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Fundamental of Plant Pathology

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Topic

DISPERSAL OF PLANT PATHOGENS

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DISPERSAL OF PLANT PATHOGENS

- The second link in disease development is the dissemination of plant pathogens.
- Transport of spores or infectious bodies, acting as inoculums, from one host to another host at various distances resulting in the spread of the disease is called dispersal, dissemination or transmission of plant pathogens.

Importance

1) The dispersal of the pathogen or disease is important not only for spread of plant diseases but also for continuity of the life cycle and evolution of the pathogen.

2) The knowledge of these methods of dispersal is essential for effective control of plant diseases because possibilities of preventing dispersal and thereby breaking the infection chain exist.

The dispersal of plant pathogens in space occurs through two ways:-

I. **Autonomous or direct or active dispersal.**

II. **Indirect or passive dispersal.**

I) Autonomous or direct or active dispersal:

In this method the dispersal of plant pathogens takes place through soil, seed and planting material during normal agronomic operations. There is no major role of external agencies like insects, wind, water, etc. in this type of dispersal.

1. **Seed as the source of autonomous dispersal**
2. **Soil as a means of autonomous dispersal**
3. **The plant and the plant organs as a means of autonomous dispersal**

1) Seed as the source of autonomous dispersal:-

The dormant structures of the pathogen (Ex: seeds of Cuscuta, Sclerotia of ergot fungus, smut sori, etc.) are found mixed with seed lots and they are dispersed as seed contaminants.

There are three types of dispersal by seed, viz., contamination of the seed, externally seed borne and internally seed borne.

1) Seed as the source of autonomous dispersal:-

a) Contamination of the seed: Seed borne pathogens move in seed lot without being in intimate contact with the viable crop seeds.

Ex: **Smut of pearlmillet and ergot of rye**. Smut sori and ergots mix easily with the seed lots during harvest and threshing.

b) Externally seed borne: Close contact between pathogen and seeds is established when the pathogen gets lodged on the seed coat during growth of the crop or at the time of harvest and threshing.

Ex:smut of sorghum, bacterial blight of cotton, loose smut of barley etc.

c) Internally seed borne: The pathogen may penetrate into the ovary and cause infection of the embryo while it is developing. They become internally seed borne.

Ex: Loose smut of wheat.

2) Soil as a means of autonomous dispersal:-

Soil borne facultative saprophytes or facultative parasites may survive through soil. The dispersal may be by movement of pathogen in the soil or by its growth in soil (dispersal in soil) or by movement of the soil containing the pathogen (dispersal by soil).

a) **Dispersal in soil**

b) **Dispersal by the soil**

2) Soil as a means of autonomous dispersal:-

a) Dispersal in soil:-

i) Growth and spread of a pathogen in soil:- Once the pathogen has reached the soil it can grow and spread based on its ability to multiply and spread. The survival ability of the pathogen is governed by high growth rate, rapid spore germination, better enzymatic activity, capability to produce antibiotics and tolerance to antibiotics produced by other soil-microorganisms.

Ex:- *Pythium*, *Phytophthora*, *Armillaria mellea*, *Ophiobolous graminis.*

ii) Persistence of the pathogen in soil:- The pathogens persist in the soil as dormant structures like oospores (*Pythium, Phytophthora, Sclerospora* etc.), Chlamydospores (*Fusarium*), smut spores (*Ustilago*) and sclerotia (*Rhizoctonia, Sclerotium*).

2) Soil as a means of autonomous dispersal:-

b) Dispersal by the soil:-

The pathogen is dispersed by the soil during cultural operations through the agricultural implements, irrigation water, workers feet etc. Propagules of fungi and the plant debris containing the fungal and bacterial pathogens thus spread through out the field. The transfer of soil from one place to another along with propagating materials is the most important method of dispersal of pathogen.

For example transfer of papaya seedlings from a nursery infested with *Pythium aphanidermatum* (causal agent of stem or foot rot of papaya) can introduce the pathogen in new pits for transplanting the seedlings.

