

## **AGRICULTURAL ENTOMOLOGY**

### **EXERCISE 1: EXTERNAL AND INTERNAL STRUCTURES OF INSECTS**

**Prof John H. Nderitu**  
**University of Nairobi**  
**Faculty of Agriculture**  
**Department of Plant Science and Crop Science**  
**Email: [huria@uonbi.ac.ke](mailto:huria@uonbi.ac.ke)/[hurianderitu@gmail.com](mailto:hurianderitu@gmail.com)**  
**Tel: 254722308581**

### **QUESTIONS FOR DISCUSSION**

1. What are the advantages of an exoskeleton over an endoskeleton?
2. In what ways do insects differ from one another?
3. In what ways do insects resemble one another?
4. How do insects differ from the higher animals?
5. Are there any advantages in having six legs?
6. What parts of an insect's leg correspond to our own?
7. Of what significance is the distribution of the spiracles?
8. What are the structural features that are responsible for the success of the insect type of organization?
9. Name some external insect structures that show remarkable adaptations to their environment.
10. How could a knowledge of external structures and their functions help in insect pest control?
11. In general, what would be the difference between the manner of ovipositing in insects with ovipositors and those without?
12. State some sexual differences in insects.
13. How is it possible for some sucking insects to feed on solid foods?
14. Why is it not advisable to spray food orchards during the blossoming period?
15. What are the differences between plant injury produced by chewing insects and that by piercing-sucking insects? Which injures the plant more?
16. What type of mouth parts must boring insects have? Why?
17. If an insect has a beak or snout, how could you tell whether it was piercing-sucking or chewing? Could you do so without looking at the mouth parts?
18. Can you give any reason why curculios (snout beetles) are hard to control?
19. What use does a honey bee make of its double functioning mouth parts?
20. In what parts of plants is most of the food found? Does this correspond with points of greatest insect attack?
21. Why can a scale insect remain stationary throughout its life and still obtain ample food?
22. Why can an insect be kept alive for weeks in a tightly closed bottle?
23. What will happen if an insect's head is placed under water? If its body is placed under water?

24. What are the advantages of a generalized nervous system as found in insects?
25. Criticize the following statement: Insects react in certain ways because they wish to protect themselves or accomplish something.
26. Do you know of any instances when insects seemed to use the power of reasoning?
27. Name some methods utilized by insects to protect themselves from their enemies.
28. In killing insects, what are some of the ways in which we utilize their senses?
29. Name a problem in agriculture in which a knowledge of insect physiology would be valuable.

## **EXERCISE 2**

### **QUESTIONS FOR DISCUSSION**

1. In what stages are insects usually harmless to crops? Why?
2. What insects are usually harmless to plants in adult stage?
3. What characteristics of insect larvae usually determine whether they will develop into beetles, curculios, moths or butterflies, flies or sawflies?
4. What larvae have no legs at all? How are they distinguished from one another?
5. Why is it important to know what a larva will become?
6. Give the main structural differences between a larva and an adult; a pupa and a larva; a nymph and an adult.
7. At what stages are insects usually most susceptible to insecticides?
8. In general, do any nymphs and adults have the same habits? Do caterpillars and moths?
9. Why are insect eggs so inconspicuous?
10. Can an insect species be determined from eggs alone?
11. What is the value of recognizing insect eggs?
12. What may determine whether one generation of insects or several occur during one season and not the other?
13. Why is an insect considered an adult once it has acquired functional wings?
14. Is there any truth in the statement that little flies grow into big flies? Why?
15. At what stages are insects usually most harmful to plants? Why?
16. Are all adult insects winged? Name some that are not.
17. During what stages does an insect grow larger and fatter?
18. What determined the number of molts a nymph or a larva will undergo before transforming to the next stage?
19. How does an insect grow?
20. What insects remain in one place during most of their life? What adaptations enable them to do this?
21. Differentiate between true worms and insect larvae.
22. At which stage of growth are insects the most defenseless? How are they usually protected in these stages?
23. Which type of reproduction in insects is more efficient: sexual or parthenogenetic?

