# Plant pathogens

There are two types of pathogens in plants diseases….

1- Non-parasitic pathogens.

2 - parasitic pathogens.

## 1- Non-parasitic pathogens

Uncomfortable climate, environmental conditions, soil, or inappropriate agricultural processes usually limit plant growth, but are considered sick only when these specific factors are so severe that they produce abnormal plants.

### 1- Inappropriate temperatures

Each plant has an optimal temperature of growth usually between 15-30 $^{O}$C. At other near optimal temperatures, the plant stops growing but is not sick. In extreme heat and cold, the plant is damaged and eventually dies. Under floor temperatures may damage plant cells to form ice crystals in or between cells, rupture cell membranes and cause death.

High temperatures cause wilt due to high heat, causing pollen to be unwell or plants suffer from the death of the cambium due to the high temperature of the surface layers of the plants.

### 2- Loss of oxygen

In soils saturated with water the roots of most plants die from suffocation and become unable to absorb water and therefore die from drought. Dead plant patches in lowing areas are often due to root deaths in soil saturated with water.

### 3- Decrease and increase in mineral elements

Deficiency in one or more essential elements may cause disease of the plant, that O, H, C The most important elements of plant nutrition are N, P, S, K, Ca, Mg, Fe and the less important elements are Br, Mn, Cu, Z, Mo. These elements are essential for all plants and some may need other elements such as chlorine, Under certain conditions, plants with a lack of these essential elements grow weak and exhibit distinctive symptoms. The decrease in N, S causes yellowing and the phosphorus-deficient plant appears blue-purple to purple. In calcium- deficient plants, peripheral buds die and their leaves wrinkle.

Na increase naturally in arid areas and may cause yellowing symptoms and increase other elements causing yellowing, dwarfing and high concentrations of ions. There is no growth of plants because of their toxic effects.

**4- Toxic gases**

There are many polluting gases that can cause damage to plants, the most important of which is sulfur dioxide and ethylene gas, which causes yellowing and cell death. Ethylene gas can cause the formation of roots and the wrapping of leaves because of inhibiting the growth of meristimatic tissues.

# 2- Parasitic pathogens

**Koch's postulates**

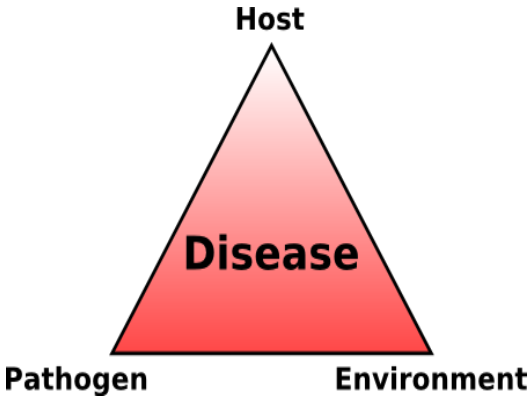
The fact that a particular organism accompanies the disease does not necessarily mean that the organism is the causative agent, as it may be a secondary gas of a thermo active nature that has entered after the disease.

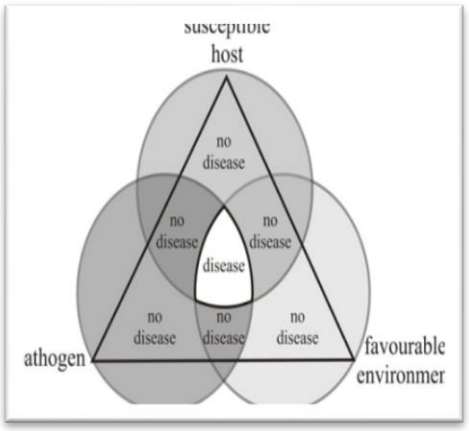
In 1884, the Scientist Koch's put several conditions that must be met before we prove that the organism is the causative agent.

1. The organism is permanently associated with the sites of the disease.
2. The living organism must be isolated and cultured in a pure and free manner from other organisms.
3. The living organism should be injected from the pure culture to the healthy plant, which belongs to the same species from which the organism was isolated and should cause the same disease as was observed in the original.
4. The organism must be isolated again and re-injected and result in the same original disease again.

## Triangle disease

Plant diseases can be analyzed conveniently using the concept called the 'Disease Triangle this places the three factors which must interact to cause plant disease at the three corners of a triangle. Those three factors are: ... disease causing organism (the pathogen) favorable environment for disease.






