

Modes of Spread of Plant Pathogens

The plant viruses, being obligate parasites, require an injury in order to get into the plant tissues. The spread of these organisms is altogether different. The transmission of plant pathogens takes place through two different mechanisms under natural conditions (vertical transmission and horizontal transmission). This topic is elaborated in detail in the paragraphs below. The spread of all the plant pathogens is through both living and non-living agents (Table 2.1; Fig. 2.1). The vertical transmission mode of spread involves vegetative propagation, such as grafting, mechanical means, seed/pollen transmission and parasitic plants. The other means viz. insects, mites, nematodes, fungi, protozoa, animals, birds, slugs and earthworms in the living category, and air, water and soil in the non-living, are known to spread via horizontal pattern.

2.1 Vertical Transmission

2.1.1 Vegetative propagation

Vegetative propagation is an important practice, used as a means to improve the quality of fruit and flowering plants. This process involves the use of plant parts, such as tubers, rhizomes, suckers, and corms, to plant crops. Viruses are systemic in nature; thus, all plant parts are known to carry plant viruses since the infected plant parts are often used as seed or for grafting purposes, without there being any knowledge of the viruses that they are spreading. The vegetative plant parts are taken to far-off places by various methods of human transportation. This method of propagation is extensively used, and is the most common way of spreading plant viruses in crop plants, particularly in horticultural crops. The vegetative propagation

Table 2.1 Transmission/spread of plant viruses through different means.

Sl. No.	Mode of spread	Part(s)	Virus	Mechanism	Source(s)/Remarks
1	Vegetative Propagation	Tubers	Potato virus X (PVX), Potato virus Y (PVY), Potato leaf roll virus (PLRV), etc.	Seed potato; contaminated implements; transportation of seed	Hollings, 1965
		Cuttings	Rose mosaic virus (RMV), Sugarcane mosaic virus (ScMV)	Cutting implements due to systemic nature of plant viruses	Hollings, 1965
		Rhizomes	Canna yellow mottle virus (CaYMV)	On account of systemic nature of plant viruses	Hollings, 1965
		Corms	White break mosaic virus (WBMV), Cucumber mosaic virus (CMV)	Viruses being systemic and all parts contain virus	Hollings, 1965
		Suckers	Banana bunchy tops virus (BBTV)	Viruses are systemic	Hollings, 1965
2	Mechanical means	Sap inoculation	Tobacco mosaic virus (TMV), potato virus X (PVX)	During sap inoculation; contaminated hands; contaminated implements	Gray and Banerjee, 1999
		Grafting	Citrus tristeza virus (CTV), Apple mosaic virus (ApMV)	All parts carry virus due to systemic nature of viruses	All viruses are transmissible
3	Vectors	Animals (cow, monkeys, grass rats)/ human activity; use of contaminated implements for tillage, etc.	Rice yellow mosaic virus (RYMoV), Tobacco Mosaic Virus (TMV), Seed borne viruses	Through injury while moving in field; transportation of seed; ingestion of contaminated seed pass out through faeces; human activity with agricultural implements	Sara and Peters, 2003

		Birds (sparrows, weaver bird, bulbul, and other birds)	Rice yellow mosaic virus (RYMoV)	Carry contaminated plant parts; ingest infected seed; contaminated body and appendages; pollination process	Peters et al., 2012
4	Non-living agents	Soil (through particles, soil inhabiting fungi and nematodes)	Lettuce big vein virus (LBVV), Wheat mosaic virus (WMV), Tobacco rattle virus (TRV), Tobacco ring spot virus (TRSV)	Adherence of viruses on soil particles and movement through tillage operations and through soil inhabiting organisms	Campbell, 1996
		Air (through injury of strong wind)	Tobacco mosaic virus (TMV)	Highly infectious viruses through strong wind injury	It causes injury for passive entry of the virus
		Water (soil borne pathogens)	Soil-borne fungi and nematodes	Transportation of soil borne viruses through the movement of soil organisms in the soil	Bacteria spreads Through Water
5	Parasitic plants	Cuscuta, mistletoe	Most viruses (viruses being systemic in nature)	Through human activity birds carry Cuscuta for nest building	Viruses Spreads Through penetration of haustoria
6	Natural spread	Seeds	Alfalfa mosaic virus (AMV), Arabis mosaic (ArMV), Cowpea mosaic virus (CPMV), Leaf crinkle virus (LCV), Bean common mosaic virus (BCMV), Cherry leaf roll virus (CLRV)	Use of infected seed in the case of Seed borne viruses	Latham and Jones, 2001; Sharma et al., 2007; Choi et al., 2006; Dinesh et al., 2007; Cooper et al., 1984
		Pollen	Prunus necrosis ring spot virus (PNRSV), Prune dwarf virus (PDV), Cucumber green mottle virus (CGMV)	Transportation of infected pollen through living agencies, especially through pollinating insects	Cooper et al., 1988; Liu et al., 2014

