KAVERI'S IAS TEST SERIES

UPSC TEXT BOOKLET: OPTIONAL

DAILY ANSWER WRITING PRACTICE
AGRICULTURE OPTIONAL

1. **Discuss biological control of pests illustrating your answer with some of the classical examples from India and abroad.**

Biological control of pests is a method that uses natural enemies to control invasive species or pests. It's a cost-effective and environmentally sound way to manage pests. Here are some examples of biological control and some of its history:

- **Classical biological control**: This method involves introducing non-native natural enemies, such as predators or parasitoids, to the affected area. The goal is to establish a self-sustaining population of the natural enemy to keep the pest population in check. **Some examples include:**
  - **Decapitating flies**: Used against red imported fire ants
  - **Flea beetles, thrips, and stem borers**: Used against alligator weed
  - **Australian lady beetle**: Introduced to North America to control cottony cushion scale populations

- **Cochineal insect**: Imported from Brazil to India in 1795 to suppress a pest
- **Mynah bird**: Introduced from India to Mauritius in 1762 to control the red locust
- **Pentatomid**: Released in Europe in 1776 to control the bedbug
- **Insectary plants**: Grown to attract, feed, and shelter beneficial insects

Biological pest control has many merits, including:

- **Environmentally friendly**: Biological control is an eco-friendly method that uses natural enemies of pests instead of chemical pesticides.
- **Safe for humans and pets**: Biological control is safer for humans and pets because it doesn't use toxic chemicals.
- **Minimal resistance**: Pests are less likely to develop resistance to natural enemies than to chemical pesticides.
- **Self-sustaining**: Once established, biological control populations can be self-sustaining.
- **Cost-effective**: Biological control can be cost-effective.
- **Effective in all seasons**: Biological control can be effective in all seasons.
- **Easy to use**: Biological control is easy to use.
- **Conservation of biodiversity**: Biological control can help conserve biodiversity by supporting natural enemies that are already adapted to the habitat.

Biological control can be used in pest control manufacturing to manage pest populations that can damage or contaminate products. It can also be used as part of an Integrated Pest Management (IPM) program, which combines biological, chemical, physical, and cultural strategies to minimize the use of synthetic pesticides.

2. **What precautions are taken while using toxic insecticides? Also mention the safety measures and devices.**

When using toxic insecticides, you should take the following precautions:

- **Read the label**: Carefully follow the instructions on the pesticide container label.
- **Wear protective clothing**: Wear long-sleeved shirts, long pants, closed-toe shoes, rubber gloves, a face mask, and a broad-rimmed hat.
- **Avoid contamination**: Avoid splashing, spilling, leaks, spray drift, and contamination of clothing.
- **Avoid eating, drinking, or smoking**: Do not eat, drink, smoke, or chew while using pesticides.

- **Keep children and pets away**: Keep children, pets, and toys away from areas where you mix and apply pesticides.
- **Mix in a well-ventilated area**: Mix or dilute the pesticide outdoors or in a well-ventilated area.
- **Use the recommended amount**: Only use the amount listed on the label and measure the pesticide carefully.
- **Dispose of properly**: The only legal way to dispose of pesticides is to take them to your local household hazardous waste disposal facility.
- **Prepare for emergencies**: Provide for emergency medical care in advance as required by regulation. In case of an emergency, you can call the Poison Control Center at 1-800-222-1222.
- **Avoid splashing**: Pour the pesticide down the side of the tank to avoid splashing.
- **Use clean water**: Use clean water when preparing the spray solution.
- **Avoid mixing with granules**: Do not mix granules with water.
- **Avoid using leftover solution**: Do not use a spray solution that is more than 24 hours old.
- **Avoid spraying in certain conditions**: Avoid spraying in high winds, high temperatures, or rain.
- **Avoid spraying near livestock**: Do not spray if the wind is blowing towards grazing livestock or pastures.
- **Clean equipment**: After use, clean and oil the equipment and store it in a safe place.
- **Dispose of pesticides**: After spraying, empty any remaining pesticides from the tank and dispose of them in a pit dug in wasteland. Do not empty the tank into irrigation canals or ponds.

3. Define botanical pesticides. Give examples of their successful use in integrated pest and disease management.

Botanical pesticides are naturally occurring chemicals derived from plants or minerals that are used to repel, attract, or inhibit the growth of insects and other pests. They are also known as natural insecticides.