These three elements, pathogen, host, and environmental conditions, make up the disease triangle. The disease triangle is a concept that illustrates the importance of all three elements—just as there are three sides to a triangle, there are three critical factors necessary for disease to develop.

1 - A parasitic organism capable of causing the disease
2 - sensitive host to infection.
3. Environmental conditions suitable for the occurrence to the infection.

## Plants diseases development

Pathogen is successful in its parasitism if it has the specifications that enable it to continue life and the infection and complete diseases development in plants by :

### 1- Pathogens infection

Some viruses and most phytoplasmas are carried by insects, especially sucking insects such as aphids, and others are transmitted mechanically by humans touching, Many fruit trees viruses are transmitted by grafting.

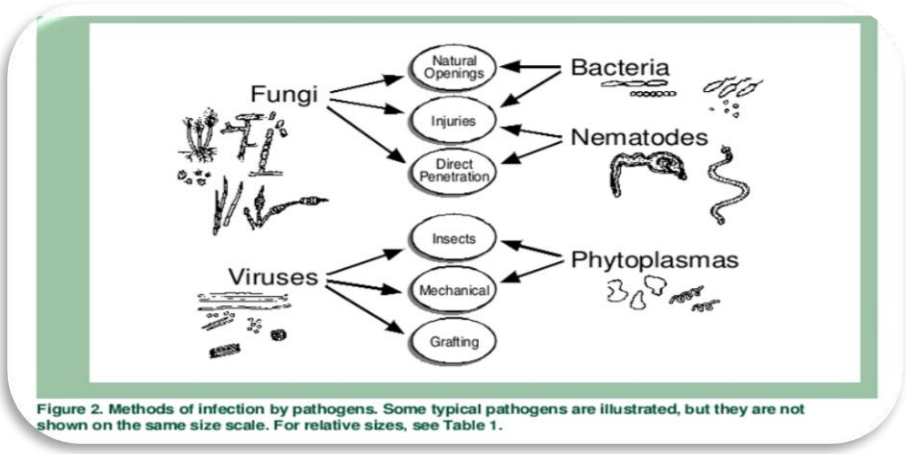



Figure 2. Methods of infection by pathogens. Some typical pathogens are illustrated, but they are not shown on the same size scale. For relative sizes, see Table 1.

Pathogens (Fungi, bacteria and viruses) can infected plants in several ways. may penetrate (enter) through :

**A : Enter Pathogens through wounds**

Many fungi pathogens can not enter the host's tissue through the natural openings, but needed to form wound in the host's body so that the

pathogen can enter through them, Wounds forming from the exposure of the plants to certain environmental factors such as wind and various agricultural processes and insects.

**B : Natural openings such as the stomata**

Like many pathogens such as bacteria *Erwinia amylovora* which caused disease fire blight in pear.

Many fungal spores germination at the surface of host and growth germ tubes in a direction of stomata and apical hypha swelling and produce structure called **Appresorium** .

Appresorium produced infection hyphe (direct penetrated) or infection pigs (mechanical and chemical penetrated), after the penetrated hyphe branched and produce the **Haustoria** such as infection by uredospores in fungi cause rusts disease .