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Sl. No.	Mode of spread	Part(s)	Virus	Mechanism	Source(s)/Remarks
7	Protozoa	<i>Phytomonas</i>	Hart rot of coconut, Phloem necrosis of coffee	Phloem inhabiting organisms are transmitted	Alves-Silva et al., 2013
8	Nematodes	Soil nematodes	Fan leaf of grapevine virus (GFLV), Arabis Mosaic virus (ArMV), Tobacco rattle virus (TRV) Raspberry ring spot virus (RaspRSV), Tomato ring spot virus (TRSV), etc.	Genera of nematodes viz <i>Xiphinema</i> , <i>Longidorus</i> , <i>Trichodorus</i> , <i>Paratrichodorus</i>	Jones et al., 2013
9	Fungi	Soil fungi	Lettuce big Vein virus (LBVV), Wheat Mosaic virus (WMV), Cucumber necrosis virus (CNV), Tobacco necrosis virus (TNV)	<i>Ospidium</i> , <i>Polymyxa</i> , <i>Spongospora</i> , <i>Synchytrium</i>	Campbell, 1996
10	Mites	Arachnids	Wheat streak mosaic virus (WStMV), Barley stripe virus (BSV), Brome mosaic virus, (BMV), etc.	Mites of families viz. Eriophyidae; Tetranychidae	Sarwar, 2015
11	Insects	Insects (Hemiptera; Thysanoptera; Coleoptera; Hymenoptera; Orthopteran; Dictyoptera; Dermaptera; Lepidoptera; Diptera)	Cucumber mosaic virus (CMV), Cauliflower mosaic virus (CaMV), Tomato spotted wilt virus (TSWV), Tomato yellow leaf curl virus (TYLCV), Turnip yellow mosaic virus (TYMV), etc.	Transmission mechanism viz. non-persistent–stylet borne, semi-persistent-foregut-borne, persistent circulative and persistent propagative	Nault, 1997

TRANSMISSION OF PLANT PATHOGENS

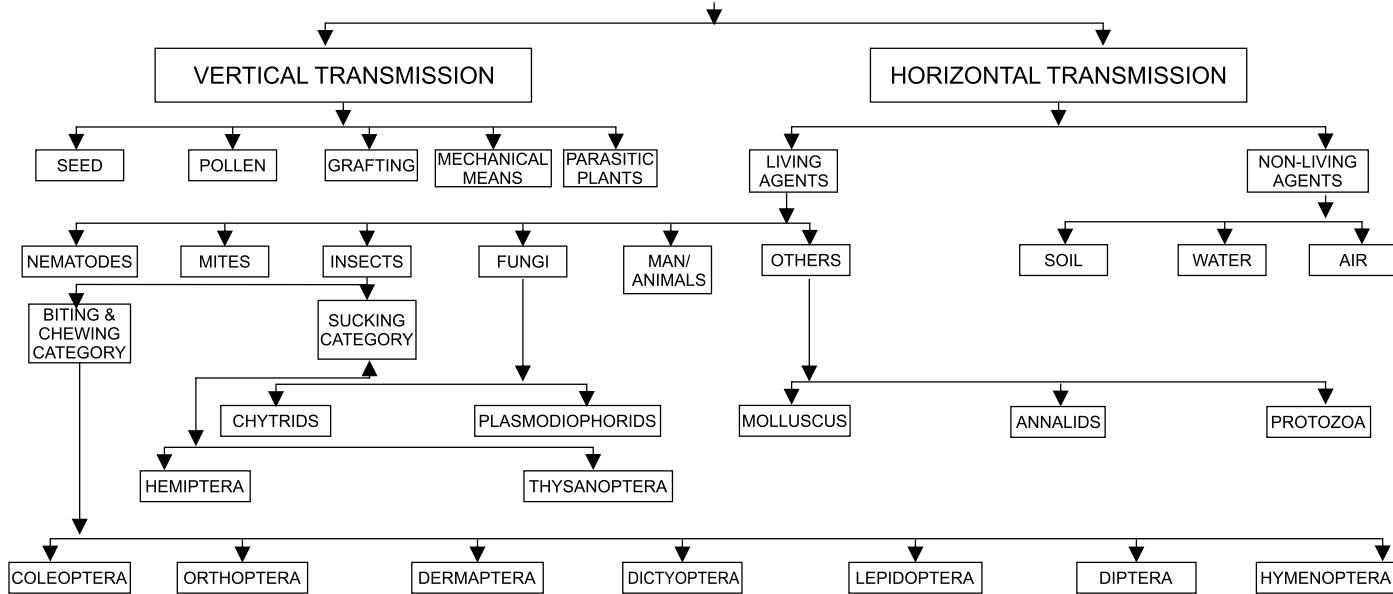


Fig. 2.1 Modes of Spread of Plant Pathogens.