Here are some examples of botanical pesticides and their uses:

- **Neem**: This botanical insecticide is frequently applied to control insect pests, but it can degrade quickly and may not be effective for three to seven days.
- **Rosemary, myrrh, and juniper**: These herbs were used by the Ancient Romans to fumigate storehouses and ward off pests.
- **Helleborus niger L. roots**: A decoction of these roots was used to keep rodents away.
- **Pyrethrum**: A powder collected from the dry flowers of this plant was used by the Persians to delouse children.

Botanical pesticides, also known as biopesticides, have many merits, including:

- **Effective**: Botanical pesticides are effective against a wide range of pests and diseases.
- **Inexpensive**: Botanical pesticides are inexpensive and widely available.
- **Biodegradable**: Botanical pesticides are biodegradable and rapidly break down.
- **Less toxic**: Botanical pesticides are less toxic to humans and non-target organisms.
- **Residue-free**: Botanical pesticides produce residue-free food.
- **Safe environment**: Botanical pesticides create a safe environment.
- **Pest resistance**: Botanical pesticides help prevent pest resistance.
- **Environmental burden**: Botanical pesticides reduce environmental burden.
- **Biodiversity**: Botanical pesticides encourage biodiversity by promoting beneficial microorganisms and insects.
- **Soil health**: Botanical pesticides can improve soil health and promote healthy plant growth.

Botanical pesticides are derived from natural materials like plants, animals, bacteria, and viruses.

Botanical pesticides are becoming more popular because they do not release toxins as they decompose. However, some say that they are usually claimed to be more toxic to humans than synthetic pesticides.

4. Microbial Toxins and their Significance in Pest and disease control.

Microbial toxins, poisonous substances produced by microorganisms like bacteria and fungi, are highly significant in pest and disease control as they can be harnessed to selectively target and kill specific pest species while having minimal impact on other organisms, essentially acting as a natural pesticide with a high degree of specificity; a prime example being the use of Bacillus thuringiensis (Bt) toxins to control insect pests in agriculture.

Key points about microbial toxins in pest and disease control:

- **Selective Toxicity:** Microbial toxins often have a specific mode of action, targeting specific receptors or physiological pathways in targeted pests, minimizing harm to non-target organisms like beneficial insects and humans.
- **Environmental Benefits:** Compared to synthetic pesticides, microbial toxins are often considered more environmentally friendly due to their natural origin and faster degradation in the environment.
- **Diverse Applications:** Microbial toxins can be used to control a wide range of pests including insects, nematodes, and even some fungal pathogens, depending on the specific toxin and its target organism.

Examples of microbial toxins used in pest control:

- **Bacillus thuringiensis (Bt):** This bacterium produces crystal proteins (Cry toxins) that are highly toxic to specific insect larvae when ingested, making it a widely used biopesticide against various pest insects like bollworms and corn borers.
- **Beauveria bassiana and Metarhizium anisopliae:** These fungi produce toxins that are effective against a wide range of insects, including beetles, aphids, and grasshoppers, by infecting and killing them through direct contact.
- **Paecilomyces fumosoroseus:** Another fungal species that produces toxins effective against various insect pests, including whiteflies and thrips.
- **Verticillium lecanii:** This fungus produces toxins that are particularly effective against whiteflies and aphids.

How microbial toxins work:

- **Disruption of gut function:** Many bacterial toxins like Bt Cry proteins disrupt the insect gut lining, causing paralysis and death when ingested.
- **Membrane disruption:** Some fungal toxins can directly disrupt the cell membranes of the target pest, causing cell lysis and death.
- **Neurotoxin activity:** Certain microbial toxins can act as neurotoxins, interfering with the nervous system of the pest, leading to paralysis and mortality.

Challenges and considerations:

- **Environmental factors:** The efficacy of microbial toxins can be influenced by environmental conditions like temperature and humidity.
- **Resistance development:** Like any pesticide, there is a potential for pest populations to develop resistance to microbial toxins over time.
- **Formulation and application:** Developing efficient formulations and application methods to ensure optimal delivery of microbial toxins to the target pest is crucial.

