Module 8: Biological Control and Natural Predators

Duration: 20 minutes

Overview:

Biological control is a powerful and environmentally sustainable strategy used in Integrated Pest Management (IPM) to regulate pest populations. By leveraging the natural enemies of pests, such as predators, parasites, or pathogens, biological control can reduce the need for chemical pesticides and help maintain ecological balance. This module explores the role of natural predators and microbial agents in pest control, focusing on how they can be effectively incorporated into an IPM strategy.

By the end of this module, learners will understand the principles of biological control, recognize the importance of natural predators, and appreciate the benefits and limitations of using biological agents in agricultural pest management.

Key Topics:

- **Natural Predators in Biological Control**
  Natural predators are organisms that directly consume pest species, often helping to keep pest populations in check. Using these predators in agricultural systems can be an effective method of pest control, often reducing the need for chemical interventions.
    - **Green Lacewings (Chrysoperla spp.)**
        - Green lacewings are highly effective natural predators, especially for aphids, mealybugs, thrips, and other soft-bodied insects. Both the larvae and adults are active feeders, with lacewing larvae consuming large quantities of pests—sometimes hundreds of aphids in a single day. This makes them valuable in crops like soybeans, lettuce, and various fruits and vegetables, where aphids and similar pests are common.
        - **Effectiveness:** Green lacewings help reduce aphid populations and can also prevent the transmission of plant viruses spread by aphids. They are effective against a wide range of pests, including scale insects, mealybugs, and thrips.
        - **Benefits:** Green lacewings are non-toxic to plants, beneficial insects, and humans, and they support a balanced ecosystem by targeting multiple pest species.
        - **Challenges:** While they are effective at controlling aphid populations, lacewings may not be enough for large infestations, and they may leave an area if food sources or suitable shelter become scarce.
    - **Nematodes**
      Nematodes are microscopic worms that can target soil-dwelling insect pests, such as root weevils, root maggots, and other larvae. Parasitic nematodes infect the larvae of pests, releasing bacteria that kill the pest while the nematode feeds.

        - **Effectiveness**: Nematodes are particularly useful in controlling soil-borne pests that are hard to reach with chemical pesticides. They can be used in both agricultural and horticultural settings to protect crops like strawberries, carrots, and tomatoes.
        - **Benefits**: Nematodes are safe for plants, animals, and humans, and they offer a targeted solution to soil-dwelling pests, minimizing damage to the broader ecosystem.
        - **Challenges**: The effectiveness of nematodes can be influenced by environmental conditions such as soil moisture, temperature, and organic matter. Nematodes may not work well in dry, hot conditions or if soil is too compacted.
- **Microbial Agents in Biological Control**
  Microbial agents, including bacteria, fungi, and viruses, play a crucial role in pest management by attacking specific pests without harming other organisms. These agents can be applied directly to crops, often providing a more selective and environmentally friendly alternative to chemical pesticides.
    - **Bacillus thuringiensis (Bt)**
      Bacillus thuringiensis (Bt) is a bacterium commonly used to control caterpillar pests, such as cabbage worms, corn earworms, and the larvae of various moth species. Bt produces toxins that are lethal to the larvae of many pest insects but are harmless to humans, animals, and beneficial insects.
        - **Effectiveness**: When sprayed on crops, Bt is ingested by caterpillar larvae, and the toxins cause paralysis and death. This makes it highly effective for controlling pests like the cabbage worm, tomato hornworm, and the larvae of various moths.
        - **Benefits**: Bt is selective and does not affect non-target insects such as bees or beneficial predators like ladybugs. It is a biodegradable product, breaking down quickly in the environment and having minimal residual effects.
        - **Challenges**: Bt is most effective when applied early in the pest's life cycle. Its effectiveness can be reduced by environmental factors such as rain or UV exposure, and pests may develop resistance to it over time if used repeatedly on the same crops.

Common vendors of biological control agents include:

- Koppert Canada (https://www.koppert.ca/)
- Biobest (https://www.biobestgroup.com/)
- NIC (https://naturalinsectcontrol.com/)

- **Case Study: The Release of Trichogramma Wasps in Ontario Orchards**
  The use of biological control agents in Ontario orchards is an excellent example of how IPM strategies can be implemented. **Trichogramma wasps**, tiny parasitic wasps, are released in orchards to control **codling moths**, a major pest that affects apples and other fruits.

    - **Codling Moth Problem**: Codling moth larvae feed on the fruit, causing significant damage and rendering the crop unmarketable. Chemical control methods, such as insecticides, have been used historically but can be costly, environmentally damaging, and harmful to beneficial insects.
    - **Trichogramma Wasps as Biological Control**: Trichogramma wasps are natural parasitoids of codling moth eggs. The wasps lay their eggs inside the moth eggs, and the larvae feed on the moth eggs, preventing them from hatching. This helps reduce the population of codling moths without harming the environment.
        - **Effectiveness**: When released at the right time, Trichogramma wasps can significantly reduce codling moth populations and minimize the need for chemical insecticides. Studies have shown that releasing Trichogramma wasps early in the moth's egg-laying cycle can result in up to 80% parasitism of moth eggs, leading to a decrease in moth populations in subsequent generations.
        - **Benefits**: Trichogramma wasps are a safe, non-toxic control method that does not harm other beneficial organisms, including pollinators. They also help preserve the health of the orchard ecosystem by reducing pesticide use.
        - **Challenges**: The success of this biological control method depends on the correct timing and proper application. The release of Trichogramma wasps must coincide with the moth's egg-laying period for maximum impact. In addition, the wasps' effectiveness can be influenced by environmental factors, such as weather conditions and predator pressures.
- **Homework/Challenge**
    - **Assignment**: Select a pest that you find commonly in agriculture or horticulture and identify at least one natural predator that could be used as a biological control. Your analysis should include:
        - A description of the pest, including the crops or plants it affects and the damage it causes.
        - The natural predator or biological control agent that can be used, including how it works to reduce the pest population.
        - The benefits and challenges of using this predator or agent in an IPM strategy.
        - Any environmental or management considerations that would need to be taken into account when using this biological control.

Conclusion:

Biological control offers an environmentally sustainable and effective way to manage pest populations, making it an essential component of integrated pest management (IPM). By utilizing natural predators like ladybugs and Trichogramma wasps, as well as microbial agents like Bacillus thuringiensis, farmers can reduce their reliance on chemical pesticides and protect their crops in a more ecologically balanced way. However, it is important to consider the specific

conditions and challenges associated with biological control to ensure its success. Through careful planning and monitoring, biological control can contribute to healthier, more resilient agricultural ecosystems.