### **EXERCISE 3**

#### **QUESTIONS FOR DISCUSSION**

1. Of what importance is it to a farmer to know the life history of his crop pests?
2. What factors would lead to the presence of all stages of an insect on a plant at the same time?
3. What pest would be easier to control: one that has definite broods with little overlapping of stages or one in which there is so much overlapping of stages that no definite broods can be recognized.
4. What insects tend to flourish during the wet season? Dry seasons?
5. How does light regulate insect activities?
6. Why is accurate timing of control measures dependent on knowledge of the life history of a pest?
7. Discuss the importance of correct timing of control practices with forage-chewing insects, with sucking insects, with boring insects and with subterranean insects.
8. Is it good policy for a farmer to have to depend on some agricultural agency to inform him of a pest's appearance and of what control measures should be applied?
9. Why is control usually directed against the larvae of moths and butterflies and not against the adults?

## **EXERCISE 4**

### **QUESTIONS FOR DISCUSSION**

1. Why is the classification of insects important to people that deal with insect control?
2. What would happen if there were no standard system of classification?
3. Why are not definitions of a species foolproof?
4. How do varieties, races or strains originate?
5. What is the procedure for naming a new, formerly unclassified insect or other organism?
6. Why is it impossible for a person to be proficient in classifying all types of insects?
7. What are the characteristics common to all insects?
8. Is there any value in being able to identify insects to the correct order? To the correct family?
9. Which Orders contain species most harmful to plants? To animals?
10. Give an outstanding characteristic of each order that includes important plant pests.
11. Cite examples of beneficial insects.
12. What are the harmful groups, as far as crops are concerned? In the animal kingdom? Give examples.
13. What features distinguish insects from all other organisms?
14. Can you advance any theories to explain why protozoa are unimportant as the cause of plant disease but of great importance in the cause of animal and human diseases.
15. How do millipedes differ from insects?
16. Where are millipedes usually found?
17. Do millipedes undergo a metamorphosis before reaching the adult stage?
18. Since mites are wingless, how are they able to disseminate themselves very well?
19. Distinguish between millipedes and centipedes?
20. What makes mites difficult to control?

## **EXERCISE 5: PEST ECONOMIC LEVELS, SAMPLING, CONCEPTS AND TYPES OF PESTS**

### **QUESTIONS FOR DISCUSSION**

1. Why have more pest problems arisen in recent years as compared to the situation in the past?
2. Why is protection of plants necessary? How much loss is likely to be incurred due to attack of crops by pests?
3. Can you cite an instance or instances where a minor pest has become a major one?
4. What is the direct damage of crops? How does it differ from indirect damage?
5. What are quantitative, qualitative and qualitative damages of crops by pests?
6. Is it correct to state that populations of organisms in nature are in a state of balance with one another? How does agriculture affect such a balance?
7. For increasing production in agriculture, attention must be paid to crop protection. Justify the statement.
8. Are crop protection measures always economically justified?
9. Under what conditions would it not be worthwhile to control crop pests?
10. How can knowledge of mouthparts be helpful in chemical control of insect pests?
11. Why is accurate timing of control measures dependent on knowledge of the life history of the pest?
12. Discuss preliminary considerations for control of crop pests.
13. Discuss three categories of phytophagous insects and their plant host range.
14. Discuss how insects are harmful and beneficial to man.
15. Discuss four types of mouthparts found in insects of agricultural importance.
16. Discuss the type of plant injury caused by biting and chewing, piercing and sucking and lapping insects.
17. Discuss five major factors which influence crop yield in relation to pest injury.
18. Define a pest. Discuss five categories of crop pests.
19. Discuss general Equilibrium Position (EP), Economic Injury Level (EIL) and Economic Thresholds (ET) of a pest.
20. Discuss five methods of assessing pest population in a crop.
21. Define each of the main types of pest control strategies.
22. Explain the importance of sampling to insect pest management.
23. Discuss the use of insect traps in insect pest management programs.
24. Explain the significance of economic levels to insect pest management.

25. Discuss the significance of knowing the biology and ecology of most insects in the ecosystem.
26. Give examples of how biological or behavioral differences in insect pests affect insect-pest-management strategies.
27. Discuss the major environment components involved in maintaining an insect at such low numbers that is not a pest.
28. Discuss the factors influencing sampling of insect populations in the field.
29. Differentiate between density dependent and density independent regulation of insect numbers.
30. Discuss the attributes of a potential pest problem.
31. Discuss the concepts of a pest.