5. **Write a note on: 5 + 5**

   a) Insecticidal poisoning, symptoms and treatment.

   b) Plant protection equipment's

Insecticidal poisoning, symptoms and treatment.

Symptoms of insecticide poisoning include: Tremors, Trouble breathing, Vomiting, and Respiratory distress.

If you experience symptoms of insecticide poisoning, you should:

- **Call emergency services**: Call an ambulance immediately.
- **Provide first aid**: Remove the person from the insecticide, remove contaminated clothing, and wash the skin or eyes with running water for at least 15 minutes. If the toxin was inhaled, breathe in fresh air.

Note; please refer to the class notes for Insecticide poisoning.

a) Plant protection equipment's

Plant protection equipment is used to apply pesticides, herbicides, fungicides, insecticides, and other chemicals to plants and soil to protect crops from pests, diseases, and weeds:

- **Sprayers**: Used to apply chemicals in liquid form. There are many types of sprayers, including foot, knapsack, compression, tractor-mounted, and self-propelled high clearance sprayers. Sprayers can be operated by hand or foot, or by an engine.
- **Dusters**: Used to apply chemicals in dry powder form. There are many types of dusters, including hand, rotary, and shoulder carried rotary dusters.
- **UAVs**: Unmanned aerial vehicles (UAVs), also known as drones, can be used to spray chemicals on crops. UAVs can save time and energy, and reduce the risk of chemical contact with the operator.

Proper maintenance and calibration of plant protection equipment is important for effective pest control. Common issues include leaks, clogs, and loss of pressure.

6. What you understand by Third generation pesticides? Describe in brief about their mechanism & example's.

Third generation pesticides are modified insect hormones that are designed to be more effective and prevent the development of resistance. They work by disrupting the normal activity of an insect's endocrine system, which can affect its progress, propagation, or metamorphosis. This results in a gradual reduction in the insect population because adult insects are unable to be produced.

Third generation pesticides are altered insect hormones, also known as insect growth regulators (IGRs), that are designed to be more effective and prevent insects from developing resistance. IGRs disrupt the normal activity of an insect's endocrine system, which can affect its development, propagation, or progress. As adult insects are unable to be produced, the insect population is slowly reduced.

An example of a third-generation pesticide is bifenthrin, which was first discovered and manufactured in the United States by the FMC

Corporation. The US Environmental Protection Agency (US EPA) first registered bifenthrin for use in 1985.

ROLE OF INSECT GROWTH REGULATOR IN PEST CONTROL

An Insect Growth Regulator (IGR) plays a key role in pest control by disrupting the normal development cycle of insects, preventing them from reaching adulthood and reproducing, effectively limiting pest populations without necessarily causing immediate death to adult insects; essentially, they work by interfering with the molting process, hindering the transition from larva to adult stages.

Key points about IGRs in pest control:

- **Mechanism of action:** IGRs mimic or disrupt the natural insect hormones that regulate growth and development, like juvenile hormone, thereby causing developmental abnormalities like failure to molt, inability to hatch eggs, or premature metamorphosis.
- **Selective toxicity:** Compared to traditional insecticides, IGRs are often considered safer for humans and non-target organisms as they specifically target insect developmental pathways.
- **Long-term control:** By preventing new generations of insects from reaching maturity, IGRs can provide long-term pest control when used strategically.
- **Application areas:** IGRs are commonly used against a variety of pests including fleas, cockroaches, mosquitoes, termites, and certain agricultural insect pests.
  Examples of IGRs and their applications:
- **Chitin synthesis inhibitors (CSIs):** These IGRs like diflubenzuron interfere with the production of chitin, a key component of the insect exoskeleton, preventing molting and causing larval mortality.
- **Juvenile hormone mimics:** Compounds like methoprene and pyriproxyfen mimic the action of juvenile hormone, causing insects to remain in the larval stage and not develop into adults.

Important considerations when using IGRs:

- **Slower acting:** Unlike contact insecticides, IGRs may take longer to show visible effects as they disrupt the insect's development cycle over time.

- **Integrated pest management (IPM):** IGRs are often best used as part of a comprehensive IPM strategy, combining them with other control methods for optimal results.

