ENEMIES OF CROPS

Chapter 1: Importance of crop pests and the need for protection

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1. Importance of crop enemies and need for protection	- Enemies (pests, diseases, weeds) threaten agricultural production. - Need for an **integrated protection strategy**. - Losses occur during production and also post-harvest.
2. Epidemiology, dynamics and identification of pest populations	- Study of pest population development and spread. - Identification of insects, mites, myriapods, nematodes. - Recognition of harmful rodents and birds. Understanding pest biology is key for control methods.
3. Development and identification of plant diseases	- **Parasitic diseases**: fungi, bacteria, mollicutes, viruses, viroids. - **Non-parasitic diseases**: physical/chemical factors. - Knowledge of symptoms helps in diagnosis.
4. Competition and identification of weeds	- Weeds compete with crops for water, light, and nutrients. - Methods of classification and identification. - Cultural factors favoring weed development. Examples of harmful weeds.

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5. Observation techniques and sampling methods	- Field observation = basis of crop protection. - Sampling techniques for pests, fungi, and bacteria. - Use of **damage thresholds** and forecasting models. - Early warning systems to limit losses.
6. Developing a crop protection strategy	- Enemies (pests, diseases, weeds) threaten agricultural production. - Need for an **integrated protection strategy**. - Losses occur during production and also post-harvest.
7. Chemical treatment of crops and harvested products	- General principles of chemical protection. - Properties and modes of action of **insecticides, fungicides, herbicides**. - Management of pest resistance to pesticides.

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Importance of crop pests and the need for protection

1. The Importance of Crop Enemies and the Need for a Crop Protection Strategy:

1.1 Introduction:

Crops constantly face threats from pests, diseases, and weeds. Such damage not only reduces yield and quality but can sometimes cause severe economic losses and trigger crises in food security. Therefore, crop protection is crucial for ensuring stable agricultural production and safeguarding farmers' livelihoods. Modern protection strategies not only focus on pest control but also emphasise sustainable implementation methods combining measures such as prevention, monitoring, and precision interventions.

1.2. Crop Enemies:

Crop enemies are any living organisms or plants that negatively affect agricultural crops. They include:

- **Insect pests** (e.g., locusts, aphids, caterpillars).
- **Diseases** caused by fungi, bacteria, viruses, and nematodes.
- **Weeds** that compete with crops for resources.

1.3. Global Impact of Crop Enemies:

FAO estimates that 20–40% of global crop yields are lost annually due to pests, diseases, and weeds.

Example: Desert locust swarms in Africa and Asia can devastate thousands of hectares of crops in a few days.

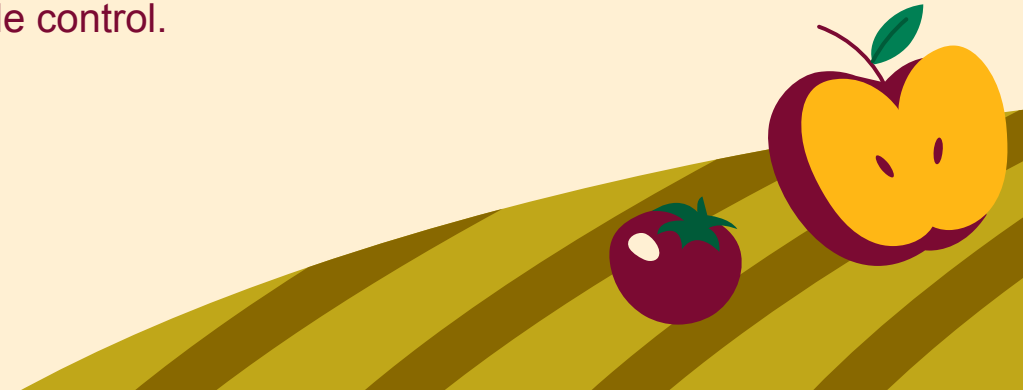
Example: Irish Potato Famine (1845–1849) caused by potato late blight (Phytophthora infestans), leading to famine and migration.

1.4. Why Crop Protection is Necessary:

- ➔ **Food Security:** Ensuring enough safe food for growing populations.
- ➔ **Economic Stability:** Preventing major financial losses for farmers and countries.
- ➔ **Environmental Protection:** Sustainable strategies reduce overuse of chemical pesticides.
- ➔ **Human Health:** Controlling pathogens and avoiding contamination (e.g., aflatoxin from fungi in maize).

1.5. Strategies for Crop Protection:

- ➔ **Traditional methods**: manual weeding, crop rotation, local knowledge.
- ➔ **Chemical control**: pesticides (effective but can cause resistance and pollution).
- ➔ **Biological control**: using natural predators or parasites (e.g., ladybirds against aphids).
- ➔ **Cultural practices**: crop rotation, resistant varieties, sanitation.
- ➔ **Integrated Pest Management (IPM)**: combining biological, cultural, and chemical tools for sustainable control.



