



Viral Diseases of Soybean

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Soybean is the world's foremost provider of protein and oil in recent day. Soybean viruses cause economic yield losses, and are sometime a major limiting factor in soybean production. Virus diseases can be diagnosed on the basis of their symptoms, the host reactions, vector specificity, particle morphology, and other features. Use of virus-free seed, rouging of the virus suspected plants, removal of weed host and use of botanical pesticides helps in better management of soybean viruses.

Introduction

Soybean, *Glycine max* (L.) is the world's foremost provider of primarily protein and secondarily oil. Soybean is called as "golden bean", "miracle bean" and "crop of the planet". It increases the soil fertility by fixing atmospheric nitrogen in soil. It is presently grown in many parts of the world, as a source of vegetable oil and protein. Soybean plant health is a critical component of profitable soybean production. Over hundred of plant diseases caused by viruses, fungi, bacteria and non-infectious agents are known to affect soybean. About 67 or more virus diseases have been reported to infect soybean worldwide, of which 27 viral diseases are considered to be a threat to the soybean cultivation. The viral diseases which cause economic losses in soybean are: *Soybean mosaic virus* (*Potyvirus*), *Cowpea mild mottle virus* (*Carlavirus*), bud blight caused by *Tobacco ring spot virus* (*Nepovirus*), *Mungbean yellow mosaic virus* (*Begomovirus*), *Alfalfa mosaic virus* (*Alfamovirus*), *Bean pod mottle virus* (*Comovirus*) and *Cucumber mosaic virus* (*Cucumovirus*).

***Soybean mosaic virus* (SMV):** It is the most prevalent virus and is recognized as the most serious, long-standing problem in many soybean producing areas in the world. SMV is a member of the genus *Potyvirus* in the family *Potyviridae*. Infection by SMV usually results in severe yield losses (8 to 50%) and seed quality reduction. SMV virions consist of filamentous, flexuous rod-shaped particles with 650-760 x 15-18 nm in dimension. The genome of SMV is a monopartite positive ssRNA molecule.

Host range: SMV has a relatively narrow host range, infecting six plant families, *Fabaceae*, *Amaranthaceae*, *Chenopodiaceae*, *Passifloraceae*, *Schropulariaceae* and *Solanaceae*, but mostly the *Leguminosae* including soybean and its wild relatives.

Symptoms: In SMV-infected soybeans symptoms commonly observed include rugosity, dark green vein banding and light green inter-veinal areas, stunting, leaf curling and seed coat mottling, necrosis, sometimes necrotic local lesions, systemic necrosis and bud blight.

Transmission: About 30% or more of the seeds from SMV-infected soybean plants carry SMV depending on cultivar and time of infection before flowering. Weeds and other plants may also serve as a reservoir of SMV. Further spread within and among soybean fields is through the

activity of more than 32 different aphid species in a non-persistent manner. In addition, SMV can be efficiently sap-transmitted.

Management

- Plant seeds free of SMV.
- Selection and use of resistant varieties.
- In seed-producing fields, rouging of the virus suspected plants.
- Do not plant seed produced in late season plantings.

Cowpea mild mottle virus (CPMMV): CPMMV is a member of genus *Carlavirus* under the plant virus family *Flexiviridae*. Virions contain a single molecule of positive sense ssRNA, usually straight filaments 650 nm long and 13 nm wide.

Symptoms: Field symptoms associated with virus infection, including mosaic, mottling, vein clearing, dwarfing and leaf crinkle.

Host range: It mainly infects in the family, *Fabaceae*, *Solanaceae* and *Chenopodiaceae*. The major hosts of CPMMV are cowpea, groundnut, soybean, common bean, tomato and bambara groundnut.

Transmission: It can be transmitted from plant to plant mechanically by sap, whitefly (*Bemisia tabaci*) in a non persistent manner and also through the seeds of soybean.

Management

- Use disease free seed.
- Selection of resistant varieties.
- Since CPMMV is transmitted mechanically, avoid handling or brushing up against infected plants whenever possible.

Tobacco ringspot virus (TRSV): It is a member of the genus *Nepovirus* in the family *Comoviridae*. Virus particles are isometric, about 28 nm in diameter with a bipartite RNA genome. Some isolates are associated with a satellite RNA.

Symptoms: Principal symptoms include stunting, leaf distortion, and characteristic browning and curling of the terminal branch. The clearest symptoms are the proliferation of buds and flowers and poorly formed pods.