3) The plant and the plant organs as a means of autonomous dispersal :-

The plants, plant parts other than seed that are used for vegetative propagation, and plant debris that accumulates during the course of cropping constitute the third method of autonomous dispersal.

Ex:

• Late blight of potato was introduced in North America and in Europe through seed tubers brought from the native source of the in South America.

• Citrus canker was introduced into California from Asia.

II) Passive or Indirect dispersal:

Passive dispersal of plant pathogens happens through animate and inanimate agents.

1) **Animate agents:** Insects, Mites, Fungi, Nematodes, Human beings & other animals, Phanerogamic parasites.
2) **Inanimate agents:** Wind, and Water

1) Animate agents:

a) **Insects (Entomochory) :** Insects carry plant pathogens either externally (epizoic) or internally (endozoic). They can disseminate bacteria, fungi, viruses, mycoplasmas, spiroplasmas, rickettsia, etc.

Examples:-

➢**Fungal diseases:-** Dutch elm disease (*Ceratostomella ulmi*) is transmitted by elm bark beetles.

➢**Bacterial diseases:-** The fire blight organism (Erwinia amylovora) and citrus canker bacterium (Xanthomonas axonopodis pv. citri) are transmitted by flies (bees) and leaf miner respectively.

1) Animate agents:

➢**Viral diseases:** More than 80 per cent of the viral and phytoplasmal diseases are spread by different types of insects. The insect which acts as specific carriers in disseminating the diseases are called insect vectors.

Insect vector	Disease/pathogen
Myzus persicae	Beet mosaic, Lettuce mosaic, Potato virus Y, Turnip mosaic, Beet yellows.
Nephotettix virescens	Rice tungro virus
Micrutalis malleifera	Tomato-pseudo curly top
Bamesia tabaci	Bhendi yellow vein mosaic, Bhendi leaf curl, Chilli leaf curl, Cotton leaf curl, Papaya leaf curl, Mungbean yellow mosaic.
Ceratomatri furcata	Cow pea mosaic

1) Animate agents:

b) *Mites*: Mites belonging to the families Eryophyiidae (eryophyiid mite) and Tetranychidae (spider mite) of class Arachnida transmit plant viruses.

Ex: *Aceria cajani* transmits Pigeonpea sterility mosaic virus *Aceria tulipae* transmits wheat streak mosaic

c) *Fungi*: Some fungal plant pathogens carry plant viruses in or on their resting spores and zoospores, and transmit them to susceptible hosts during the infection process.

Tobacco necrosis virus and *Cucumber mosaic virus* are carried outside the fungi, while lettuce big vein virus is carried inside the zoospores.

Fungi	Virus
Olpidium brassicae	**Tobacco necrosis**, Tobacco stunt, Lettuce big vein
Polymyxa betae	Beet necrotic yellow vein
Synchytrium endobioticum	**Potato virus X**

1) Animate agents:

d) ***Nematodes***: Several nematodes act as vectors for transmission of fungi, bacteria and viruses.

Example:

➢**Bacterial diseases:** The bacterium which causes **yellow ear rot** of wheat (*Corynebacterium tritici* or *Clavibacter tritici*) is disseminated by **ear cockle nematode**, *Anguina tritici*. If these two diseases appear together, a complex disease called **tundu** of wheat occurs.

➢**Fungal diseases:** Similarly, root rot and wilt pathogens such as *Phytophthora, Fusarium, Rhizoctonia, Verticillium*, etc., are disseminated by nematodes.

1) Animate agents:

Viral diseases: Plant nematodes play a vital role in transmitting certain virus diseases. Many soil borne viruses are known to be transmitted by the nematodes.

The nematode transmitted viruses are divided into two groups on the basis of shape of their particles:

i) Nematode transmitted polyhedral viruses (**NEPO-**Ex: Tobacco ringspot virus, Tomato ringspot virus) and

ii) Nematode transmitted tubular viruses (**NETU**-Ex; Pea early browning virus (*Trichodorus*sp.), Tobacco rattle virus) viruses.