**EXERCISE 6: CULTURAL CONTROL, BIOLOGICAL CONTROL, HOST PLANT RESISTANCE, LEGAL ACTION, MICROBIAL CONTROL**

**QUESTIONS FOR DISCUSSION**

**1. CULTURAL CONTROL**

- (a) Describe the essentials of cultural control.
- (b) Discuss the advantages and disadvantages of cultural control methods.
- (c) Name different cultural practices available for coping with pest problems.
- (d) Discuss the additive effects of several cultural practices used against a single insect pest.

**2. BIOLOGICAL CONTROL**

- (a) Discuss the advantages of biological control over other control methods.
- (b) Distinguish between classical and naturally occurring biological control.
- (c) Explain how farm management practices are important to beneficial insects.

**3. HOST PLANT RESISTANCE**

- (a) Discuss the degrees of plant resistance
- (b) Describe how host-plant resistance fits in the insect-pest-management system.
- (c) Discuss the prominent advantages and limitations of host plant resistance.

**4. PHYSICAL AND CHEMICAL CONTROL**

- (a) Distinguish between physical and chemical controls and other forms of insect control.
- (b) Explain why physical and mechanical insect control methods have not been used more extensively.

**5. LEGAL ACTION**

- (a) Discuss the fundamental regulatory control principles.
- (b) Explain the importance of regulatory control to insect-pest-management programs.

**6. MICROBIAL CONTROL**

- (a) Clarify the place of microbial control in a pest management system.
- (b) Compare microbial control with biological and chemical methods.
- (c) Discuss the major limitations and advantages of microbial agents as a means of insect control.

## **7. INSECT HORMONES**

- (a) Identify the practical uses for sex pheromones in insect-pest-management systems.
- (b) Describe some of the potential uses of sex pheromones in insect-pest-management systems.

## **8. INSECT GROWTH REGULATORS**

- (a) Explain why insect growth regulators are highly compatible with insect-pest-management systems.
- (b) Identify classes of insect growth regulators showing potential in insect-pest-management systems.
- (c) Indicate the primary difficulty in using juvenile hormones for insect control.

## **EXERCISE 7: INSECTICIDES INTEGRATED PEST MANAGEMENT**

### **QUESTIONS FOR DISCUSSION**

1. Discuss the basic principles of insect pest control with insecticides.
2. Summarize the purpose of formulating insecticides.
3. Describe how the common formulations of insecticides are made.
4. Explain the need for various formulations of insecticides.
5. Describe the modes of action for the organochlorines, organophosphates, carbamate and synthetic pyrethroid insecticides.
6. Identify insecticides classifications based on chemical structures of insecticides.
7. List several factors that influence efficacy.
8. Discuss the positive and negative aspects of insecticide utilization.
9. Discuss several factors that influence insecticide efficacy.
10. Clarify the meaning of selective insecticides.
11. Compare the value of selective versus broad-spectrum insecticides.
12. Describe ways of achieving selective action with insecticides.
13. Discuss methods of improving selectivity of insecticides.
14. Outline the instructions provided on a typical insecticide label.
15. Write short notes on each of the following:-
  - (a) Insecticide application techniques.
  - (b) Toxicity of pesticides.
16. Discuss why there is necessity of integrated approach to pest management.
17. Discuss the major reasons for emphasizing integrated pest management programmes in African agriculture.
18. Identify and discuss the essential components of integrated pest management.

