**Unit 3: Plant Disease Epidemiology**

**Concepts of monocyclic, polycyclic and polyetic diseases**

Some pathogens complete only one, or even part of one, disease cycle in 1 year and are called monocyclic, or single-cycle, pathogens (Fig. 2-22).

Diseases caused by monocyclic pathogens include the smuts, in which the fungus produces spores at the end of the season (these spores serve as primary — and only — inoculum for the following year); many tree rusts, which require two alternate hosts and at least 1 year to complete one disease cycle; and many soil borne diseases, e.g., root rots and vascular wilts. In root rots and vascular wilts, the pathogens survive the winter or summer in decaying stems and roots or in the soil, infect plants during the growth season, and, at the end of the growth season, produce new spores in the infected stems and roots.

These spores remain in the soil and serve as the primary inoculum the following growth season. In monocyclic pathogens the primary inoculum is the only inoculums available for the entire season, as there is no secondary inoculum and no secondary infection. The amount of inoculum produced at the end of the season, however, is greater than that present at the start of the season and so in monocyclic diseases the amount of inoculums may increase steadily from year to year.



In most diseases, however, the pathogen goes through more than one generation per growth season, and such pathogens are called polycyclic, or multicyclic, pathogens (Fig. 2-22).

Polycyclic pathogens can complete many (from 2 to 30) disease cycles per year, and with each cycle the amount of inoculum is multiplied manyfold. Polycyclic pathogens are disseminated primarily by air or airborne vectors (insects) and are responsible for the kinds of diseases that cause most of the explosive epidemics on most crops, e.g., downy mildews, late blight of potato, powdery mildews, leaf spots and blights, grain rusts, and insect-borne viruses.

In polycyclic fungal pathogens, the primary inoculums often consists of the sexual (perfect) spore or, in fungi that lack the sexual stage, some other hardy structure of the fungus such as sclerotia, pseudosclerotia, or mycelium in infected tissue. The number of sexual spores or other hardy structures that survive and cause infection is usually small, but once primary infection takes place, large numbers of asexual spores (secondary inoculum) are produced at each infection site and these spores can themselves cause new (secondary) infections that produce more asexual spores for more infections.

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In some diseases of trees, e.g., fungal vascular wilts, phytoplasmal declines, and viral infections, the infecting pathogen may not complete a disease cycle, i.e., it may not produce inoculum that can be disseminated and initiate new infections, until at least the following year and some may take longer. Such diseases are basically monocyclic, but if they take more than a year to complete the cycle, they are called polyetic (multiyear).

There are pathogens, however, such as those causing several rusts of trees and the mistletoes, that take several years to go through all the stages of their life cycle and to initiate new infections. These pathogens and the diseases they cause are clearly polyetic. Although polyetic pathogens may not cause many new infections over a given area within a single year and their amount of inoculum does not increase greatly within a year, because they survive in perennial hosts they have the advantage that, at the start of each year, they have almost as much inoculums as they had at the end of the previous year.

Therefore, the inoculum may increase steadily (exponentially) from year to year and may cause severe epidemics when considered over several years. Examples of such diseases are Dutch elm disease, cedar apple rust, white pine blister rust, and citrus tristeza.