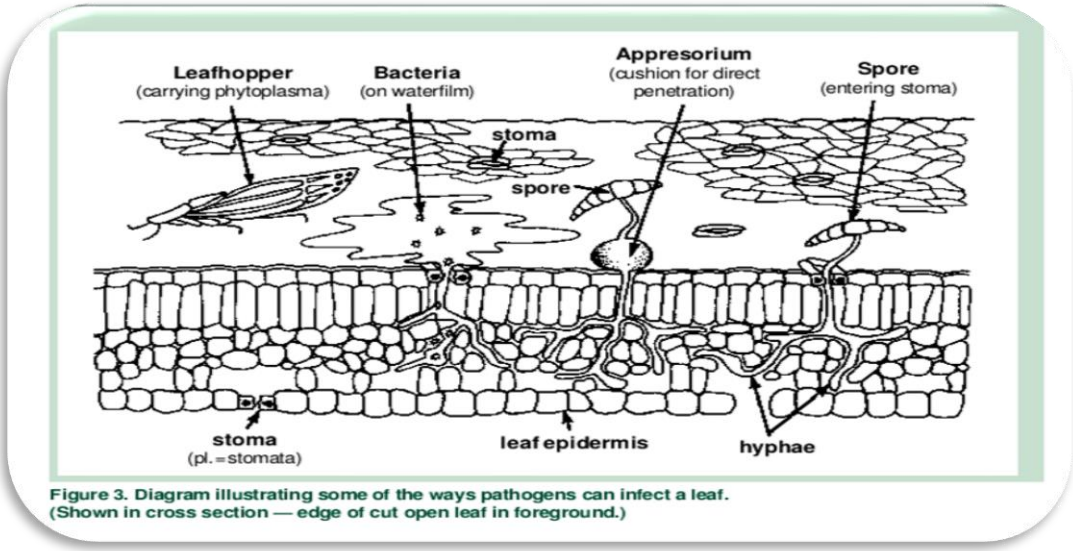


Figure 3. Diagram illustrating some of the ways pathogens can infect a leaf. (Shown in cross section — edge of cut open leaf in foreground.)

## Haustoria

Haustoria are of various shapes and sizes ranging from knob like structures ,to simple, lobed ,branched ,coiled or coralloid hyphae .haustoria penetrate the cell wall but do not rupture the plasma membrane even though they ramify extensively.

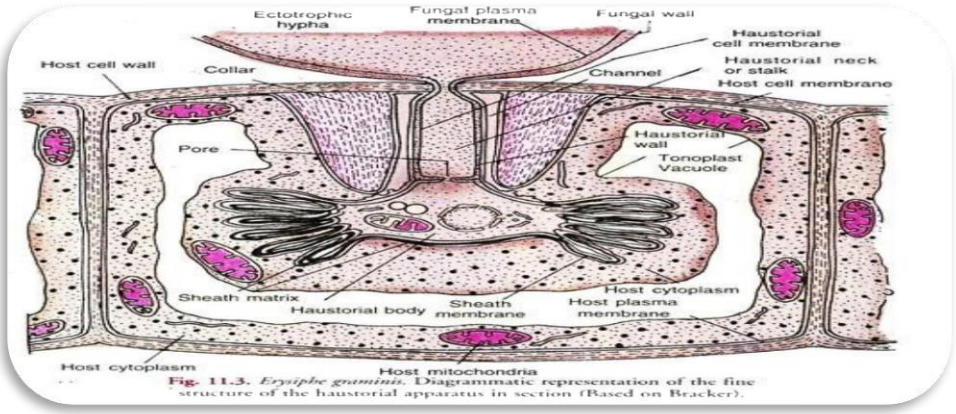


Fig. 11.3. *Erysiphe graminis*. Diagrammatic representation of the fine structure of the haustorial apparatus in section (Based on Bracker).

**Types of Haustoria**

1- Simple binucleate haustorium.
2- Lobed multinucleate haustorium.
3- Branched filamentous haustorium.
4- Simple uninucleate haustorium.
5- Forked haustorium.
6- Finger like haustorium.

## 2- Pathogens reproduction in the host tissues and causing infection

Pathogens differ in their ability to reproduce spores rapidly in large numbers. The success of the pathogen in causing pathogenicity depends on the extent of his ability to reproduce quickly in a short time.

## 3- Disseminations of pathogens

Pathogen and its spores are considered to be low dangerous if they spread from one place to another limitedly . Pathogens are disseminated (spread) by:

A: (Air )Wind B: Insects C : Water

D : Human E: Animals and birds F : Pollen grains
H : Agricultural processes G : Plants producers

## 4- Tolerant of pathogens to inappropriate conditions

Fungi form special spores with thick wall such as chlamydospores and zygospores and sclerotia. Some viruses have ability to inappropriate the dray and high temperatures , and some nematode resistance Inappropriate conditions therefore Turn into eggs to resist inappropriate conditions.

## 5- pathogen adaptation

The ability of pathogens to change some of their living and parasitic properties in proportion to the environmental changes that may occur when the parasite moves from one place to another or the host difference.