## EXERCISE 8: CROP PESTS, STORAGE PESTS

### QUESTIONS FOR DISCUSSION

1. Critically review the problems of practices of the locust control programme.
2. Write brief notes on the following:-
  - (a) The suitability of the coffee plant as a habitat of insect pests.
  - (b) The lepidopterans as important crop pests.
3. Discuss the drawbacks in the management of maize pests in the tropics.
4. The order Homoptera contains some of the most serious pests on Agricultural crops:-
  - (a) Give 2 examples of insect pests from this order, mentioning crops that they attack.
  - (b) Give 2 factors that make these insects such serious pests.
5. What makes the maize stalk borer a serious pest of maize and related crops in Kenya?
6.
  - (a) What are the characteristics of primary and secondary pests of stored products?
  - (b) Briefly describe the life histories of (i) the maize weevil, *Sitophilus zeamais* (ii) The red flour beetle, *Tribolium Castenum* (iii) Potato Tuber moth, *Phthorimaea operculella* (Zell), (iv) Bean bruchid, *Acanthoscelides obsectus* (Say).  
Discuss the symptoms of damage and management of these pests.
7. Write an essay on the pest complex of coffee and cotton.
8. Discuss the insect pests of cotton bolls in Kenya.
9. The Lepidoterans are both beneficial and harmful insects. Explain this statement giving examples.
10. What would you say are the differences between field and stored products pests?
11. *Helicoverpa (Heliothis) armigera* (Hub) is said to be a polyphagous feeder. Discuss this statement basing your discussion on the Kenyan situation in terms of hosts feeding behaviour, biology and control.
12. Discuss why *Busseola fusca* is a serious pest of maize in Kenya, i.e. feeding behaviour, biology, control e.t.c.
13. Discuss mainly the main pests of the major horticultural crops in Kenya.
14. Discuss the Larger Grain Borer, *Prostephenus truncates* (Horn) as a major threat to stored grains in Kenya.

## **EXERCISE 9. ADVANCED PEST MANAGEMENT**

### **QUESTIONS FOR DISCUSSION**

1. Discuss the economic impact of crop loss and pest control at the farm level.
2. Discuss the place of sample survey in crop loss estimation.
3. Discuss insect infestation and their effects on growth and yield of field crops.
4. Discuss the question of applicability of economic threshold of insects, pest infestation in peasant agriculture in Africa.
5. Discuss a possible explanation of plant yield increase following insect damage.
6. Discuss some relationship between yield and infestation.
7. Discuss the methods for studying the pest/yield relationship and for appraising losses due to insects.
8. Discuss the factors affecting insect population dynamics.
9. Discuss economics of pest and crop loss management.
10.
  - (a) What are your concepts of IPM? Would it be different for small holders and large farming units?
  - (b) How would a practical IPM system look like?  
What are the components?  
How will it be managed?  
What are the constraints?  
What will be the yard sticks for success or comparative advantage?  
Who designs, introduces and sustains an IPM programme/system?
  - (c) When is IPM not needed, possible or unacceptable?
11. Discuss how development and implementation of IPM programmes can be undertaken in Africa.
12. Discuss how to develop an IPM system for small scale farmers in Africa.
13. Discuss the principle and elements of pest surveillance.
14. Discuss the use of monitoring and forecasting in pest management
15. Discuss forecasting and of infestation of Desert Locust and Africa Armyworm in Africa
16. Discuss past forecasting possibilities and limitations.
17. Discuss the assessment of insect pests and crop losses.
18. Discuss the principles and elements of pest forecasting and pest surveillance.
19. Discuss the economics of pest management.
20. Discuss the economic strategies and decisions in pest management.

## **EXERCISE 10. BREEDING FOR PLANT RESISTANCE TO INSECTS AND DISEASES**

### **QUESTIONS FOR DISCUSSION**

1. Discuss the use of plant resistance in insect pest management systems.
2. Discuss some of the criteria used to evaluate insect resistance in plants.
3. Discuss the types and classification of resistance to insects.
4. Discuss situations when plant resistance to insects may offer significant advantages over other control methods.
5. Discuss 3 ways on how you would locate sources of plant resistance to insects.
6.
  - (a) What are the disadvantages of using natural field populations of insect pests for plant resistance studies?
  - (b) Discuss how you would manipulate field insect pest population for plant resistance studies.
  - (c) Mention 3 ways of manipulating insect populations in order to determine if insect resistance exists in plant material.
  - (d) Discuss the advantages and disadvantages of using caged insect populations for plant resistance studies.
  - (e) Discuss the advantages and disadvantages of supplementing insect pest populations with artificially reared insects for plant resistance studies.
7.
  - (a) What are the advantages and disadvantages of using plant seedlings to differentiate between resistance categories?
  - (b) When is it necessary to evaluate test plants at mature stage?
  - (c) Discuss the insect and plant measurements that are useful criteria for resistance.
8. Discuss the use of biotechnological methods to develop plant resistance to insects.
9. Discuss the morphological characters that impact resistance to plants.
10. Discuss breeding for insect resistance to maize, wheat, rice, sorghum and cotton.