2. Overview of Pests, Diseases, and Weeds:

2.1. Insect Pests:

Definition: Insects that feed on crops directly or indirectly.

Feeding habits:

- Insects and mites: The largest group, including sap-sucking insects like aphids or scale insects, and chewing insects such as caterpillars or locusts.
- Nematodes: Microscopic worms living in the soil that attack roots, causing deformities and poor growth.
- Mollusks: Slugs and snails that feed on young, tender plants.
- Vertebrates: Rodents and birds that consume seeds and grains, both in the field and during storage.

Examples:

- Locusts – massive swarms destroy cereals and vegetables.
- Cotton bollworm (*Helicoverpa armigera*) – attacks cotton, tomato, maize.
- Rice stem borer – reduces rice yields drastically.

Indirect damage: insects can transmit plant viruses (e.g., aphids spreading mosaic virus).

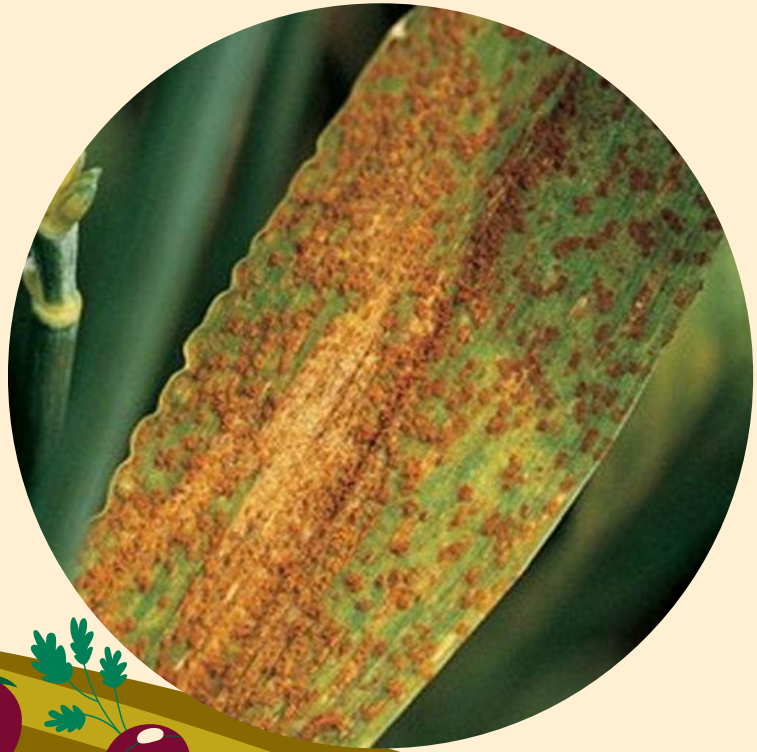
2.2. Plant Diseases:

Definition: Plant diseases are abnormal conditions in plants caused by infectious pathogens (microorganisms) like fungi, bacteria, viruses, and nematodes, or by non-infectious factors such as nutrient deficiencies.

Causes:

- **Fungi:** Cause most plant diseases (downy mildew, rusts, fusarium wilts) and spread easily by spores.
- **Bacteria:** Enter through wounds and cause rots, blights, or cankers.
- **Viruses:** Require living cells to multiply and are often spread by insect vectors, producing symptoms such as tobacco mosaic virus.
- **Nematodes:** root-knot nematodes damaging roots.

Effects: stunted growth, leaf spots, wilting, reduced photosynthesis, death of plants.



Fungi: rusts (wheat rust)

Wheat rust refers to a group of fungal diseases that affect wheat plants.

Bacterial wilt in tomato:

is a devastating soil-borne disease of tomatoes caused by the bacterium Ralstonia solanacearum, characterized by rapid wilting of the plant without significant yellowing or spotting, followed by permanent collapse and death

Viruses: tobacco mosaic virus TMV

is a single-stranded RNA virus that infects plants, particularly tobacco and other Solanaceae family members, causing a characteristic mosaic-like mottling on leaves.

Nematodes: root-knot:

are microscopic roundworms that infect plant roots, causing characteristic "knot-like" swellings or galls.

2.3.Weeds (Adventitious Plants) :

Definition: Any unwanted plant growing among crops.

Harmful effects:

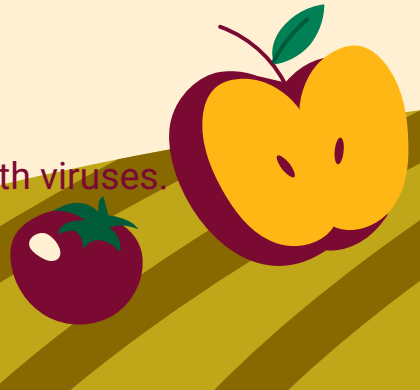
- Competition for water, nutrients, sunlight.
- Release of toxic chemicals (allelopathy).
- Shelter for pests and diseases.

Examples:

- Striga (witchweed) – a parasitic weed affecting maize, sorghum, and millet in Africa.
- Johnson grass – a competitive invasive weed in cereals.
- Wild oats – common weed in wheat and barley.

