToMV is more common than TMV in peppers, although both strains cause similar symptoms in peppers. Symptoms include severe dwarfing of plants and mosaic chlorotic patterns on leaves and fruit. Other symptoms may vary depending on the age of the plant, disease and weather conditions. These include necrotic (brown) spots on leaves and fruit and deformed leaves that are often accompanied by prior defoliation.

Management:

Rotation to non-host plants is one of the ToMV management strategies following an infection epidemic. Particularly in endemic regions, the adoption of resistant cultivars along with enhanced cultural methods can assist to boost productivity. Clean planting materials in the nursery are ensured by disinfecting screen-house soils, planting tools, and containers. After transplantation, the virus can be contained by carefully treating healthy seedlings and eliminating those that are exhibiting symptoms. ToMV that is present on the seed coat can be removed by sterilizing seeds with 10% TSP.

3. Begomovirus

Monopartite or bipartite plant viruses belonging to the genus Begomovirus infect a variety of crops worldwide. The whitefly (*Bemisia tabaci*) is the only persistent and circulative carrier of viruses in this genus. Circular single-stranded DNA (ssDNA) particles of these virus species are around 30 nm in length and 18 nm in diameter. PepLCV and TYLCV are two important begomoviruses that cause pepper damage.

a) Pepper Leaf Curl Virus (PepLCV)

Pepper leaf curl virus (PepLCV) has been detected in many African countries and is responsible for many epidemics and significant economic losses. PepLCV spreads by inhibiting flower growth, thereby reducing

fruit production and causing the most damage to young, immature plants. PepLCV symptoms include severe stunting, flower abscission, decreased pollen production, increased leaf curl, leaf yellowing, and fruit failure. Losses can range from 90% to 100%.

Management:

Pesticides and other cultural practices are the most common treatments used to control vector diseases. Planting resistant or tolerant plants, mulching, edging, and plastic mulch are other ways to prevent the spread of PepLCV.

b) Tomato Yellow Leaf Curl Virus (TYLCV)

Tomato yellow leaf curl virus (TYLCV) is one of the most harmful diseases that targets many vegetable crops, including tobacco (Nicotiana tabacum), beans (Phaseolus vulgaris), okra (Abelmoschus esculentus), tomato (Solanum lycopersicum), beetroot and other crops. and vegetables. Hot pepper (Capsicum spp.) and some other plants. Interveinal yellowing, leaf curl, and stunting are symptoms of TYLCV in pepper plants, all of which can reduce productivity.

Management:

Plastic mulching on pepper farms has proven successful in reducing whitefly infestations. Resistant line planting in nurseries, use of crop rotation, use of pesticides, selection of plant resistant varieties, improved cultural methods to eliminate weeds and plant replacement are another way to control TYLCV.

4. Cucumovirus

The triplet ssRNA of the genus Cucumbervirus is encapsulated in small icosahedral particles with a diameter of 29 nm. More than 1,200 plant species worldwide, including herbs and wild plants, are affected by diseases of this genus.

a) Cucumber Mosaic Virus (CMV)

The most important disease of peppers spreading all over the world is cucumber mosaic virus (CMV). Although there are many types of diseases, it seems that they can all infect peppers, although their symptoms may differ. The symptoms the plant will show mostly depend on its age at the time of infection. The most common symptoms of pepper plant damage include slightly mosaic and dull-colored leaves; slightly mottled; nibbling on shoes; fern-like leaves; venous bands; cleansing of muscles; deformed leaves; limited development; and small fruits. Gossypium gossypii and the green peach aphid are the most effective vectors of the disease, which is not found in more than 80 aphid species. Transmission can also occur manually via seeds or parasites.

Management:

Strategies to delay early infection can be implemented to increase yield. The best way to control CMV is to isolate peppers from overgrown border areas or plant them next to taller borders, such as corn, that can serve as an uninjured host. check for disease plantings Screening and antibiotics; clean and disinfect hands and tools; and breeding resistant pepper genotypes.

5. Alfamovirus

Viruses of the Alphamovirus genus are ssRNA. Clover mosaic virus (AMV) is a member of this genus, whose natural hosts include more than 250 plant species and is closely related to CMV.

a) Alfalfa Mosaic Virus (AMV)

Many aphid species transmit clover mosaic virus (AMV) mechanically and nonpersistently. Pepper seeds or pollen can also transmit AMV. A bright yellow or white mosaic pattern on pepper leaves is an indication of AMV in the pepper. Slow growth and visible, misshapen fruits are other symptoms, especially when the plant is affected at a young age. Clover mosaic disease makes peppers susceptible to other diseases and may cause decline.