Host range: It causes significant disease in soybeans, tobacco, *Vaccinium* spp., especially *V. corymbosum*, and *Cucurbitaceae*. Many other hosts have been found naturally infected, including: anemone, apples, blackberries, capsicum, cherries, gladiolus, grapes pelargonium, petunia and various weeds.

Transmission: It is transmitted by the nematode *Xiphinema americanum*. The virus is acquired within 24 hours and is transmitted by both adult and larval stages. A number of other vectors have been suggested: *Thrips tabaci* and *Melanoplus differentialis* (grasshopper). The virus is readily transmitted mechanically to herbaceous hosts. Seed transmission has been reported in soybean (up to 100%).

Management

- Plant virus-free seed.
- Avoid fields infested with dagger nematodes or apply an appropriate nematicide, if feasible.
- Removal of stubbles and grasses on bunds as disease is generally more severe near pastures or at the edges of fields.

Mungbean yellow mosaic virus (MYMV): It is caused by a virus belonging to the genus, *Begomovirus* of the family, *Geminiviridae*. Virions have single-stranded circular DNA genomes encoding genes that diverge in both directions from a virion strand origin of replication.

Symptoms: Yellow mosaic symptoms on leaves and stunted growth of soybean plants. The most prominent symptom on the foliage starts as small yellow specks along the vein-lets and spreads over the lamina; the pods turn into thin and curl upwards.

Host range: The significant hosts of MYMV include mung bean, urd bean, moth bean, pigeon pea, soybean, cowpea and common bean.

Transmission: MYMV is transmitted by the whitefly *Bemisia tabaci* in persistent (circulative) manner and grafting but not by sap and seed.

Management

- Basal application of botanical insecticides controls the whitefly population.
- Maintenance of good field sanitation by removing the crop residues and weeds is effective against whiteflies.
- Avoiding excess use of nitrogen fertilizer, including manures, as succulent growth will amplify whitefly populations.

Alfalfa mosaic virus (AMV): It is a member of the genus *Alfavirus* in the family *Bromoviridae*. The genome of AMV consists of three positive sense RNAs (RNAs 1 through 3).

The icosahedral symmetry of the capsid is round to elongate.

Host range: It is remarkably wide, including the agriculturally valuable crops, soybean, alfalfa, tomato, lettuce, common bean, potato, white clover and soybean.

Symptoms: It naturally soybean causing bright yellow mosaic leaves and vein yellowing symptoms on soybeans. Plants also can be stunted and produce few pods.

Transmission: The virus is transmitted by mechanical inoculation or by an aphid vector.

Management

- Use of resistant varieties.
- Control of the aphid vector as a means of virus management.

Bean pod mottle virus (BPMV): BPMV is a member of the genus *Comovirus* in the family *Comoviridae*, has a bipartite positive-strand RNA genome consisting of RNA-1 and RNA-2 which are separately encapsidated in isometric particle 28 nm in diameter. Soybean yield losses due to BPMV have been reported to range from 3 to 60%.

Host range: It infects soybean, snap bean and many other legumes.

Symptoms: The young leaves of infected soybean plants will turn light green to yellow and puckering of the leaves. BPMV is a cause of the green-stem syndrome.

Transmission: The virus is disseminated most commonly by the bean leaf beetle in soybean. Seed transmission has been documented, but appears to occur at a very low percentage (0.1%).

Management

- Selection and use of resistant varieties.
- Control of the leaf beetle vector as a means of virus management.
- Adjusting planting date to avoid peak beetle populations when soybeans are young should decrease severity of disease

Cucumber mosaic virus (CMV): CMV is a member of the genus *Cucumovirus* in the family *Bromoviridae*. It consists of spherical particles about 30 nm in diameter. It is a linear positive-sense, single-stranded RNA virus. Its total genome size is 8.6 kb and is broken into three parts. It contains a tripartite positive sense RNA genome (RNAs 1–3).

Symptoms: CMV generally produces mosaic, and stunting symptoms in soybean plants, but many cultivars show only indistinct symptoms. Seeds from infected soybean plants sometimes show the ring type of brown mottle symptoms

Host range: This virus has a worldwide distribution and a very wide host range over 1000 plant species.

Transmission: It can be transmitted from plant to plant mechanically by sap, aphids in non persistent manner and through the seeds of soybean.

Management

- The use of resistant varieties.
- Use a “trap crop” method.
- Crop growers also often spray mineral oil on their plants as the aphids do not like the mineral oil.

Conclusion

Viral diseases cause maximum losses in soybean yield. Various strategies including the use of disease free seeds, growing of disease resistant variety, rouging of infected plants, removal of collateral host, and control of insect vectors, use of botanical pesticides reduces these setback diseases.

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