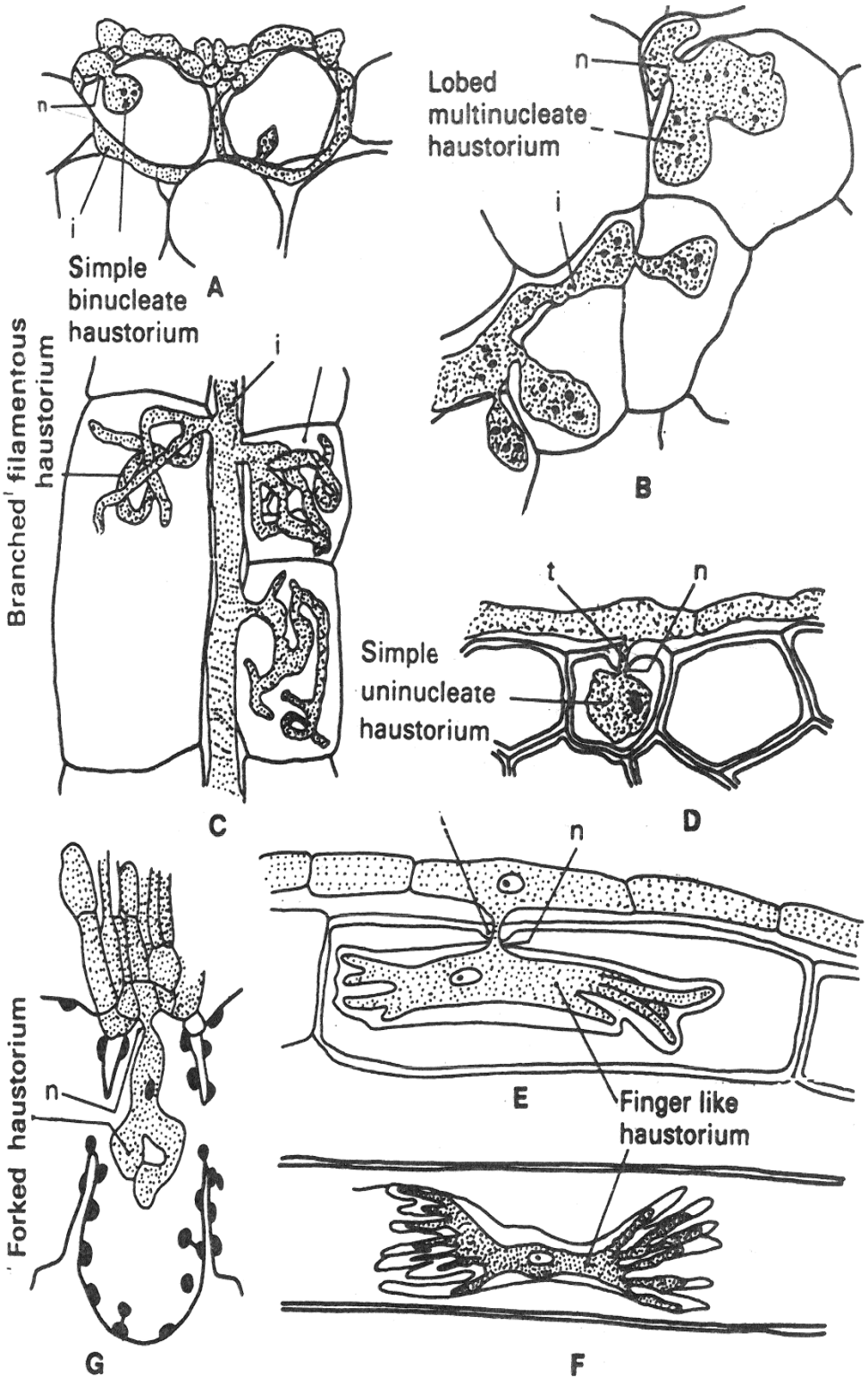



**Fig. 1.5:** Types of haustoria. (A) of *Coleosporium senecionis* in cell of groundsel. (B) of *Peronospora parasitica* in leaf cell of wallflower. (C) of *Peronospora calotheca* in stem cells of *Asperula odorata*. (D) of *Erysiphe polygoni* in epidermal cell of garden pea. (E,F) of *Erysiphe graminis* in epidermal cell of oat in longitudinal section (E) and surface view (F). (G) of *Puccinia triticina* in mesophyll cell of little club wheat. *i* = intercellular hyphae; *n* = narrow neck; *t* = thickening of host wall (Redrawn from S.A.J. Tarr, 1972).