7. **Write the mode of action, examples of carbomate insecticide, endosulphan & organophosporous chemical in Agriculture**

The mode of action of carbamate, organophosphorus, and endosulfan insecticides is to inhibit the acetylcholinesterase enzyme, which is toxic to insects and mammals:

- **Carbamate**: Carbamate insecticides inhibit the acetylcholinesterase enzyme reversibly, which means that the enzyme activity can recover faster and the poisoning lasts for a shorter period. This causes acetylcholine to build up in the brain and skeletal muscles, which overstimulates receptors and causes hyperactivity and tremors in insects. Examples of carbamate insecticides include carbaryl, methyl, and aldicarb.
- **Organophosphorus**: Organophosphorus insecticides inhibit the acetylcholinesterase enzyme by forming a covalent bond with it. This can cause muscle paralysis, respiratory failure, and delayed neuropathy.
- **Endosulfan**: Endosulfan is a broad-spectrum insecticide that can control sucking, chewing, and boring insects and mites. It can also reduce fertility levels in male animals and cause DNA damage.

Pesticides can contaminate the environment and be harmful to humans and wildlife. They can enter the body through the skin, nasal openings, oral openings, and gills. Pesticides can also leach into groundwater and remain there for a long time.

8. **Define epidemiology. Describe the forecasting models used for pests and diseases of major food crops in India.**

Epidemiology is the study of the distribution and causes of disease in populations. It can also refer to the study of the dynamics of plant pathogens infecting host populations.

Forecasting models for pests and diseases of major food crops in India use a variety of techniques, including:

- **Weather-based models**: These models can be used to provide early warnings of insect pests and diseases.
- **Crop weather calendars**: These calendars can help forecasters create weather warnings and forecasts for farmers.
- **Regression models**: These models represent the relationship between two or more variables, allowing one variable to be predicted from the other.
- **Machine learning techniques**: These techniques include decision tree induction algorithms, genetic algorithms, neural networks, and rough sets.
- **Sampling**: Sampling insect pests on alternate hosts or weeds can help forecast pest population development.
- **Counting immature stages**: Counting the immature stages of insects can help estimate later stages.
- **Adult catch in traps**: The adult catch in traps, especially pheromone traps, can help estimate the abundance of pest populations.

9. **Enlist the storage pests of pulses with their nature of damage. Write their management practices.**

Here are some storage pests of pulses and their management practices:

Bruchids or pulse beetles: The most important insect pests that damage pulses in storage and in the field.

Pulse beetles can cause significant damage to stored pulses, such as pigeon pea, green gram, black gram, cowpea, and chickpea. The damage includes:

- **Seed quality**: Pulse beetle larvae feed inside seeds, making them unfit for human consumption. The seeds lose nutritional reserves and embryos, resulting in low germination and weak seedlings.
- **Market prices**: The quality of the seeds is reduced, which can lower their market prices.
- **Secondary infestations**: When infested seeds are harvested and stored, the larvae continue to feed and emerge as adults, causing secondary infestations. These secondary infestations can destroy the entire seed lot within a few months.

Here are some other facts about pulse beetles:

- **Early stages**: In the early stages of an attack, the only symptom is the presence of eggs cemented to the surface of the pulses.
- **Adult emergence**: Adults emerge through round holes in the grain.
- **Life cycle**: A single female can lay about 50–79 eggs in her lifetime. The eggs hatch in 7–14 days, and the pupae develop in 11–28 days.
- **Infestation intensity**: Infestation is more intense in the summer than in the winter due to higher temperatures and relative humidity.
- **Botanicals**: Botanical powders can be used to protect stored pulses from pulse beetles. Neem acts as a repellent, and plant powders have insecticidal properties.

Management practices:

- **Store in a cool, dry place**: Keep pulses away from direct sunlight and humidity in a cabinet or pantry that stays relatively cool.
- **Check for infestations**: Before filling silos with pulses, check for pre-existing insect infestations.
- **Monitor regularly**: Monitor stored pulses for pests and quality regularly (monthly).
- **Use aeration cooling**: Use aeration cooling to manage pests.
- **Use phosphine fumigation**: Use phosphine fumigation to manage pests.
- **Remove infested material**: Do not mix new grain with old. Old material that must be kept should be thoroughly fumigated.
- **Clean storage structure**: Clean the storage structure.

Other pests that affect pulses include: gram pod borer, plume moth, blue butterfly, pod fly, stem fly, pod bug, thrips, whitefly, leafhopper, and black aphid.