1) Animate agents:

e) **Human beings *(anthropochory):*** Human beings role in dissemination of plant pathogens is very important. The ways and means in which human beings help in dispersal of plant pathogens are as follows.

i) Transportation of seeds (seed trade): The import and export of contaminated seeds without proper precautions lead to movement of pathogens from one country to another or from one continent to another.

Ex: Late blight of potato, Downy mildew of grapevine, Citrus canker, Fusarium wilt of banana, etc.

ii) Planting diseased seed materials: Planting diseased bulbs, bulbils, corms, tubers, rhizomes, cuttings, etc., of **vegetatively propagated** plants such as potato, sweet potato, cassava, sugarcane, banana, many ornamentals and fruit trees etc., help in dispersal of pathogens from field to field, orchard to orchard, locality to locality or from one country to another.

1) Animate agents:

iii) During adoption of normal farming practices: Human beings engaged in preparatory cultivation, planting, irrigation, weeding, pruning etc., help in dispersal of plant pathogens. Spores and other external structures of fungi can be carried by workers clothing's, shoes, and hands etc., from plant to plant and from field to field.

iv) By use of contaminated implements: Pathogens are transferred from one area to another through implements used in various cultural operations (weeding, thinning, hoeing etc.) in the field. Ex: Soil borne diseases such as root rot, wilt etc.

Cutting knives and pruning knives also help in dispersal from one plant to another. Ex: Bunchy top of banana.

v) By use of diseased grafting and budding material: Grafting and budding between healthy and diseased plants is the most effective method of distribution of pathogens of horticultural crops.

1) Animate agents:

f) *Dispersal by phanerogamic parasites:* Phanerogamic parasites transmit the viruses by acting as a bridge between the diseased and healthy plants.

Ex:- *Cuscuta campestris*- Tomato bushy stunt virus

g) *Dispersal by birds:* This mode of dispersal is important in dissemination of seeds of flowering parasites and certain fungi. Seeds of *Loranthus* are disseminated by birds as they stick on their beaks and also through excreta. Stem segments of dodder are carried by birds for preparing their nests and thus get transported to new areas. Moreover, spores of chestnut blight fungus, *Endothea parasitica* are disseminated by more than 18 species of birds. Cleistothecia of many powdery mildew fungi are carried by feathers of birds.

h) *Farm and wild animals:* Farm animals (cattle) while feeding on diseased fodder ingest the viable fungal propagules (spores or oospores or sclerotia) and pass out as such in the dung. This dung when used as manure spread in the field and act as source of inoculum. Further, soil inhabiting fungi especially sclerotia adhere to the hoofs and legs of animals and get transported to other places.

2) Inanimate agents:

a) Wind: The dispersal of pathogens by wind is known as **anemochory**. Wind acts as a potent carrier of propagules of fungi, bacteria and viruses.

Fungi: Usually the fungal pathogens are light in weight and are well adapted to wind dispersal. The **adaptations for wind dispersal** in fungal pathogens include production of numerous spores and conidia, discharge of spores with sufficient force, production of very small and light spores so that they can move to long distances.

Ex: Powdery mildew, downy mildew, rusts, smuts etc.

Bacteria: Some pathogenic bacteria are carried along with the infected material to short distances by wind.

Ex: *Erwinia amylovora*, the causal agent of fire blight of apple and pear, produces fine strands of dried bacterial exudates which may be broken off and are transmitted by wind.

2) Inanimate agents:

b) **Water**: Transmission of plant pathogens by water is called as **hydrochory**. Water dissemination occurs mainly through **surface running water** and **rain splash.**

Ex- The mycelial fragments, spores or sclerotia of fungi, *Colletotrichum falcatum***(red rot of sugarcane)**, *Fusarium*, *Ganoderma*,*Macrophomina*, *Pythium*, *Phytophthora*, *Sclerotium*, etc., are transmitted through rain or irrigation water.

Ex- Bacterial leaf spot of rice (*Xanthomonas campestris pv. oryzae*), Bacterial leaf streak of rice (*Xanthomonas campestris pv. oryzicola*), Green ear of bajra (*Sclerospora graminicola*) through rain splash.

Thank You