Management:

Clover mosaic disease can be effectively controlled by using insecticides to control aphids. Effective methods of controlling this disease include the use of resistant strains and normal plants.

6. Tospovirus

Important plant diseases belonging to the Tospovirus genus cause serious damage to many important crops. Members of this genus contain triplet ssRNA particles 80-120 nm in size. Tomato spotted wilt virus (TSWV) can infect many pepper species and is the main virus of the Tomato spotted wilt virus genus.

a) Tomato Spotted Wilt Virus (TSWV)

Major plant diseases of the genus Tospovirus, especially tomato spotted wilt virus (TSWV), cause serious damage to many important crops, including vegetables and ornamentals. Many thrips' species are implicated in the risk of infection. The best is the western flower plant (Frankliniella occidentalis). However, only mature thrips feeding on infected plants and inoculated for less than 48 hours can become infected. More than 1,000 different plant species from approximately 80 plant taxa have been identified as susceptible to tomato spotted wilt disease. The symptoms of this disease will be host specific. Yellowing or browning of the leaves, yellowing or necrotic rings on the leaves and fruits, necrotic lines on the stems along with the terminal buds and fruits are symptoms of pepper.

Management:

Early diagnosis and control of infected plants is important to reduce the prevalence of TSWV in the country. Ginger (Zingiber officinale) is an intercrop that can be intercropped with pepper to reduce the vector's ability to reach the host. Pesticides are also an important part of TSWV management.

7. Polerovirus

a) Pepper Vein Yellows Virus (PeVYV)

The disease is transmitted by dissemination and is not spread by cotton aphids and peach blight. Important hosts include Capsicum spp. Other hosts include Chenopodium amaranticolor, Curcubrita pepo, Datura stramium, Gomphrena globose and Nicotiana spp. Was recorded. Symptoms seen in pepper plants include leaf curling, deformation, small, wrinkled leaves, prominent veins, yellowing between veins and yellow spots on the leaves.

Management:

Prevention of PeVYV introduction is the best control method. Careful selection of plants, control of aphids and increasing awareness of disease symptoms will help prevent the spread of the disease.

Figure 1. Possible symptoms that can be observe on pepper in the field. (A) Mosaic pattern on leaves, (B) leaf mottling, (C) leaf curl, (D) vein banding, (E) vein yellowing and (F) leaf reduction.

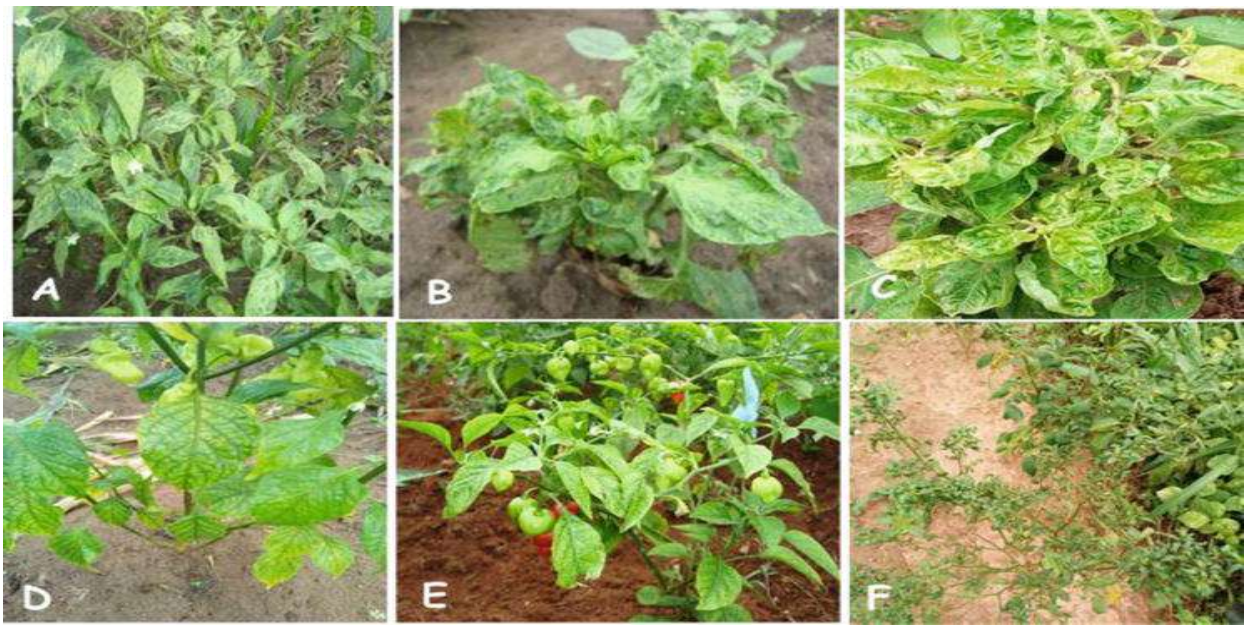


Figure 2. Comparison of healthy v/s diseased mottled virus plants of different capsicum varieties.

