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Plant Viruses – A Threat to Sustainable Agriculture

Kochan Bhoopesh Banusree
College of Agriculture, Vellayani, Thiruvananthapuram, Kerala 695522
*Corresponding Author: banusreebhoopesh@gmail.com

Contemplated as severe threat to agriculture, pathogenic plant viruses cause losses in billions of dollars every year. The harmful plant pathogenic viruses cause several destructing as well as devastating diseases across the globe. History of plant virology can be traced back to sixteenth century; a phenomenon called Tulipomania which flourished the market for tulips. It refers to the 'broken flower colour with variegations' symptoms. Tulip breaking virus belonging to the family potyviridae was responsible for the colour breaking of tulip flowers. Intricate bars, streaks or simply stripes are caused by the virus infecting the bulb of the flowers. The variegation is probably due to the escalation of the pigments in the vacuoles of higher epidermal layer ascribed to the jerky dispersion of anthocyanin. Since each exterior portion was influenced by the activity of the virus, both sides of the petal exhibit different patterns. It was later found out to be caused by potyvirus groups. Since then, a lot of discoveries and experiments led to the modern discovery of plant viruses.

Invisible to the naked eye, viruses are perceived through a light microscope. A virus exists as nucleoprotein that become numerous inside live cells which gradually parasitize the host and possess the ability to cause disease. Roughly fifty per cent of the existing viruses are known to invade and bring about malady in plants. Generally, a plant might be contaminated by more than one kind of viruses. Apart from shape and size plant viruses vary among other plant pathogens additionally in chemical composition, conformation, infection routine, dissemination etc.

Criteria used for classifying viruses

a. Structure of virus particle

b. Physicochemical properties of virus particles

c. Properties of viral nucleic acids

d. Plant viral proteins

e. Serological relationships

f. Activities in the plants

g. Methods of transmission

Types of plant viruses

Tobacco mosaic virus

The most excruciating virus in the whole plant virology clique. M W Beijernick regarded as the foremost scientist credited for delineating tobacco mosaic virus as tiny contagious body during 1898. Disease caused by TMV as an infection rather than a mere physiological out-turn or an enzyme action was proved through meticulous demonstrations and experiments by H. A. Allard of USDA (united states department of agriculture). TMV belongs to the genus Tobamovirus. A single TMV particle comprises two thousand one hundred thirty copies of the coat protein. Single stranded RNA encodes background es four genes. Necrosis, mottling, stunting, leaf curling can be some of the symptoms and signs which are largely dependent on the age, environmental condition, and genetic background of the host plant.

Tomato spotted wilt virus

TSWV make themselves distinct amidst other plant viruses in particular as virions are enwrapped in the acquired membrane of the host, contain one negative sense and two antisense SSRNA consolidated in multiple copies of viral nucleoside protein. The earliest elucidation of 'spotted wilt' tomato disease manifested in Australia around 1915. Thrips are responsible towards transmitting such disease.

Tomato yellow leaf curl virus

TYLCV causes catastrophic diseases of tomato globally. Belonging to the genus Begomo virus, they are transmitted by whitefly *Bemisia tabaci*. TLYCV has single stranded circular DNA genome enveloped in capsid comprising two joined incomplete icosahedra of twenty-two capsomere. They replicate by rolling mechanism.

Cucumber mosaic virus

Typical member of the genus cucumovirus, CMV are icosahedral in shape, consisting of one eighty subunits of single cp of 24kDa and genomic RNAs. CMV strains are widely classified as subgroup 1 and subgroup 2 on the basis of nucleic acid. The CMV

genome comprises of five genes expressed either three genomic RNAs or two subgenomic RNAs.

Potato virus Y

PMY own filamentous and curved particle. A viral genome linked protein is covalently attached to 5′ end of RNA and a tail is present at 3′ end. PVY are responsible for the alteration of chemical composition, height reductions in plants. They are transmitted by more than forty species of aphids.

Cauliflower mosaic virus

They are pararetrovirus and do not employ true retrovirus genomic integration apart of its lifecycle. The promoter of 35s RNA is responsible for prominent gene expression in dicot plants, but are futile in monocots especially in grains like cereals.

African cassava mosaic virus

Belonging to the family geminiviridae, vector transmission by whitefly *Bemisia tabaci*, ACMV consists of two single stranded DNA molecules. Mosaic of leaves, chlorosis are symptoms associated with the disease.

Papaya ring spot

Considered sometimes as sole devastating disease of papaya, this disease occurs globally from tropics to island countries. Profit from cultivation of papaya becomes unfeasible when affected with this disease. Intense yellow mosaic on leaves, small shoestring-like new leaves, dark green and slightly sunken rings on fruits are some of the symptoms.

Turnip mosaic

Occurring around the world it influences all types of vegetables and ornamental crucifers. It come into sight as spots (necrotic) in black colour, mottling, leaf distortion and stunting. Turnip mosaic is being transmitted by fifty species of aphids.

Plum pox

Appears globally in most of the European countries, Asia and Chile. Sometimes indicated as 'Sharka' this disease affects plum, peach, apricot and nectarine. Dark colored loops or as smudge on peel of fruits, red or brownish discoloration on the flesh, mottling of the leaves could be ruled out as some common symptoms.

Control measures against plant viruses

The most fruitful control of the plant viruses is the use of disease resistant variety. Usage of certified virus free planting material. Crop rotation can be another alternative. Raising trap crops which trap insect vectors that are liable for transmission of the disease.

Effects of viral diseases in agriculture

Viral diseases are known to cause critical consequence on the growth and development of plants. Occasionally it might be beneficial or harmful, according to the circumstances which the plants have grown up. The gross harmful effects of viral diseases are poor yield, discoloration, distortion, and distasteful fruits that lead to moderate to massive losses in market. Sometimes virus makes plants capable of withstanding biotic and abiotic stresses.

Despite such obstacles persisting favorable profit has also been generated in the market, as in the case of tulips: tulipomania (mentioned earlier).

Conclusion

As mentioned earlier only fifty per cent of the plant viruses are pathogenic in nature, and some of them can be regarded as beneficial. There are almost thousand plant viruses discovered so far. Plant pathogenic viruses are known to cause considerable negative impact on plant community. Symptoms ranging from discolouration of fruits, distortion, loss of vigour and yield Nevertheless the rising demand for good quality products forces the farmer to choose virus free products. Hence sometimes virus infected plants can be disregarded and left untreated leading to explosive increase in their number. Beneficial effects of virus have to be investigated upon and their potential can be exploited.

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