Interactions among Enemies:

- Weeds can serve as hosts for pests and pathogens.
- Pests can spread plant viruses.
- **Example:** aphids feeding on weeds can later infect cultivated plants with viruses.



3. Crop Infestation, Damage in Production, and Post-Harvest Losses:

3.1. Crop Infestation:

3.1.1. Definition: Infestation happens when a harmful organism (pest, pathogen, or weed) successfully establishes itself in a field and multiplies.

For this to occur, three key elements must be present. which called the “disease triangle”:

1. **Susceptible host plant** a plant that can be attacked or is vulnerable.
2. **Virulent enemy** a pest or pathogen capable of causing damage.
3. **Favorable environment** environmental conditions (such as temperature, humidity, or soil conditions) that support the survival and spread of the enemy.

3.1.2. Factors that accelerate infestation:

1. **High crop density:** when plants are too close together, pests and diseases spread more easily.
2. **Lack of crop rotation:** planting the same crop year after year allows pests and diseases to persist and multiply.
3. **Suitable climate conditions:** weather that favors the growth or reproduction of pests and pathogens (e.g., warm and humid conditions).

3.1.3. Mechanisms:

- Insects migrate with wind or through contaminated seed.
- Fungal spores spread by air, rain, or irrigation.
- Weeds spread by contaminated machinery, irrigation water, or animal manure.

3.1.4. Infestation process:

1. **Introduction (pest enters the field):**
   The pest or pathogen arrives in the crop area, for example through wind, water, contaminated seeds, or movement of insects.

2. **Establishment (survival and reproduction):**
   Once present, the pest finds favorable conditions and survives. It begins reproducing and adapting to the host plant and environment.

3. **Spread (population growth):**
   The pest population increases quickly, moving from plant to plant or across the field. At this stage, infestation becomes noticeable.

4. **Outbreak (economic damage):**
   The pest reaches a level where the damage is significant, reducing yield or quality, and control measures become necessary to avoid economic losses.

3.2. Damage in Production (Field Losses):

- **Direct damage:** insects eating leaves, fruits, roots.
- **Indirect damage:** weakening plants and transmitting pathogens.
- **Economic threshold:** the pest density at which the cost of damage exceeds the cost of control.

So we can conclude that damage during crop growth can be both quantitative and qualitative:

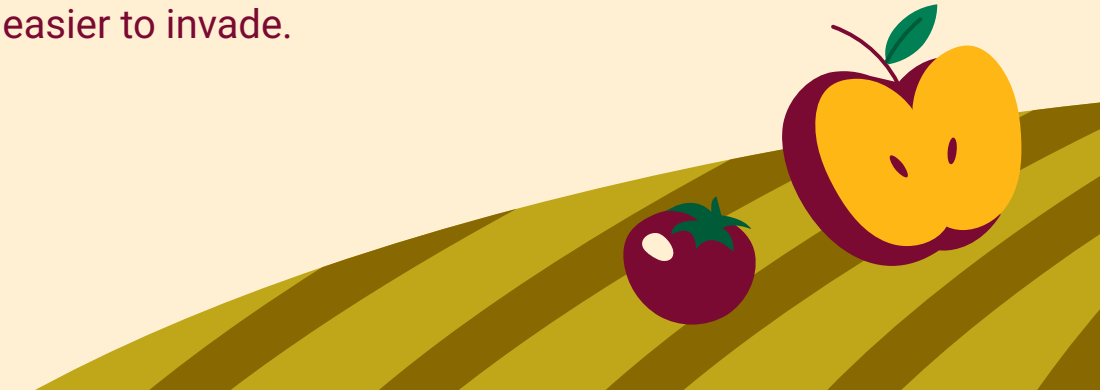
- **Quantitative losses:** Reduced harvest volume due to destroyed plants, reduced photosynthesis (eaten leaves), or damaged fruits and grains.

- **Qualitative losses:** Even if quantity is preserved, quality drops for example, fruits scarred by insects, cereals contaminated with mycotoxins, or vegetables of irregular size.

3.3. Post-Harvest Losses:

The risk does not end after harvest. During storage and transport, products are exposed to:

- **Storage pests:**
  These are mainly insects such as weevils and moths that attack stored grains. They bore into the seeds, eat the endosperm, and reduce both quality and quantity.
- **Storage rots:**
  Caused by fungi and bacteria, these mainly affect fruits and vegetables in storage. They become more severe when produce is bruised or wounded, since the damaged tissues are easier to invade.



3.4. Importance of good storage practices:

To prevent these losses, proper post-harvest handling is crucial. Key practices include:

- Drying crops to safe moisture levels.
- Ensuring ventilation to reduce humidity.
- Controlling temperature and humidity to prevent insect and microbial growth.

By applying these measures, farmers can preserve yield and quality, ensuring that the efforts made in the field are not wasted before the products reach consumers.

THANKS!

Do you have any questions?

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