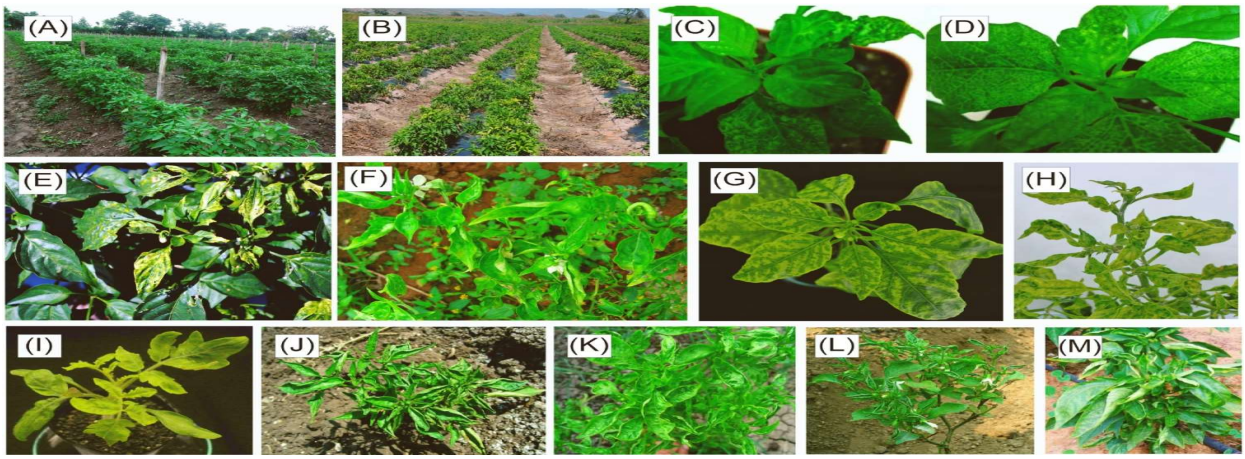
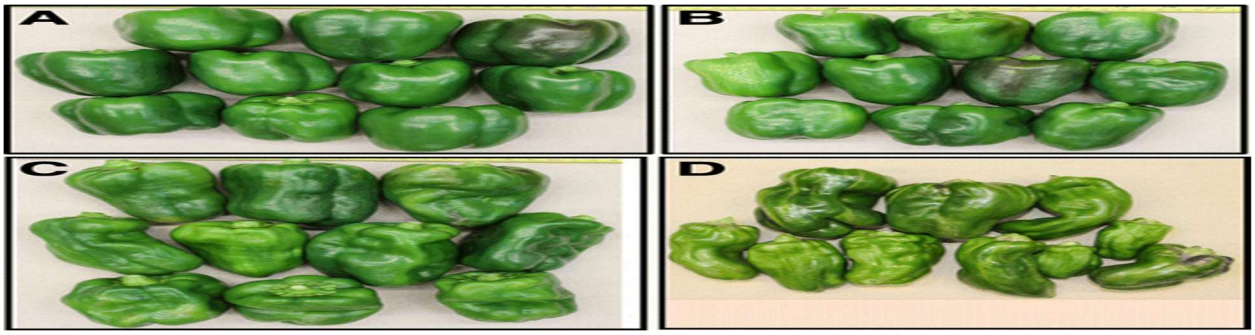


Figure 3. Various stages of tobacco virus infected capsicum fruit.



Conclusion

Diseases are still a major problem for successful pepper production worldwide, especially in underdeveloped countries. Viruses belonging to the genera Potyvirus, Cucumbervirus, Begomovirus and Tobaccovirus are currently of great concern to many producers as they affect yield. The environment, host species, and specific pathogens all influence disease severity. In many regions where disease outbreaks occur, it is often not possible to completely eliminate these diseases. However, using resistant varieties and providing adequate phytosanitary measures in the field will help prevent diseases as soon as possible. Therefore, in addition to the use of resistant varieties, local farmers need to be made aware of the effects of landscape management. To reduce disease occurrence, it is important to check seeds for disease before they arrive in the field. Finally, productivity increases in the pepper industry will benefit from the development of environmentally friendly disease control technology.

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