8. Transmission of Viruses

8.1 Mechanically Transmissable Viruses of Potato

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8.1.1 Introduction

In the early 1900's farmers, potato breeders, and plant pathologists described problems in potatoes now believed to have been caused by viruses. Terms such as "running out" and "degeneration" were coined to describe the general "loss of vigor," "loss of stamina," and "loss of yielding power" associated with tubers harvested from potato cultivars affected by viruses (Krantz and Bisby, 1921; Whipple, 1919). Schulz et al. (1919) and Schulz and Folsom (1920) were able to mechanically transmit a "mosaic dwarf agent," probably *Potato virus Y* genus *Potyvirus* (PVY), but perhaps including *Potato virus X* genus *Potexvirus* (PVX), to potato that caused running out. The discovery that several North-American potato cultivars that appeared to be healthy, but were infected with one or more mechanically transmitted viruses, was made by Johnson (1925). He transmitted a virus or viruses latent in potato plants, to several other *Solanaceous* spp. including tobacco, tomato, and eggplant, which subsequently developed various symptoms including mild mottle, spot-necrosis or ringspot. The virus or one of the viruses he transmitted mechanically eventually came to be known as PVX. Since then, numerous viruses mechanically transmissible to potato...
have been characterized. Some also have vectors that serve as the principal means of transmission (Table 8.1).

Virus-infected seed tubers serve as an important source of primary inoculum for mechanically transmitted viruses. Depending on the virus, secondary spread from infected seed tubers occurs during seed handling and, following tuber sprouting and plant growth, via plant-to-plant contact. The degree to which the spread of mechanically transmissible viruses occurs is dependent on many factors, including the host, environment, and foliage contact by animals, equipment, and man. The detection and elimination of infected seed tubers effectively reduces the carryover and geographical movement of virus inoculum, and, thus forms the basis for maintaining healthy potato seed stocks. Factors influencing the movement of viruses to tubers and the secondary spread of inoculum are discussed below.

8.1.2 Penetration and Host Infection by Mechanically Transmitted Viruses

Mechanically transmissible viruses have no intrinsic means for entering through the surface of intact plants. Wounds that permit virus entry into cells, yet are not severe enough to preclude infection by killing cells, are avenues for virus entry. Inoculum efficiency for mechanically transmissible viruses is increased in the presence of abrasive powders on foliage during mechanical inoculation (Matthews, 1970). Increased wounding caused by the abrasive increases the frequency of infectable wounds created during mechanical inoculations. Under natural conditions in the field, sublethal wounding of plant cells readily occurs during normal leaf abrasion, cultivation practices, and through other types of foliar contact, including that by various animals and man.

Matthews (1970) estimated that mechanical inoculation requires $10^4$ to $10^5$ virus particles applied to leaf surface for each cell infected. Therefore, it follows that the spread of mechanically transmissible viruses to healthy plants is favored by high concentrations of the virus in epidermal cells and if the host plants are easily wounded during abrasion. This scenario places the greatest concentration of viral inoculum at the infection court. Indeed, inclusion bodies containing virions of various mechanically transmitted viruses are present in plant cells associated with the leaf surface, and all epidermal cell types including leaf hairs and guard cells, are capable of becoming infected during mechanical inoculation (Matthews, 1970). The presence of numerous ectodesmata, the plasmodesmata that occur in the outer cell wall of epidermal cells, also may increase host susceptibility during mechanical inoculation by providing pathways for virus entry (Brants, 1964; Thomas and Fulton, 1968). Virus particles directly in contact